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PHAETHON: Software for Analysis of Shear-Critical Reinforced Concrete Columns

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Abstract

Earthquake collapse of substandard reinforced concrete (RC) buildings, designed and constructed before the development of modern seismic design Codes, has triggered intense efforts by the scientific community for accurate assessment of this building stock. Most of the proposed procedures for the prediction of building strength and deformation indices were validated by assembling databases of RC column specimens tested under axial load and reversed cyclic lateral drift histories. Usually a column structural behavior is assessed by considering all involving mechanisms of behavior, namely flexure with or without the presence of axial load, shear and anchorage. In the present paper a force-based fiber beam/column element was developed accounting for shear and tension stiffening effects in order to provide an analytical test-bed for simulation of experimental cases such as the lightly reinforced columns forced to collapse. Their peculiar characteristics are the outcome of the shear – flexure interaction mechanism modeled here based on the Modified Compression Field Theory (MCFT) and the significant contribution of the tensile reinforcement pullout from its anchorage to the total column's lateral drift. These features are embedded in this first-proposed stand-alone Windows program named "Phaethon" -with user's interface written in C++ programming language code- aiming to facilitate engineers in executing analyses both for rectangular and circular substandard RC columns.

Keywords: shear-critical columns, MCFT, anchorage pullout, fiber beam/column element, capacity curve

1. Introduction

Most of the state-of-the-art on seismic design and assessment procedures proposed recently for common engineering practice require some kind of nonlinear analysis either static or dynamic. These nonlinear analyses are mostly carried out using frame elements with different levels of approximation. Two main approaches are usually used, classified as lumped-plasticity and distributed-inelasticity models. The limitation of concentrated plasticity elements is that inelastic deformations take place at predetermined locations in the ends of the element. Another, in many respects more serious limitation, is the fact that concentrated plasticity elements require calibration of their parameters against the response of an actual or ideal frame element under idealized loading conditions. This is necessary, because the response of concentrated plasticity elements derives from the moment–rotation relation of their components. In an actual frame element the end moment–rotation relation results from the integration of the section response. This can be achieved directly with elements of distributed inelasticity (Filippou & Fenves 2004). For the latter approach, the so-called fiber beam elements (Figure 1) provide results that seem to be particularly appropriate for studying the seismic behavior of RC structures: moment-axial force (M-N) coupling is readily taken into account as well as the interaction between concrete and steel in the section. Several fiber beam-column elements have been developed with good capability of reproducing axial force and flexure effects. On the other hand, the coupling between the effects of normal and shear forces is not straightforward and hence only few modeling strategies have accounted for and implemented it up to now (Ceresa et al., 2007).

A common theory, appropriate for analysis of beam-column elements, is the Euler-Bernoulli approach. The

fundamental assumption of this theory is that cross-sections remain plain and normal to the deformed longitudinal axis. The engineering beam theory reproduces the response of a beam under combined axial forces and bending moments, while shear forces are recovered from static equilibrium; the effects of shear on beam's deformation are neglected. When effects of tangential stresses are important for the element deformation (i.e. in a beam-columns joint or in the column/wall plastic hinge length), more refined theories like as Timoshenko beam theory may be used.

In the development of a nonlinear frame element, two main approaches have been used, namely the displacement-based (stiffness) approach and the force-based (flexibility) approach. A flexibility-based frame element gives the exact solutions for non-linear analysis of frame structure, using force interpolation functions that strictly satisfy element equilibrium, and impose the compatibility conditions. Accordingly, this approach allows the overcoming of some limitations of the stiffness approach. In particular, the nonlinear analysis becomes independent of the displacement approximation, it requires fewer elements for the representation of the non-linear behavior and, above all, in the case of a Timoshenko element or exact-beam theory-element, it avoids the well-known shear-locking problem (sharp increase in the element stiffness that results in much less deformations for the element than expected) (Hughes, 2000).

One of the modeling strategies in order to incorporate the beam theory that includes shear into the fiber approach is related to the idea of adopting suitable constitutive relationships. In this category belong fiber beam-column elements using smeared cracking models. According to this approach, cracked concrete is simulated as a continuous medium with anisotropic characteristics. In general, these models are referred as "smeared cracking approaches" since cracking is modeled as a distributed effect with directionality. These approaches are particularly suitable for sectional analysis.

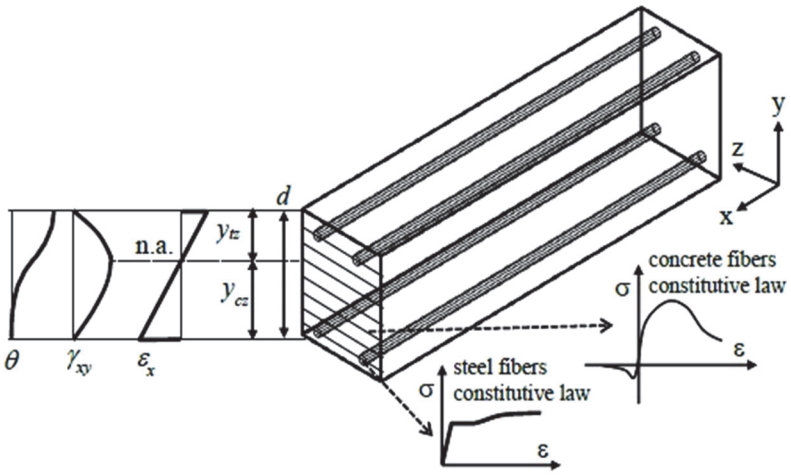

Figure 1. Fiber Element Scheme – definitions

2. RC Sectional Model Based on MCFT

Since the end of seventies considerable amount of experimental and analytical research has been conducted with the aim of developing analytical procedures capable of estimating the load-deformation response of reinforced concrete elements loaded in shear (Ceresa et al., 2008). At the University of Toronto, Collins developed a procedure called the compression field theory (CFT) in 1978 (Collins, 1978). In 1981, a competition was held to predict the load-deformation response of four reinforced concrete panels tested at the University of Toronto (Collins et al., 1985), where leading researchers from around the world entered predictions based on various constitutive approaches. The results indicated a poor state-of-the-art in analytical modeling of reinforced concrete structures. Generally, the models were not able to adequately estimate the ultimate strength, the failure mode or the load-deformation response of the panels. Most of the entrants used constitutive theories developed from tests conducted on plain concrete specimens. Conditions in the specimens are not representative of actual RC structures. The interaction between the concrete and steel strongly influences the response of reinforced concrete structures. In an effort to determine more realistic relationships for cracked reinforced concrete, Vecchio and Collins (1982) tested a series of RC panels. From these tests, the modified compression field theory (MCFT) (Vecchio & Collins, 1986) was calibrated by including stress-strain relationships for cracked reinforced concrete under plane stress conditions.

A RC element is homogenized and is treated as anisotropic elastic material shown in Figure 2. Consider an elementary panel under constant plane stress, of uniform thickness, containing an orthogonal grid of well distributed reinforcement. Loads acting on the element's edge planes are assumed to consist of uniform membrane stresses, i.e., axial stresses n_x, n_y and uniform shear stresses τ_{xy}. The deformed shape is defined by the strain tensor for plane stresses:

$$\begin{bmatrix} \varepsilon_x & \gamma_{xy}/2 & 0 \\ \gamma_{xy}/2 & \varepsilon_y & 0 \\ 0 & 0 & \varepsilon_z \end{bmatrix} \quad (1)$$

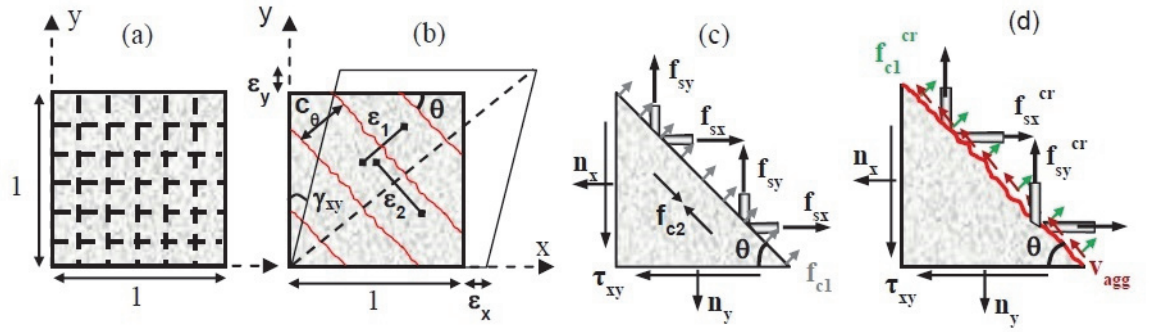

Figure 2. a) RC smeared-cracking membrane element, b) average strains (C_θ:spacing of cracks inlined at θ) c) average stresses and d) local stresses at a crack (v_{agg} :shear stress on crack surface)

The MCFT utilizes the following assumptions:

- The reinforcement is averaged or smeared throughout the element, i.e. it applies only to well-detailed members.
- The stresses applied to the element are uniform along edges.
- The total stress state is a function of the total strain state.
- The reinforcement is perfectly bonded to concrete, so that relative displacement due to bond slip between reinforcement and concrete is ignored.
- The shear stress is negligible in reinforcement.
- The principal stresses and principal strain axes are coincident; as consequence, no deviation between the two is allowed.
- The constitutive relationships for concrete and reinforcement are independent.
- The cracks are smeared and allowed to rotate.

The theory comprises three sets of relationships: compatibility relationships between concrete and reinforcement average strains, equilibrium relationships between externally applied loads and average stresses in the concrete and reinforcement; and uniaxial constitutive relationships for cracked concrete along the principal directions and for reinforcement. The constitutive relationships for cracked concrete result from tests of reinforced concrete panels using a purpose-built Panel Element Tester at the University of Toronto. As such, the formulation of the MCFT calibrated with the specific tests conducted in the panel tester, incorporates realistic constitutive models for concrete based on experimentally observed phenomena. While cracks are smeared and the relationships are formulated in terms of average stresses and strains, a critical aspect of the MCFT is the consideration of the local strain and stress conditions at cracks (Figure 2d).

2.1 Constitutive Model based on MCFT for a Fiber RC Beam

In order to determine the normal and the shear stresses for the i-th fiber / layer (σ_x^i, τ_{xy}^i) of a fiber section of a RC beam (Vecchio & Collins, 1988) a bi-axial fiber constitutive model is developed according to the Modified Compression Field Theory (MCFT) (Table 1). For the section state determination the following assumptions were made: the longitudinal ε_x and shear γ_{xy} strains are known for each fiber, according to plane section assumption and to a parabolic shear strain distribution along the height of the section with the maximum value

$\gamma_{xy.max}$ located on the neutral axis y_{na} (Equation 2, two half-parabola with the same maximum are met to the point of neutral axis with different starting point, extreme tensile and extreme compressive fiber respectively).

$$\gamma_{xy}(y) = \gamma_{xy.max} \cdot \left[2\left(\frac{y}{y_{na}}\right) - \left(\frac{y}{y_{na}}\right)^2\right] \tag{2}$$

The transversal concrete stress f_{cy} was determined for each fiber from equilibrium conditions (zero normal stress n_y was assumed). The constitutive law is based on an iterative procedure (Figure 3) where in order to accelerate the convergence of the algorithm to the right angle θ, the initial guess value of the procedure for the angle of inclination of principal stresses / strains (angle of principal axis *2* with respect to *x*-axis) is determined according to the following equation:

$$\begin{aligned} \theta(y) &= \frac{\pi}{4} \cdot \left(\frac{y}{y_{cz}}\right)^3, \quad 0 < y \le y_{cz} \\ \theta(y) &= \frac{\pi}{4} + \frac{\pi}{4} \cdot \left[2\left(\frac{y-y_{cz}}{y_{tz}}\right) - \left(\frac{y-y_{cz}}{y_{tz}}\right)^2\right], \quad y_{cz} < y \le d \end{aligned} \tag{3}$$

where y is the location of the concrete layer/fiber (y: start measuring from the extreme compressive fiber, Figure 1), y_{cz} is the depth of the compression zone, y_{tz} is the depth of the tension zone and d is the total depth of the section (i.e., $y_{cz}+y_{tz}=d$, Figure 1). Figure 4 depicts the angle shape function along the height of the section according to the above equation ($d = 457\ mm$, $y_{cz} = 280\ mm$ similar to Specimen 1 (Sezen & Moehle, 2006)). The solution of the iterative procedure is reached by applying the Regula Falsi root finding numerical solution (Chabert, 1999).

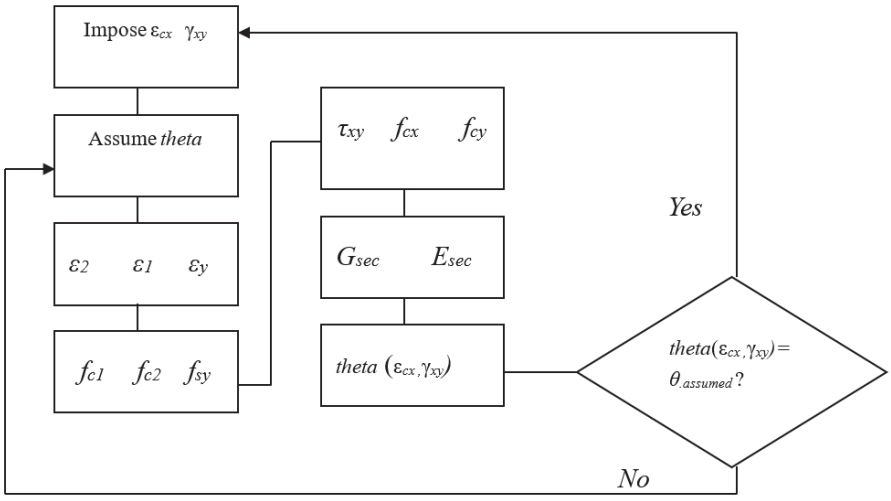

Figure 3. Iterative procedure for each fiber/layer of the section according to MCFT

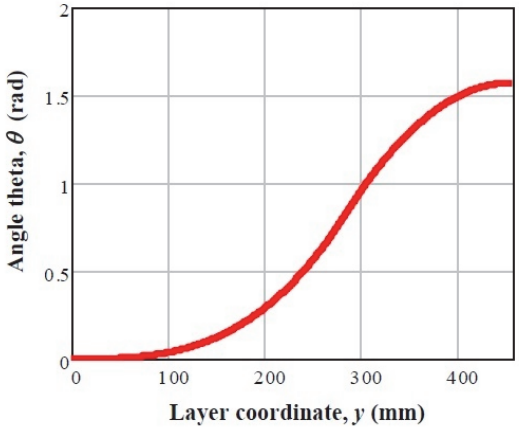

Figure 4. Shape function for angle theta *(θ)* of inclination of principal stresses/strains

Table 1. Equations embodied in the iterative procedure (Vecchio & Collins, 1988).

$$\varepsilon_x = \varepsilon_{cx}\ ,\ \varepsilon_1 = \varepsilon_x + \frac{\gamma_{xy}\cdot\tan(\pi/2-\theta)}{2}\ ,\ \varepsilon_y = \varepsilon_1 - \frac{\gamma_{xy}}{2\cdot\tan(\pi/2-\theta)}\ ,\ \varepsilon_2 = \varepsilon_x + \varepsilon_y - \varepsilon_1$$

$$f_{c1} = E_c\cdot\varepsilon_1 \text{ for } 0 < \varepsilon_1 \le \varepsilon_{cr}\ ,\quad f_{c1} = \frac{f_{cr}}{1+\sqrt{200\varepsilon_1}} \text{ for } \varepsilon_{cr} < \varepsilon_1 \le \varepsilon_{yx}\ ,$$

$$f_{c2} = f_{c2max}\cdot\left[2\left(\frac{\varepsilon_2}{\varepsilon_c'}\right) - \left(\frac{\varepsilon_2}{\varepsilon_c'}\right)^2\right]\ ,\ \frac{f_{c2max}}{f_c'} = \frac{1}{0.8-0.34\varepsilon_1/\varepsilon_c'} \le 1.0,\ f_{sy} = E_{sy}\varepsilon_y \le f_{yy}$$

$$f_{cy} = -\rho_y\cdot f_{sy},\ \tau_{xy} = \frac{f_{cy}-f_{c2}}{\tan(\pi/2-\theta)},\ f_{cx} = f_{c1} - \tau_{xy}\cdot\tan(\pi/2-\theta)\ ,\ G_{sec} = \frac{\tau_{xy}}{\gamma_{xy}},\quad E_{sec} = \frac{f_{cx}}{\varepsilon_x},$$

$$theta(\varepsilon_{cx},\gamma_{xy}) = \tan^{-1}\frac{f_{c1}-f_{cy}}{\tau_{xy}}$$

f_c'=Concrete Cylinder Compressive Strength (MPa), ε_c'=Strain at Concrete Cylinder Compressive Strength, E_c=Concrete Elastic Modulus (MPa), f_{cr}=Tensile Concrete Strength (MPa), ε_{cr}=Strain at Tensile Concrete Strength, ε_{yx}=Yielding Strain of Longitudinal Reinforcement, E_{sy}=Elastic Modulus of Stirrups (MPa), f_{yy}=Yielding Strength of Stirrups (MPa), ρ_y=Stirrups Reinforcement Ratio.

2.2 Sectional Model

Figure 5 depicts a beam element with its degrees of freedom and its displacement/ forces in global, local and basic systems of reference. The term "basic" is referred to the system of reference where the rigid body motion of the beam is extracted. Considering now the virtual work principle for the beam element of Figure 5, the Equation 4 can be derived. The external work is done by the end forces *(p)* on the corresponding displacements *(u)*, whereas the internal work is done by the basic forces *(q)* on the corresponding deformations *(v)*.

$$\delta u^T p = \delta v^T q \tag{4}$$

The internal work of Equation 4 can be derived from the integral of the stress product with the corresponding virtual strains over the element volume *V*. In many applications of nonlinear structural analysis, the internal work is limited to the internal work of normal stress σ_x and shear stress τ on the axial strain ε_x and shear strain γ respectively:

$$\delta v^T q = \int \delta\varepsilon^T\sigma\, dV = \int(\delta\varepsilon_x\,\sigma_x + \delta\gamma\,\tau)dV \tag{5}$$

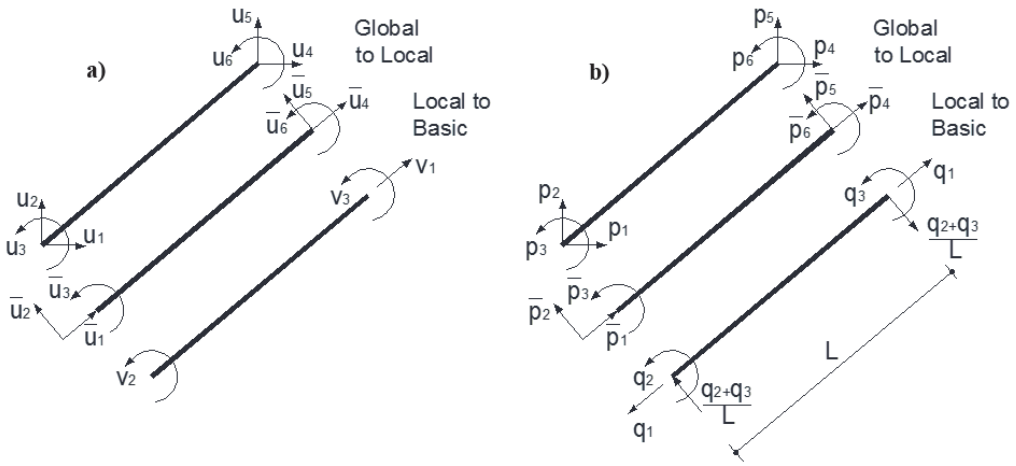

Figure 5. Beam a) displacements and b) forces in global, local and basic reference systems

The strain and stress are functions of the position along the element longitudinal axis x and the position within the cross section specified in local coordinates y (with respect to the height) and z (with respect to the width).

Equation 5 can be rewritten by substituting the integral over the element volume as integration over the section area A at a location x followed by integration over the element length:

$$\delta v^T q = \int (\delta\varepsilon_x \, \sigma_x + \delta\gamma \, \tau) dV = \int [\int (\delta\varepsilon_x \, \sigma_x + \delta\gamma \, \tau) dA] \, dx \tag{6}$$

The strains at a fiber/layer point of the beam cross section (*2d* case) are related to the section deformations as follows (Ceresa et al, 2008):

$$\varepsilon_x(x) = \varepsilon_0 - y_\varepsilon \cdot \varphi(x) \tag{7}$$

$$\gamma_{xy}(x) = \gamma_{xy.max} \tag{8}$$

Where ε_0 is the axial deformation at the center of the coordinate system of the section (center of mass) and y_ε counts also from this center, $\varphi(x)$ is the curvature of the cross-section and $\gamma_{xy.max}$ is the maximum value of shear strain located on the neutral axis. Therefore the strains at a material point m of the section can be expressed in matrix form as follows:

$$\varepsilon(x, y_\varepsilon) = \begin{Bmatrix} \varepsilon_x \\ \gamma_{xy} \end{Bmatrix} = \begin{bmatrix} 1 & -y_\varepsilon & 0 \\ 0 & 0 & 1 \end{bmatrix} \cdot \begin{Bmatrix} \varepsilon_0 \\ \varphi \\ \gamma_{xy.max} \end{Bmatrix} = B_s(y_\varepsilon) \cdot e(x) \tag{9}$$

$$B_s(y_\varepsilon) = \begin{bmatrix} 1 & -y_\varepsilon & 0 \\ 0 & 0 & 1 \end{bmatrix} \tag{10}$$

The internal forces at a section level are given by:

$$N = \int \sigma_x dA = Axial\ force \tag{11}$$

$$V = \int \tau_{xy} dA = Shear\ force \tag{12}$$

$$M = -\int y_\varepsilon \sigma_x dA = Bending\ Moment \tag{13}$$

The section generalized forces can be written in a matrix format as follows:

$$f_s(x) = \int {B_s}^T(y_\varepsilon) \cdot \sigma(x, y_\varepsilon) dA \tag{14}$$

where:

$$f_s(x) = \begin{Bmatrix} N \\ M \\ V \end{Bmatrix}, \qquad B_s(y_\varepsilon) = \begin{bmatrix} 1 & -y_\varepsilon & 0 \\ 0 & 0 & 1 \end{bmatrix}, \qquad \sigma(x, y_\varepsilon) = \begin{Bmatrix} \sigma_x \\ \tau_{xy} \end{Bmatrix} \tag{15}$$

Taking into account the section discretization into fibers/layers, the total forces on the beam section are easily computed through the summation of the contributions of each *i-th* fiber/layer:

$$N = \sum_{i=1}^{n.layer} \sigma_x^i A^i \quad , \quad V = \sum_{i=1}^{n.layer} \tau_{xy}^i A^i \quad , \quad M = -\sum_{i=1}^{n.layer} \sigma_x^i {y_\varepsilon}^i A^i \tag{16}$$

where A^i is the area of the i-th fiber/layer.

In order to determine the normal and the shear stress for the *i-th* fiber / layer (σ_x^i, τ_{xy}^i) a bi-axial fiber constitutive model is developed according to the MCFT, as it is stated previously (Figure 3, $\sigma_x^i = f_{cx}^i$).

According to the above guidelines the section forces are determined based on known sectional deformations. In case where the section forces are known and the section deformations are the desirable results iterations are necessary (this means that the roots are searched deformations, whereas the deviation from the desired section forces is negligible or zero).

The tangent section stiffness matrix k_s is defined as the derivative of the section force vector f_s with respect to the section deformation vector e, where the explicit reference to x is dropped for brevity of notation:

$$k_s = \begin{bmatrix} \frac{\partial f_{s_1}}{\partial e_1} & \frac{\partial f_{s_1}}{\partial e_2} & \frac{\partial f_{s_1}}{\partial e_3} \\ \frac{\partial f_{s_2}}{\partial e_1} & \frac{\partial f_{s_2}}{\partial e_2} & \frac{\partial f_{s_2}}{\partial e_3} \\ \frac{\partial f_{s_3}}{\partial e_1} & \frac{\partial f_{s_3}}{\partial e_2} & \frac{\partial f_{s_3}}{\partial e_3} \end{bmatrix} \tag{17}$$

$$k_s = \frac{\partial f_s}{\partial e} = \int {B_s}^T(y_\varepsilon) \cdot \frac{d\sigma(x,y)}{\partial \varepsilon(x,y)} \cdot \frac{\partial \varepsilon(x,y)}{\partial e} dA = \int {B_s}^T(y_\varepsilon) \cdot \frac{d\sigma(x,y)}{d\varepsilon(x,y)} B_s(y_\varepsilon) dA \tag{18}$$

$$\sigma(x, y_\varepsilon) = \begin{Bmatrix} \sigma_x \\ \tau_{xy} \end{Bmatrix} \quad \varepsilon(x, y_\varepsilon) = \begin{Bmatrix} \varepsilon_x \\ \gamma_{xy} \end{Bmatrix} \tag{19}$$

$$\frac{d\sigma(x,y)}{d\varepsilon(x,y)} = \begin{bmatrix} E_m & 0 \\ 0 & G_m \end{bmatrix} \tag{20}$$

where E_m and G_m are the tangent moduli of the stress – strain relations at a point m of the section approximated here by E_{sec}, G_{sec}(Table 1, Figure 3).

3. Embedded Algorithms in Phaethon Software

The most studied and tested structural form for deeper understanding of the structural behaviour in reinforced concrete structures is the simple cantilever column under various types of loading. Although it is a very simple case, its numerical simulation with all interacting deformation mechanisms is still yet a very challenging task to accomplish. Towards this need and for the case of shear-critical cantilever reinforced concrete columns the idea of "Phaethon" (i.e. "the Shining" in ancient Greek) was born. In this section the algorithms embodied in this Windows application are presented.

3.1 Moment-Curvature Algorithm

Through the cross sectional analysis are determined the unknown moment *M* (and the associated axial deformation ε_0) for given curvature φ increments and the unknown shear force *V* for given shear strain γ increments with or without the presence of constant axial load *N*. The system of equations for section equilibrium can be established as follows:

$$\begin{Bmatrix} N - N_r(\varepsilon_0, \varphi, \gamma) = 0) \\ \mathrm{M} - \mathrm{M}_r(\varepsilon_0, \varphi, \gamma) = 0) \\ V - V_r(\varepsilon_0, \varphi, \gamma) = 0) \end{Bmatrix} \tag{21}$$

The explicit dependence of the resisting forces is noted. With *N,* φ and γ given, the first equation is used to solve for ε_0; then this value is substituted along with the given φ and γ into the second and third equation to determine *M* and *V*. The resisting axial force in the first Equation 21 is expanded with Taylor series and the higher than linear terms are truncated:

$$N - \left[N_r(\varepsilon_{00}, \varphi_0) + \frac{\partial N}{\partial \varepsilon_0} \Delta\varepsilon_0 + \frac{\partial N}{\partial \varphi} \Delta\varphi + \frac{\partial N}{\partial \gamma} \Delta\gamma \right] = 0 \tag{22}$$

where the second subscript *0* denotes the initial guess for the solution. Given the axial force *N*, the curvature increment $\Delta\varphi$ and the shear strain increment $\Delta\gamma$, the above equation can be solved for $\Delta\varepsilon_0$:

$$\Delta\varepsilon_0 = \left(\frac{\partial N}{\partial \varepsilon_0} \right)^{-1} \cdot \left(N_u - \frac{\partial N}{\partial \varphi} \Delta\varphi - \frac{\partial N}{\partial \gamma} \Delta\gamma \right) \quad \text{with} \quad N_u = N - N_r(\varepsilon_{01}, \varphi_1) \tag{23}$$

The numerical solution is distinguished by the incrementation phase, which consists of the application of the curvature and shear strain increment, and by the equilibrium iterations under fixed axial force, curvature and shear strain. The axial force is applied in an initial step under zero curvature and zero shear strain. Therefore, the following algorithm is applied in Phaethon for this task:

Given section geometry and material properties, axial force N, curvature increment $\Delta\varphi$ and shear strain increment $\Delta\gamma$ (e is the section's strain vector and f_s is the resisting section forces -see Section 2)

Incrementation for *k = 1..m*

1. Initial guess $e_0^{(k)} = e^{(k-1)}$ the solution at *k-1* with $e^{(0)} = 0$
2. Determine $f_s^{(k)} = f_s\left(e_0^{(k)}\right)$ and $k_s^{(k)} = k_s\left(e_0^{(k}\right)$ according to Section 2
3. Determine $N_u^{(k)} = N - f_{s1}^{(k)}$ and $\Delta\varepsilon_0^{(k)} = \left(\frac{\partial N}{\partial \varepsilon_0}\right)^{-1} \cdot \left(N_u^{(k)} - \frac{\partial N}{\partial \varphi}\Delta\varphi - \frac{\partial N}{\partial \gamma}\Delta\gamma\right)$ where

$$\frac{\partial N}{\partial \varepsilon_0} = k_{s11}^{(k)} \quad , \quad \frac{\partial N}{\partial \phi} = k_{s12}^{(k)} \quad \text{and} \quad \frac{\partial N}{\partial \gamma} = k_{s13}^{(k)}$$

4. Update solution $e_1^{(k)} = e_0^{(k)} + \begin{pmatrix} \Delta\varepsilon_0^{(k)} \\ \Delta\varphi \\ \Delta\gamma \end{pmatrix}$

Iteration for *i = 1..n* and constant *k* (skip superscript)

1. Determine $f_s = f_s(e_i)$ and $k_s = k_s(e_i)$
2. Determine $N_u = N - f_{s1}$ and $\Delta\varepsilon_0 = \left(\frac{\partial N}{\partial \varepsilon_0}\right)^{-1} \cdot (N_u)$ where $\frac{\partial N}{\partial \varepsilon_0} = k_{s11}$
3. Update solution $e_{i+1} = e_i + \begin{pmatrix} \Delta\varepsilon_0 \\ 0 \\ 0 \end{pmatrix}$

Back to iteration Step 1 until the error norm satisfies specified tolerance. On convergence the final state is updated thus determining the bending moment and shear force and the algorithm returns to Incrementation phase at Step 1.

3.2 Pushover Algorithm

For the Pushover analysis of a cantilever shear-critical RC column in Phaethon, the sectional model (either rectangular or circular) established in Section 2 is employed along with the anchorage model in the footing established in Tastani and Pantazopoulou (2013). An increasing lateral point load at the tip of the cantilever is applied (Figure 6) and a unique fiber element is assigned to the entire height of the cantilever column with the number of Gauss-Lobatto integration points selected by the user. The user is selecting also the analysis step of lateral load V to be applied in the Pushover and the total number of steps until the maximum load (Modified Compression Field Theory in the fiber approach as described in Bentz (2000) cannot capture the descending branch of shear-critical columns that is why a load-control procedure was selected to be embedded in Phaethon). The maximum load in Phaethon is the load of last step of convergence of the algorithm in incremental form. It should be underlined that in reality the shear-critical column's ascending response is followed by a descending branch of failure; however the proposed algorithm is limited by strength attainment. After the maximum load the descending branch of the capacity curve is defined as the line connecting the maximum load point with the point at axial failure as defined in terms of drift by Elwood and Moehle (2005) and 20% of the attained maximum load as residual load at axial failure.

For each point load at the tip of the cantilever (Figure 6) the corresponding shear force at the assigned column's sections (integration points) is equal to that load (constant shear diagram). Then the bending moment for each section is defined based on the moment at the base M_0 which is the product of the tip lateral load and the given shear span of the cantilever column, as follows:

$$M(x) = M_0 \cdot (1 - x/L_s) \tag{24}$$

where x counts from the support ($x=0$) to the point load at the free edge of the cantilever ($x=L_s$). The concentric axial load (tensile or compressive) applied at the tip of the cantilever is also constant throughout the pushover analysis and along the length of the cantilever and therefore each column's section has an axial force value equal to the one applied at the tip. Following this procedure the vector f_s which is the resisting section forces (see

Section 2) should converge to the above defined section forces based on the moment, shear and axial load diagram of the cantilever column under constant axial load and gradually increasing lateral tip point loading.

The following algorithm is applied in Phaethon to achieve this convergence:

Given the section forces s i.e. an axial force N, a bending moment M and a shear force V, the equilibrium equation between applied and resisting section forces is set up:

$$s_u(e) = s - f_s(e) = 0 \tag{25}$$

The Newton-Raphson algorithm for the solution of the system of three nonlinear equations is:

1. Given the nonlinear equations $s_u(e) = 0$ and a guess of the solution e_0.
2. For $i = 0...n$ determine function value $s_u(e_i)$ and derivatives $k_s(e_i)$ (Section 2)
3. Determine correction to previous solution estimate $\Delta e_i = s_u(e_i)/k_s$
4. Update solution estimate $e_{i+1} = e_i + \Delta e_i$

Return to step 2 until the error norm is smaller than specified tolerance. On convergence determine the resisting forces for the final deformations.

It should be underlined that for the cases of "pure compression" or "pure tension" with the angle of inclination of principal stresses / strains (angle of principal axis 2 with respect to x-axis) being zero or $\pi/2$ respectively than no iteration is applied but the fiber state determination is defined by entering directly on the constitutive law of concrete (Section 2, Table 1) without defining the rotation of principal axes.

After convergence of the section forces along the length of the cantilever column to the correct values, the axial deformation, curvature and shear strain is determined for each section. Integrating the curvatures (Figure 6) along the shear span of the cantilever column leads to the rotation of the cantilever column due to flexure and can be easily transformed to lateral displacement due to flexure Δ_o^f by multiplying with the shear span. Then, integration of the shear strains (Figure 6) of the sections along the length of the cantilever column (integration points) leads to the lateral displacement Δ_o^{sh} due to shear mechanism of the cantilever column. Finally, the rotation and the displacement Δ_o^{sl} due to pull-out of the tensile reinforcement (Figure 6) is determined based on the theory established in Tastani and Pantazopoulou (2013). All the above contributions (flexure, shear and anchorage) are added together to define the total lateral displacement (i.e., $\Delta_o = \Delta_o^f + \Delta_o^{sh} + \Delta_o^{sl}$) of the cantilever column at each lateral load step and to obtain the capacity curve of the column until maximum lateral load (Figure 6).

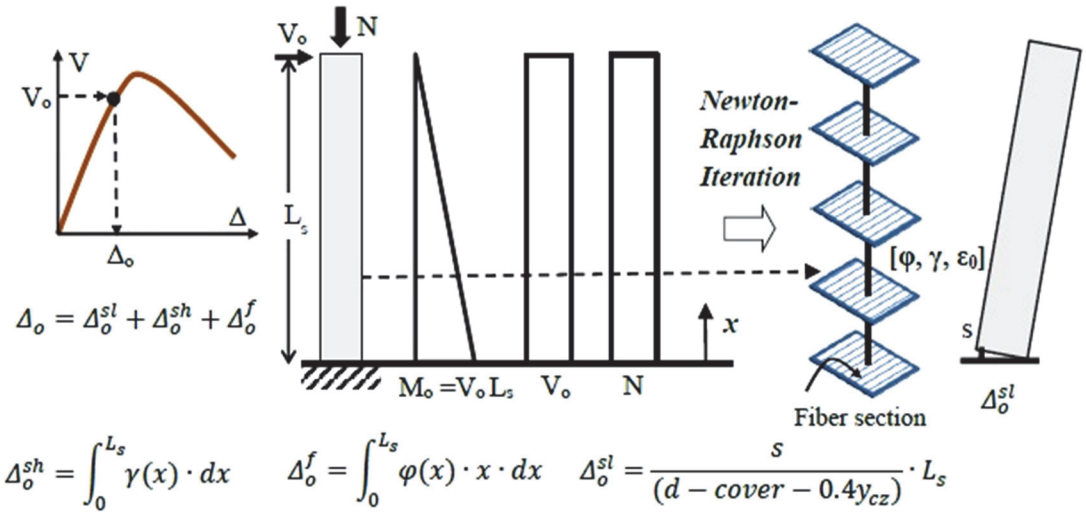

Figure 6. Pushover Analysis in Phaethon

4. Correlation with Experimental Results

This section presents the correlation of the shear-flexure capacity curves obtained with pushover analysis by Phaethon with the experimental responses of shear-critical RC columns selected from literature. In the correlation are also included for comparison capacity curves obtained from flexural fiber beam/column based toolbox FEDEAS Lab (Filippou, 2004) and from MCFT-based software and dual-section analysis Response

2000 (Bentz, 2000)

The shear capacity degradation curve of RC columns as a function of displacement ductility is approached by EN 1998-3 (2005) and ASCE-SEI 41 (2007) and can be used as the basic criterion in order to detect shear failure before or after flexural yielding depending on the point of intersection with flexural capacity curve (Figure 7). To this end, it is necessary to define the flexural capacity curve based on classic flexural analysis and combine it with shear capacity curve in order to define the strength and deformation of the RC column at shear failure. This procedure is adopted in this section in order to initially detect whether the columns under study will fail in shear before or after flexural yielding and therefore to judge whether "Phaethon" tool is applicable.

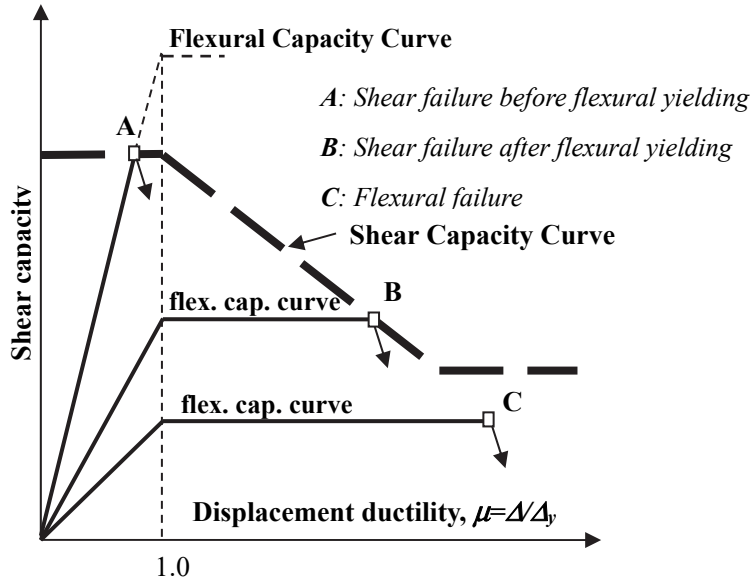

Figure 7. Shear-strength degradation model

The following Equation (26) for estimation of the shear strength degradation with ductility of RC columns is proposed by the code for seismic rehabilitation of existing buildings of the American Society of Civil Engineers ASCE/SEI 41:

$$V_R = V_c + V_w =$$

$$= k(\mu_\Delta)\left[\left(0.5\sqrt{f_c}/(L_s/d)\right)\sqrt{1+N/\left(0.5A_g\sqrt{f_c}\right)}\right]0.8A_g + k(\mu_\Delta)\left[A_{sw}f_{yw}d_e/S\right] \quad (26)$$

where:

$\boldsymbol{V_c}$: concrete contribution in shear resistance; $\boldsymbol{V_w}$: shear reinforcement contribution is shear resistance; $\boldsymbol{d_e}$: is the effective depth; $\boldsymbol{L_s}$: is shear span of the column; $\boldsymbol{N}$: is the compressive axial force (positive, taken as being zero for tension); $\boldsymbol{A_g}$: is the gross cross-sectional area of the column; $\boldsymbol{A_{sw}}$: is the cross-sectional area of the stirrup; $\boldsymbol{S}$: is the centerline spacing of stirrups. If the spacing is equal or greater than *d/2* of the column then the contribution of steel reinforcement V_w in shear strength should be taken as half of its estimated value from the above equation. In addition if the spacing is equal or greater than *d* then zero shear strength contribution from steel reinforcement V_w should be considered; $\boldsymbol{f_c}$: is the concrete compressive strength; $\boldsymbol{k(\mu_\Delta)}$: is the shear strength reduction factor that depends on displacement ductility m_D. (If $\mu_\Delta \leq 2$ then k(μ_Δ) =1, if $\mu_\Delta >6$ then k(μ_Δ) =0.6, and if $2< \mu_\Delta <6$ then the k(μ_Δ) varies linearly between the proposed values.).

EN 1998-3 (2005) proposes the following expression for the shear strength degradation with ductility:

$$V_R = [(d - y_{cz})/2L_s]\min(N; 0.55A_c f_c) + [1 - 0.05min(5; {\mu_\Delta}^{pl})] \cdot$$

$$\{0.16max(0.5; 100\rho_{tot})[1 - 0.16min(5; L_s/h)]\sqrt{f_c}A_c + V_w\} \quad (27a)$$

where $\boldsymbol{d}$: is the depth of cross-section (equal to the diameter D for circular sections); $\boldsymbol{y_{cz}}$: is the compressive zone depth; $\boldsymbol{N}$: is the compressive axial force (positive, taken as being zero for tension); $\boldsymbol{L_s}$: M/V ratio moment/shear at the end section; $\boldsymbol{A_c}$: is the cross-section area, taken as being equal to $b_w d_e$ for a cross-section with a rectangular web of width (thickness) b_w and effective depth d_e or to $\pi {D_c}^2/4$ (where D_c is the diameter of the concrete core to the inside of the hoops) for circular sections; $\boldsymbol{f_c}$: is the concrete compressive strength; $\boldsymbol{\rho_{tot}}$: is the total longitudinal reinforcement ratio; ${\mu_\Delta}^{pl} = \mu_\Delta - 1$.

$\boldsymbol{V_w}$: is the contribution of transverse reinforcement to shear resistance, taken as being equal to:

a) for cross-sections with rectangular web of width (thickness) b_w:

$$V_w = \rho_w b_w z f_{yw} \quad (27b)$$

where $\boldsymbol{\rho_w}$: is the transverse reinforcement ratio; $\boldsymbol{z}$: is the length of the internal lever arm (taken as being equal to d_e-d' in beams, columns (where d' is the distance of the extreme compression fiber to the level of the compression reinforcement); and $\boldsymbol{f_{yw}}$: is the yield stress of the transverse reinforcement;

b) for circular cross-sections:

$$V_w = \frac{\pi}{2}\frac{A_{sw}}{s} f_{yw}(D - 2c) \quad (27c)$$

where $\boldsymbol{D}$: is the diameter of the section; $\boldsymbol{A_{sw}}$: is the cross-sectional area of a circular stirrup; $\boldsymbol{S}$: is the centerline spacing of stirrups; $\boldsymbol{f_{yw}}$: is the yield stress of the transverse reinforcement; $\boldsymbol{c}$: is the concrete cover.

4.1 Rectangular Shear-Critical Columns

This first selected rectangular column for comparison is Specimen 1 by the experimental campaign of Sezen and Moehle (2006) that failed in shear after flexural yiedling. Its properties are reported in Table 2. Figure 8 compares the experimental response (by red) with the analytical flexural capacity curve (by blue) and the shear capacity obtained by EN 1998-3 (by green) and by ASCE-SEI 41 (by black) (here the yielding displacement in both shear-strength degradation models is defined by the flexural analysis based on the applied fiber element included in FEDEAS Lab; It can be read from the end of the initial plateau of EN 1998-3 model). The ASCE-SEI 41 estimates a very conservative shear strength as compared to the yielding strength of specimen which would be interpreted as premature brittle failure; EN 1998-3 detects the column's shear failure after yielding in terms of strength but at lower displacement compared to the experimental result.

As it can be seen in Figure 9 the comparison of the capacity curve defined by Phaethon for Specimen 1 (that failed in shear after flexural yielding) until the maximum load is close to the experimental response but also close to the capacity curves by the other already mentioned softwares. The deviation of stiffness close to peak load from Phaethon can be improved if slip from shear span L_s is added (Megalooikonomou et al., 2018). Since the latter established methodology refers only to extended flexural yielding it was not incorporated to "Phaethon" software as it would not have been general in simulating shear failures which could occur also before flexural yielding.

Response 2000 doesn't provide the descending branch of the capacity curve due to shear failure after flexural yielding while FEDEAS Lab overestimates the response after maximum load is attained since it doesn't consider any shear-flexure interaction mechanism. Phaethon postdicts both the maximum load but also the descending branch of the response in this case.

Figures 10 and 11 depict the displacement contributions in each pushover analysis step from the various interacting mechanisms as they are defined by Phaethon and they are compared also to the ones measured during the experiment. It can be seen that at yielding (10 mm total lateral displacement reported by Phaethon) Phaethon

gives correctly 62% contribution from flexure, 35% from Pull-Out and almost 3% from shear mechanism (which in this case is a bit underestimated).

In Figure 8, the shear capacity curve of Eurocode 8 part 3 (EN 1998-3) for the second selected specimen by Lynn et. al. 1996 doesn't intersect with the flexural capacity curve. This takes place only with the model of ASCE-SEI 41 almost at yielding at a lower strength and displacement compared to the experimental response.

The second selected rectangular column for comparison is by the experimental campaign of Lynn et al. (1996) that failed in shear before flexural yielding. Its properties are presented in the Table 2. As it can be seen in Figure 9 the comparison until the maximum load is close to the experimental response but also close to the capacity curves by the other already mentioned software. Here, Response 2000 underestimates the specimen's strength and doesn't provide the descending branch of the capacity curve due to shear failure before flexural yielding while FEDEAS Lab overestimates the response after maximum load is attained since it doesn't consider any shear-flexure interaction mechanism. Phaethon postdicts correctly both the maximum load but also the descending branch of the response in this case too. However, in all analytical capacity curves the experimental initial stiffness is overestimated. The axial failure (i.e. collapse as defined by Phaethon) is also reached at a lower displacement compared to the experiment. Finally, Figure 10 depicts the displacement contributions in each pushover analysis step from the various interacting mechanisms as they are defined by Phaethon. As it can be seen they are correctly increasing with the applied lateral load.

4.2 Circular Shear-Critical Columns

The third selected column for comparison is the circular Specimen 19 by the experimental campaign of Ang et al. 1989 that failed in shear before flexural yielding. Its properties are presented in Table 2. In Figure 12, it can be observed that it is a shear-critical column since both the shear strength degradation models detect shear failure (although wrongly after flexural yielding) at a displacement lower than the corresponding experimental one. The strength at shear failure is better predicted by the model of Eurocode 8 part 3 (EN 1998-3) compared to the alternative of ASCE-SEI 41.

As it can be seen in Figure 9 the comparison of Phaethon response until the maximum load is close to the capacity curves by the other already mentioned software. However, the initial stiffness predicted by Phaethon is higher compared to the experiment although identical to what the other software tools define. Phaethon captures well also the maximum load but not the corresponding displacement. The descending branch as defined by Phaethon follows the experimental strength degradation. The shear strength is better postdicted by Phaethon compared to Response 2000. Finally, Figure 11 depicts the displacement contributions in each pushover analysis step from the various interacting mechanisms as they are defined by Phaethon. As it can be observed they are correctly increasing with the applied lateral load and here due to the aspect ratio of the circular column (short column) the shear mechanism displacement contribution is significant. It should be stated that an incremental filtering (that is omitting some steps from the capacity curve) of the pushover results was applied in this specimen since in some steps the converged displacements given by the program were higher than the previous or the next load steps compared to the current one. This filtering was applied only to the given capacity curve in Figure 9 but the displacement contributions in Figure 10 are given as obtained by the program.

The fourth selected column for comparison is the circular Specimen 20 by the experimental campaign of Ang et al. 1989 that failed in shear after flexural yielding. Its properties are presented in Table 2. In Figure 12, it can be observed that it is a shear-critical column since both the shear strength degradation models detect shear failure after yielding at a displacement lower than the corresponding experimental one. The strength at shear failure is better predicted by the model of Eurocode 8 part 3 compared to the alternative of ASCE-SEI 41.

Table 2. Details of RC columns failed in shear (units: mm, MPa, kN)

Case	Axial Load	Width - Depth or Diameter	Shear Span	Clear Cover	Concrete Strength	Number - Diameter – reinforcing ratio of Longitudinal Bars	Yielding – ultimate Strength of Long. Bars	Yielding Strength - spacing – Diameter –ratio of Transv. Reinf.
Sezen & Moehle (2006) – (Spec. 1) Rectangular cross section	667	457 457	1473	65.13	21.1	8 28.65 0.025	434 645	476 304.8 9.5 0.0025
Lynn et. al. (1996) – (Spec. 3CMH18) Rectangular cross section	1512	457 457	1473	38.1	27.6	8 31.75 0.03	331 496	400 457 9.5 0.00082
Ang et. al. (1989) – (Spec.19) Circular cross section	432	400	600	18*	34.4	20 16 0.032	436 679	326 80 6 0.0038
Ang et. al. (1989) – (Spec.20) Circular cross section	807	400	700	18*	36.7	20 16 0.032	482 758	326 80 6 0.0038

*: Cover to Ctr. of Hoop Bars

As it can be seen in Figure 9 the comparison of Phaethon response until the maximum load is close to the capacity curves by the other already mentioned software. However, the initial stiffness predicted by Phaethon is higher compared to the experiment although identical to what the other software tools define. Phaethon, captures well also the maximum load but not the corresponding displacement. The descending branch as defined by Phaethon follows the experimental strength degradation. The axial failure (i.e. collapse as defined by Phaethon) is reached at a lower displacement compared to the experiment. The shear strength is better postdicted by Phaethon compared to Response 2000. Finally, Figure 10 depicts the displacement contributions in each pushover analysis step from the various interacting mechanisms as they are defined by Phaethon. The same idea of filtering as described in the previous circular specimen was applied here too.

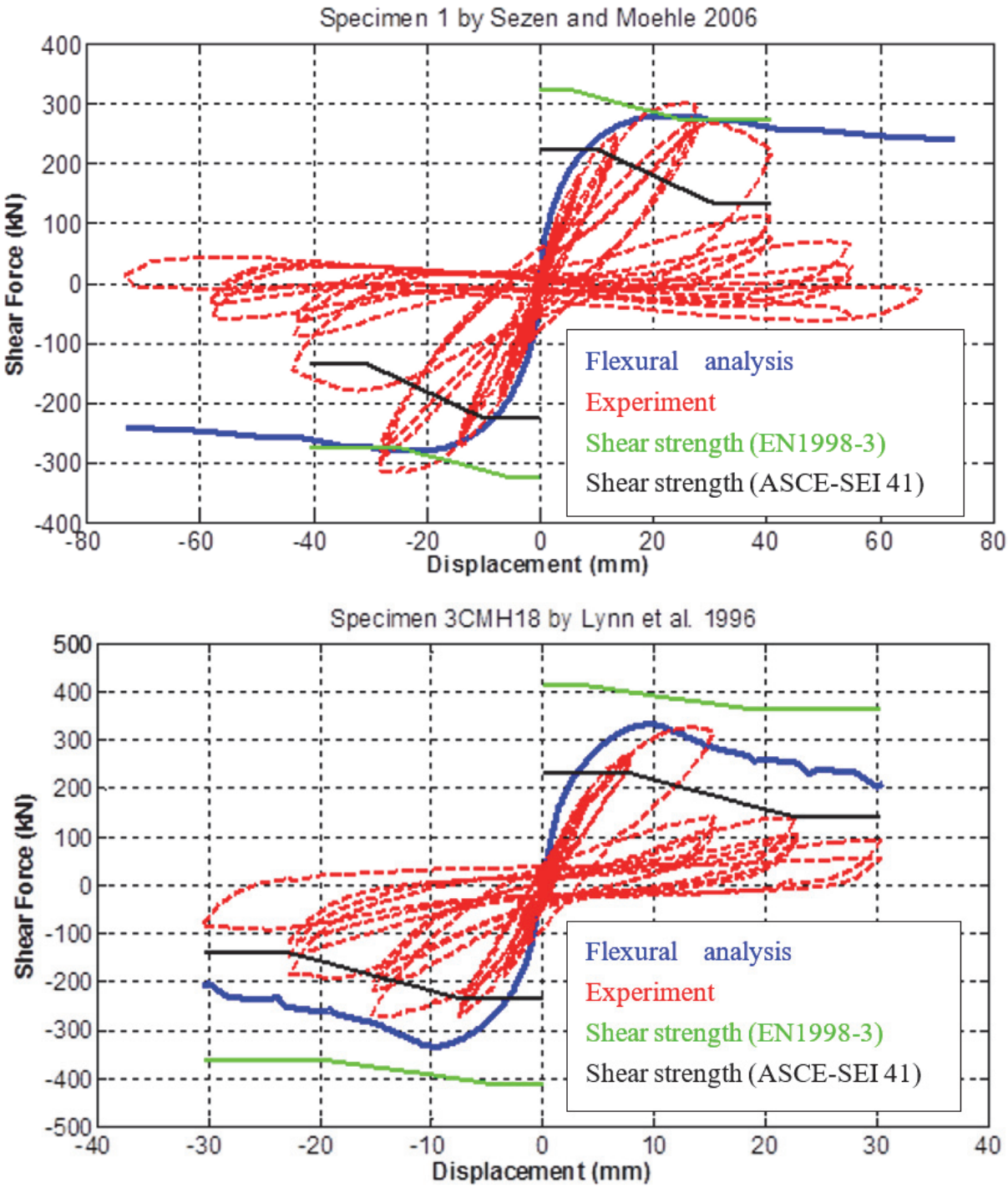

Figure 8. Detection of shear-critical rectangular reinforced concrete columns

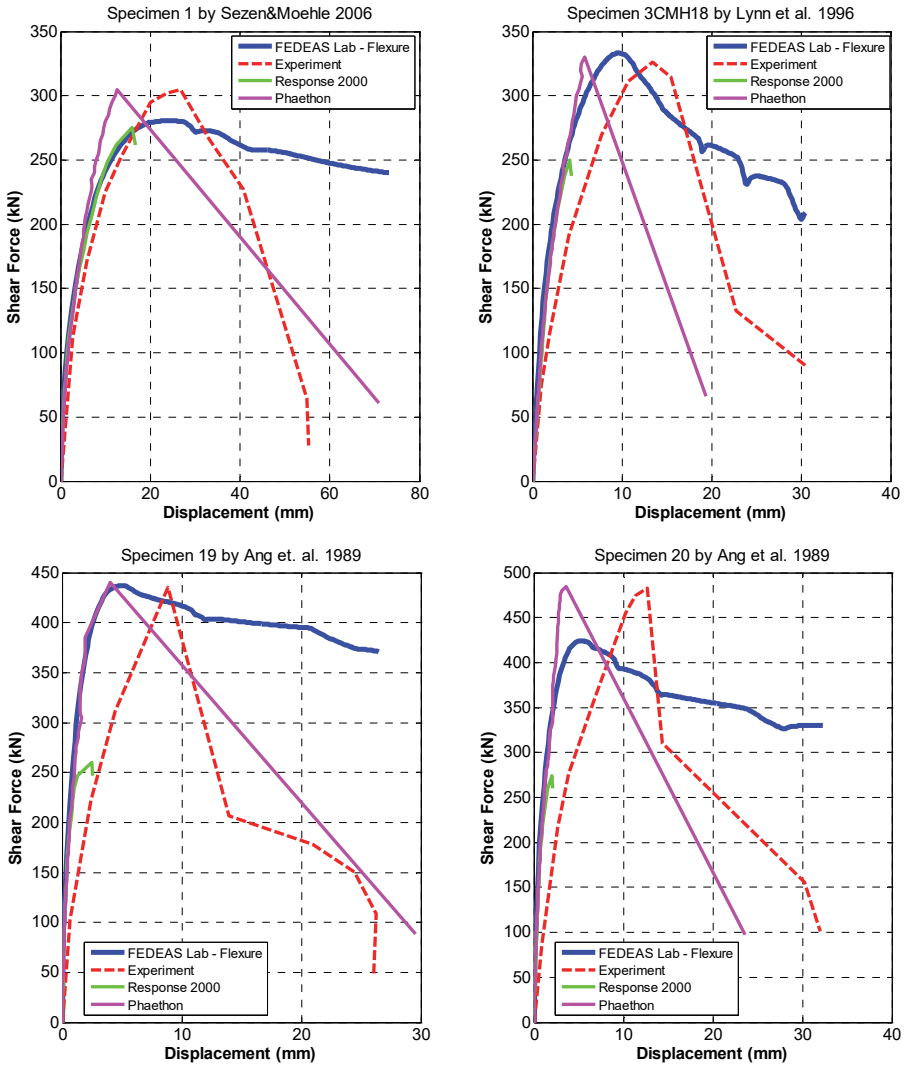

Figure 9. Comparison of the capacity curves provided by Phaethon and other softwares with the experimental responses

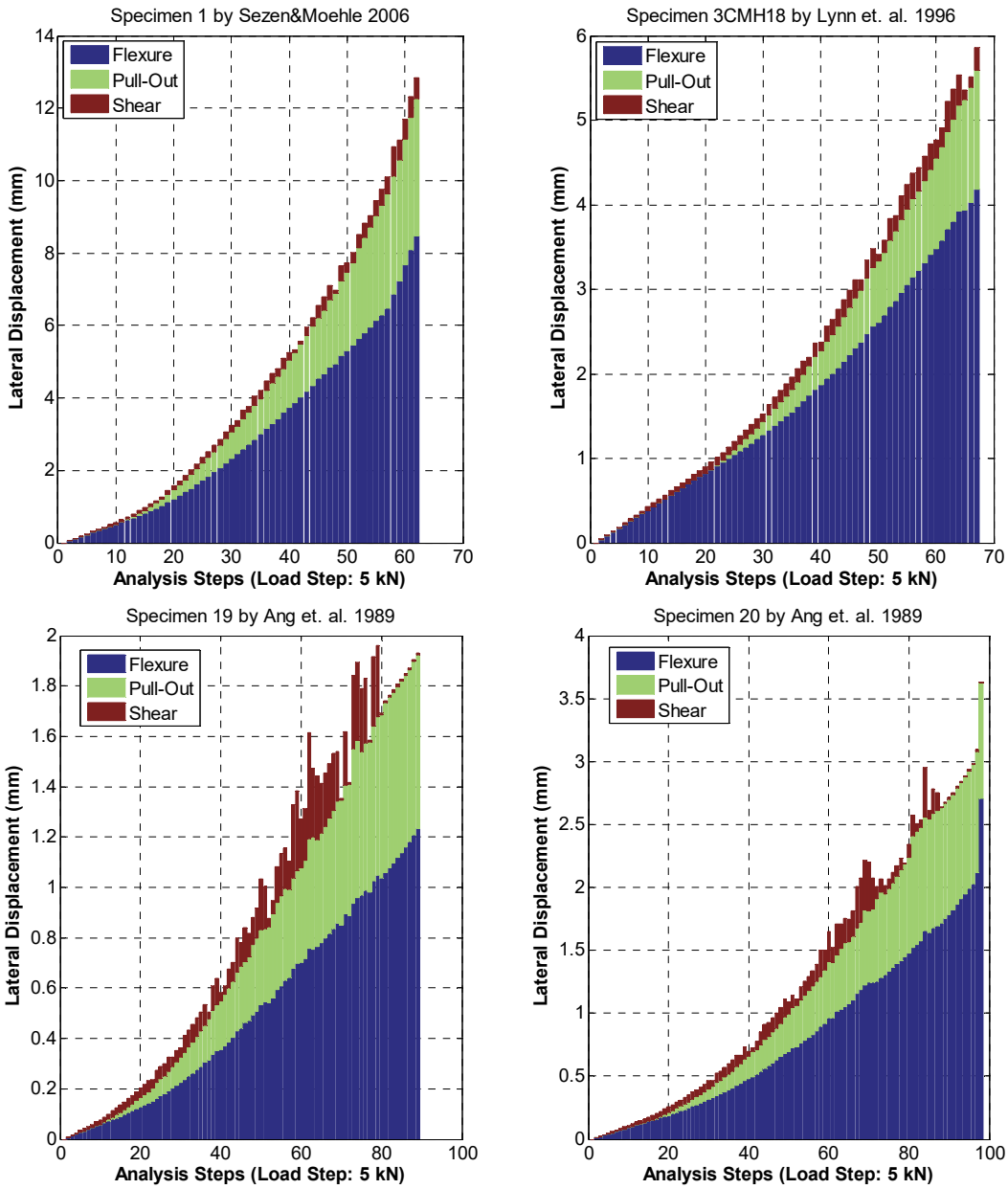

Figure 10. Displacement Contributions from various deformation menchansims included in Phaethon for cantilever columns

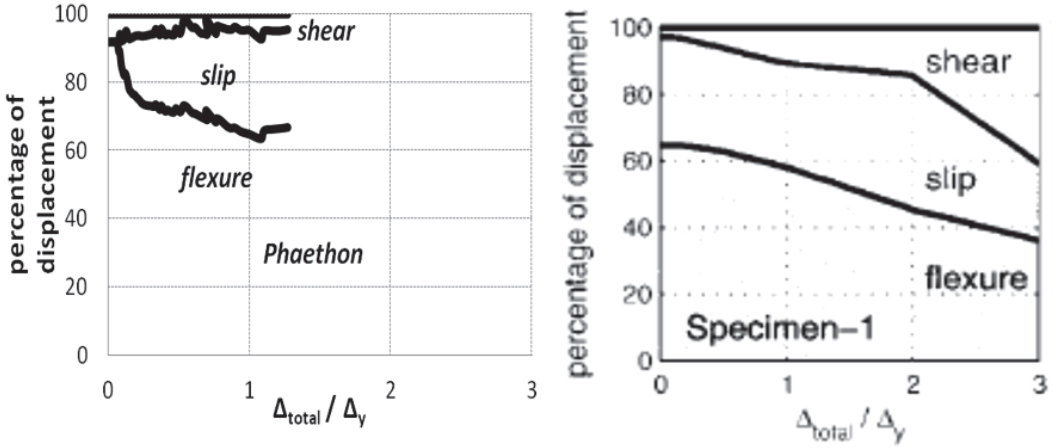

Figure 11. Displacement Contributions from various deformation menchansims included in Phaethon (left) for rectangular column compared to the experiment (right) (Sezen and Moehle (2006))

5. Parametric Investigation

The parametric sensitivity of the developed software on the produced capacity curve is investigated in this section considering as a point of reference Specimen 1 by Sezen and Moehle (2006) examined in the preceding section. Parameters considered are the discretization sensitivity of the force-based fiber element of the cantilever column and the effect of axial load, stirrups spacing and shear span length on the produced pushover curve; in each case one parameter is varied at a time keeping the reference values for all other variables (so the possible interaction effects between variables have not been considered in conducting the sensitivity analysis).

In Figure 13 it can be observed the effect on the pushover curve of different amount of Gauss-Lobatto integration points [Ele(Number)IP] along the element as well as the amount of integration points/layers of the Midpoint integration rule along the section [Sec(Number)L]. As expected by increasing the amount of Midpoint layers and Gauss-Lobatto integration points the capacity curve stabilizes to the final result. The deviation from the final result is evident only at the lower amount of integration points both at the section and along the element.

As it can be observed in Figure 14 by increasing the compressive axial load (here is given in normalized form) the shear strength of the column under study is correctly increasing and the deformability of the column is decreasing with lower displacements at maximum load (shear failure) and at point of axial failure (collapse). The effect of stirrups spacing (Figure 15) for a given shear-critical column on the capacity curve produced by Phaethon is negligible until the maximum load (shear strength) but the displacement at axial failure (collapse) is decreasing correctly by increasing the spacing of stirrups. The insensitivity of Phaethon in defining shear strength as a function of stirrups spacing in lightly reinforced columns where shear failure is driven by sparsely spaced stirrups, is justified by the assumptions of the MCFT theory - as described initially in this paper - about smearing of reinforcement. Finally the decrease of the shear span of the cantilever column (Figure 16) correctly produces a more shear-dominant and less deformable reinforced concrete column both at maximum load (shear failure) but also at the point of axial failure (collapse).

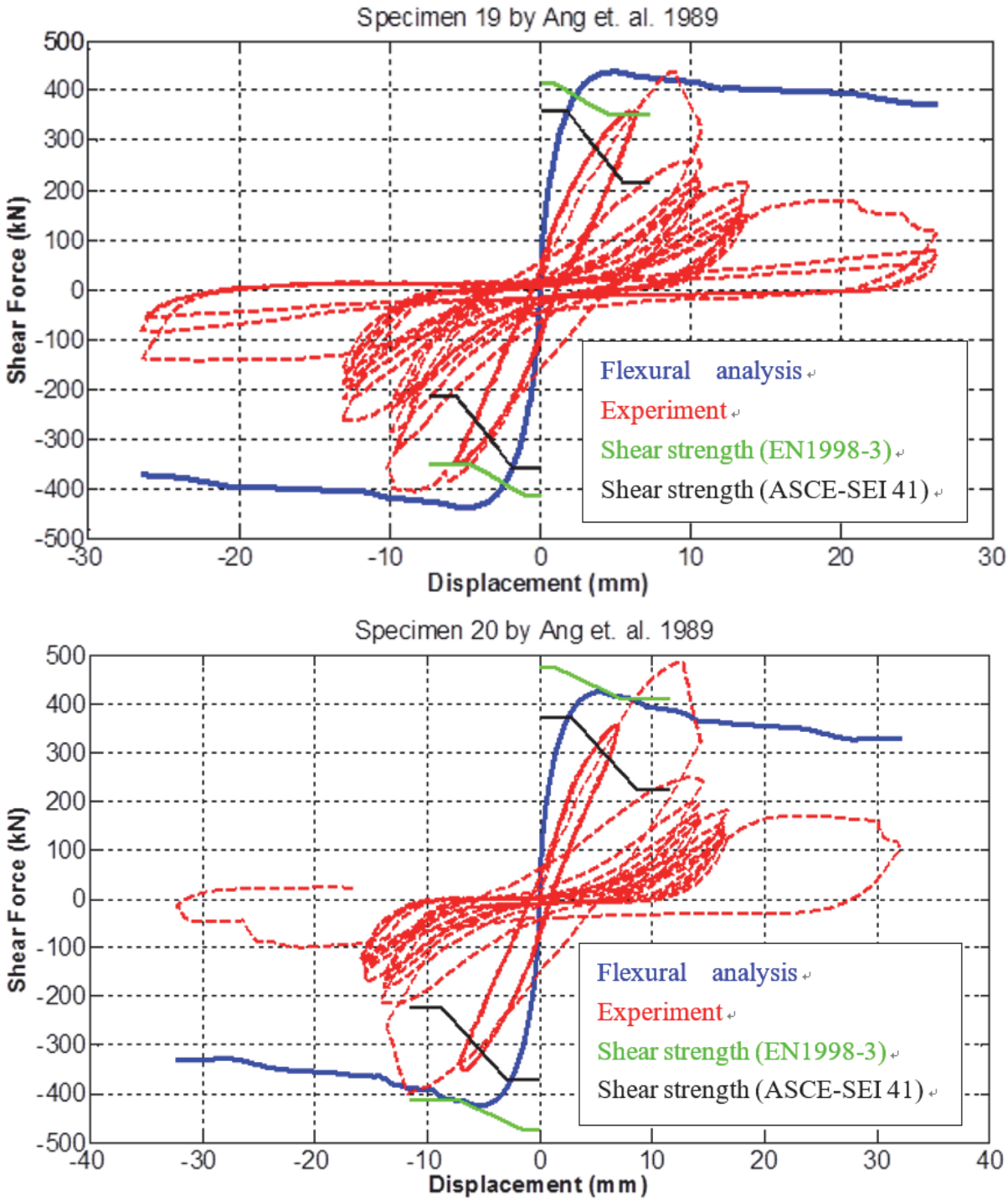

Figure 12. Detection of shear-critical circular reinforced concrete columns

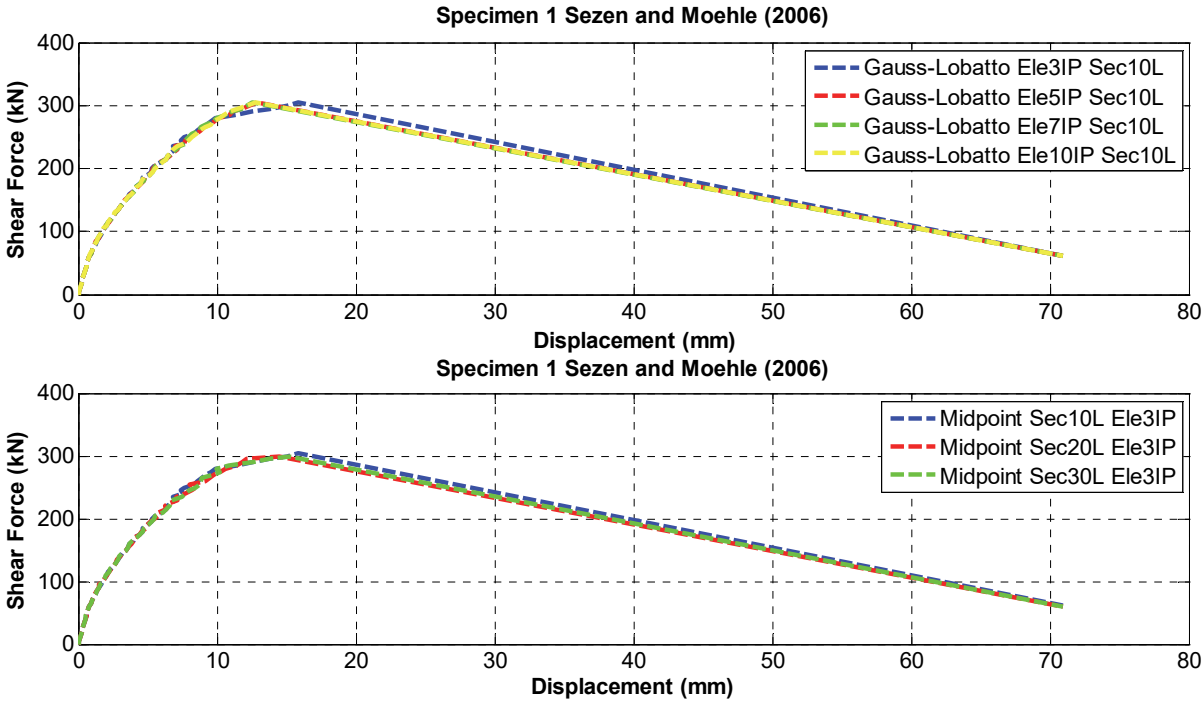

Figure 13. Discretization sensitivity along fiber section and element of the capacity curve provided by Phaethon

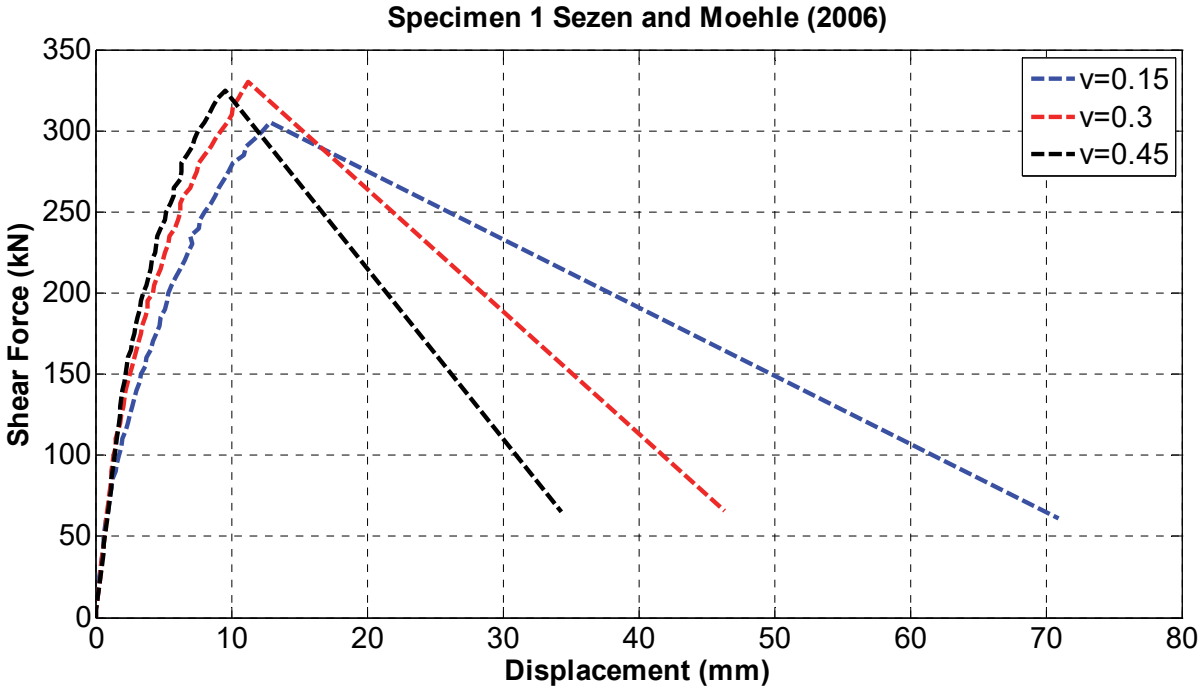

Figure 14. Effect of axial load on capacity curve provided by Phaethon

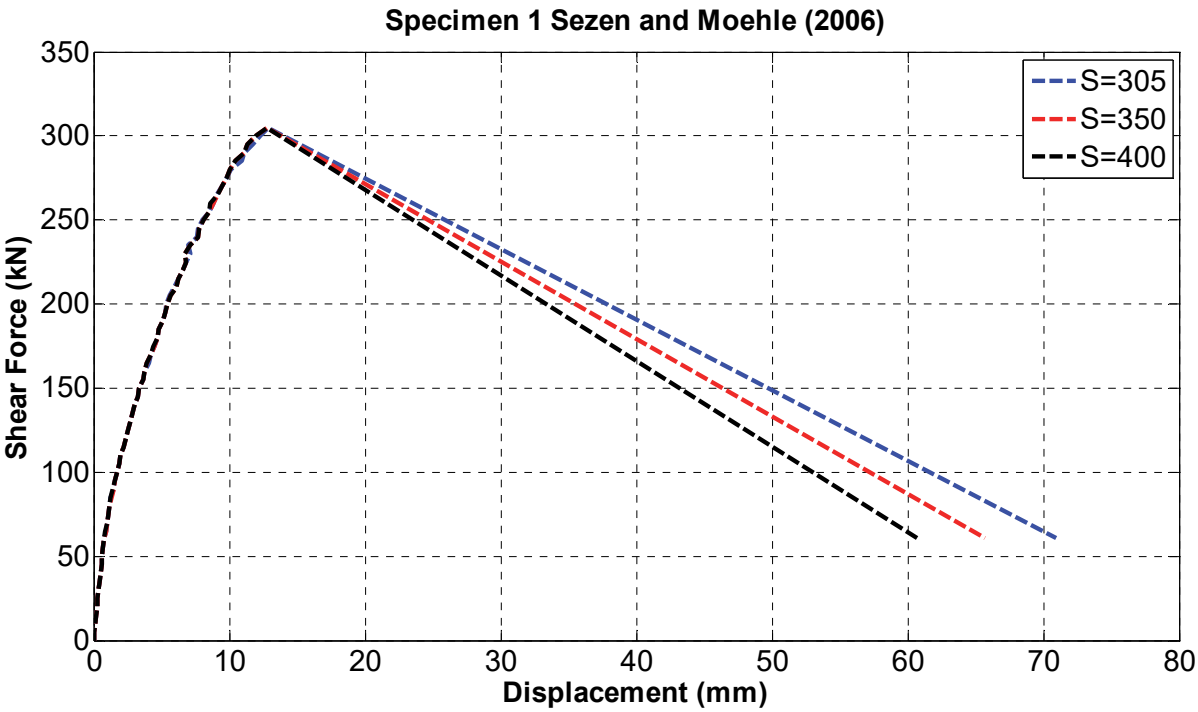

Figure 15. Effect of stirrups spacing on capacity curve provided by Phaethon.

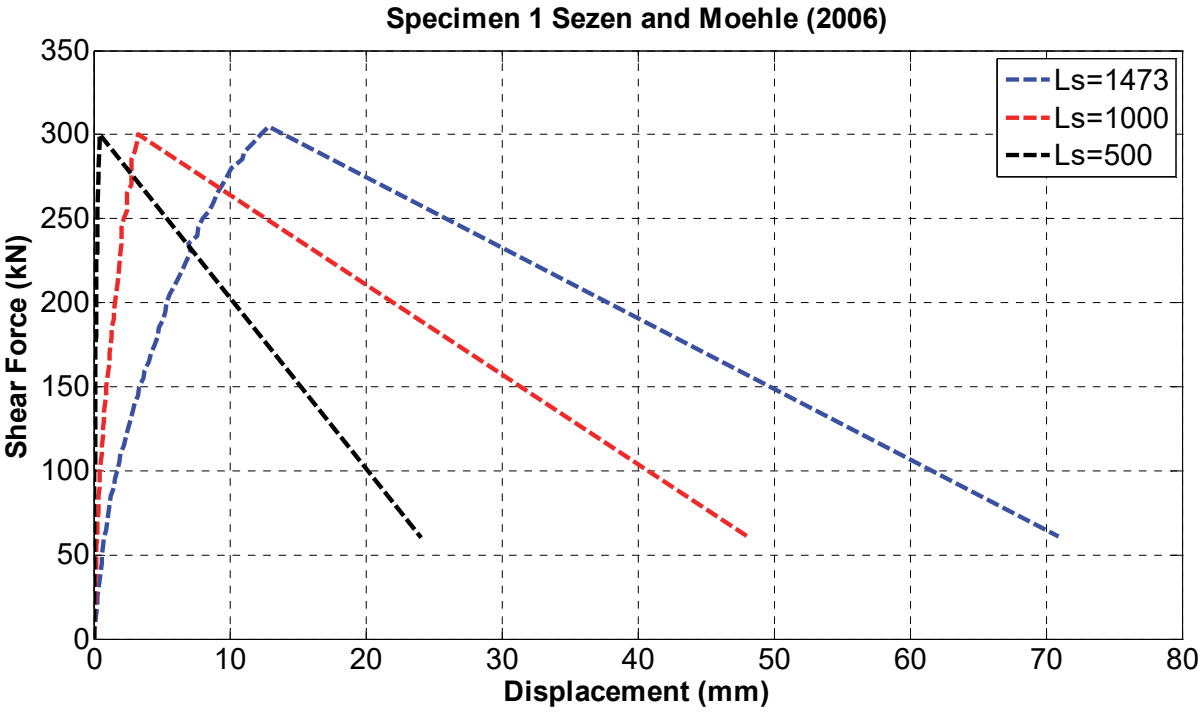

Figure 16. Effect of shear span on capacity curve provided by Phaethon

6. Conclusions

In the present paper a force-based fiber beam-column element accounting for shear effects and the effect of tension stiffening was developed, in order to provide an analytical test-bed for simulation and improved understanding of experimental cases where testing of reinforced concrete columns actually led to collapse. The developed fiber-element is incorporated in the stand-alone Windows program Phaethon with user's interface

written in C++ programming language code that offers the possibility to its user to obtain the capacity curve for shear-critical reinforced concrete cantilever columns taking into account shear – flexure interaction mechanism but also of the important contribution in the final column's lateral displacement, of the pull-out of the inadequate anchorage of the tensile longitudinal reinforcing bars of the column. This is available for both rectangular but also circular reinforced concrete columns. In addition, the software resolves strain, slip and bond distributions along anchorage length. Comparison with experimental results from the literature verifies the capability of this Windows software tool to assess strength and deformation indices of shear-critical reinforced concrete columns. Finally, the moment curvature but also the shear force – shear strain analysis of the sections of these columns is also possible, all based on the Modified Compression Field Theory.

Acknowledgments

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References

Ang, B. G., Priestley, M. J. N., & Paulay, T. (1989). Seismic Shear Strength of Circular Reinforced Concrete Columns. *ACI Structural Journal, 86*(1), 45-59. https://doi.org/10.14359/2634

ASCE/SEI 41 (2007). Seismic Rehabilitation of Existing Buildings. American Society of Civil Engineers, Reston, VA.

Bentz, E. C. (2000). Sectional Analysis of Reinforced Concrete Members. PhD Thesis, Department of Civil Engineering, University of Toronto, Toronto, Canada. Retrieved from http://www.ecf.utoronto.ca/~bentz/r2k.htm

Ceresa, P., Petrini, L., & Pinho, R. (2007). Flexure-shear fiber beam-column elements for modeling frame structures under seismic loading-state of the art. *Journal of Earthquake Engineering, 11*, 46–88, https://doi.org/10.1080/13632460701280237

Ceresa, P., Petrini, L., & Pinho, R. (2008). A fibre flexure–shear model for cyclic nonlinear behavior of RC structural elements. Research Report ROSE-2008/07. IUSS Press: Pavia, Italy.

Collins, M. P. (1978), Towards a rational theory for RC members in shear. *ASCE Journal of Structural Division, 104*(4), 649-666.

Collins, M. P., Vecchio, F. J., & Mehlhorn, G. (1985). An international competition to predict the response of reinforced concrete panels. *Canadian Journal of Civil Engineering, 12*, 624-644. https://doi.org/10.1139/l85-070

Elwood, K. J., & Moehle, J. P. (2005). Axial Capacity Model for Shear-Damaged Columns. *ACI Structural Journal, 102*(4), 578-587. https://doi.org/10.14359/14562

EN 1998-3. (2005). Eurocode 8: Design of structures for earthquake resistance -Part 3: Assessment and retrofitting of buildings. European Committee for Standardization (CEN), Brussels.

Filippou, F. C., & Constantinides, M. (2004). FEDEAS Lab – Getting Started Guide and Simulation Examples, NEESgrid Report 2004-22 and SEMM Report 2004-05. Retrieved from http://fedeaslab.berkeley.edu/

Filippou, F. C., & Fenves, G. L. (2004). Methods of analysis for earthquake-resistant structures. In: Bozorgnia Y, Bertero VV (eds) *Earthquake engineering: From engineering seismology to performance-based engineering*. CRC Press, Boca Raton.

Hughes, T. J. R. (2000). The *Finite Element Method: Linear Static and Dynamic Finite Element Analysis*, Dover Publications.

Jean-Luc Chabert, ed. (1999) *A History of Algorithms: From the Pebble to the Microchip,* Berlin: Springer, pp. 86-91.

Lynn, A. C., Moehle, J. P., Mahin, S. A., & Holmes, W. T. (1996). Seismic Evaluation of Existing Reinforced Concrete Columns. *Earthquake Spectra, 1*2(4), 715-739. https://doi.org/10.1193/1.1585907

Megalooikonomou, K. G., Tastani, S. P., & Pantazopoulou, S. J. (2018). Effect of Yield Penetration on Column Plastic Hinge Length. *Engineering Structures Journal, Elsevier, 156*, 161-174, https://doi.org/10.1016/j.engstruct.2017.11.003

Sezen, H., & Moehle, J. P. (2006). Seismic Tests of Concrete Columns with Light Transverse Reinforcement. *ACI Structural Journal, 103*(6), 842-849. https://doi.org/10.14359/18236

Tastani, S. P., & Pantazopoulou, S. J. (2013). Reinforcement and concrete bond: State determination along the development length. *ASCE J. of Structural Eng., 139*(9), 1567-1581, Retrieved from https://ascelibrary.org/doi/10.1061/%28ASCE%29ST.1943-541X.0000725

Tastani, S. P., & Pantazopoulou, S. J. (2013). Yield penetration in seismically loaded anchorages: effects on member deformation capacity. *Techno press Earthquake and Structures, 5*(5), 527-552, https://doi.org/10.12989/eas.2013.5.5.527

Vecchio, F. J., & Collins, M. P. (1982). Response of Reinforced Concrete to In-Plane Shear and Normal Stresses, Publication No. 82-03, Department of Civil Engineering, University of Toronto, Canada.

Vecchio, F. J., & Collins, M. P. (1986). The modified compression field theory for reinforced concrete elements subjected to shear. *ACI Journal Proceedings, 83*(2), 219-231.

Vecchio, F. J., & Collins, M. P. (1988). Predicting the Response of Reinforced Concrete Beams Subjected to Shear Using Modified Compression Field Theory. *ACI Structural Journal, 85*(3), 258-268.

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Role of Educational Mediain Promoting the Values of Citizenship Among Students of Secondary Schoolsin Zarqa Education Directorate II from View point of Their Teachers

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Abstract

This study aimed at defining the role of educational media in promoting the values of citizenship among students of secondary schools in Zarqa Education Directorate II from viewpoint of their teachers.

The study used a descriptive approach. A questionnaire was developed, consisting of 30 paragraphs, which evaluated the role of educational media in promoting the values of citizenship among students of secondary schoolsin Zarqa Education Directorate II from viewpoint of their teachers. The validity and reliability of the study's tool have been verified. The sample of the study consisted of the schools' teachers of Zarqa Education Directorate II.They were 250 male and female teachers for the academic year 2016-2017 selected from among the schools of Zarqa Education Directorate II.The results of the study were as follows:

- The role of educational media in promoting the values of citizenship among the students of secondary schools in Zarqa Education Directorate II from the viewpoint of their teachers.
- In favor of females, there were statistically significance differences in the role of educational media in promoting the values of citizenship among the students of secondary schools from the viewpoint of their teachers due to gender variable.
- In favor of females, there were statistically significant differences in promoting of the values of citizenship among students of secondary schools in Zarqa Education Directorate II from the viewpoint of their teachers attributed to specialization variable.
- There were no statistically significant differences due to experience variable.

The study recommended achieving the goal of education through the institutions of the Ministry of Education by educational media, and activating the role of educational media to develop the values of citizenship among the students of secondary schools.

Keywords: Educational Media, Citizenship Values, Citizenship, Zarqa Directorate of Education II

1. Introduction

Education is the most important community tool for building countries and societies, especially with many developed and rapid technologies, and multiple media that produce information. Any progress in any society is measured by how students are prepared to cope with the rapid changes that have taken place in all areas of life. All this cannot be achieved unless there is educational information capable of bringing them to education based on correct understanding of these changes.

Secondary education is a middle stage between primary and higher education. Students of secondary education are adolescents. In this stage the students will become metaphases psychologically, physically, mentally and socially. They have moved from childhood to youth, and may be at some point confused and imbalanced in addition to physiological and social changes, which require guidance, direction and vision unification, proper preparation of citizenship, walking towards it properly. As well as inherent readiness based on effective school leaders to achieve the educational goals until their readiness for college education is assured (2014).

Secondary stage shall provide students with moral principles and values of citizenship so that they can be effective citizens in a society characterized by applying democracy by activating the role of educational media in providing useful, correct This is by providing reliable information through the school media represented by the school library, and enabling them to express their criticism and opinions to face the current events, as well as making them know the problems of school and education. The activation of the media role is able to give high school students new thinking styles that have the ability to deal with the requirements of the accelerated era, and improve the quality of their performance through Botebal (2016). The study finds that the diversity of educational and cultural programs will assist them to take note of their cultural and educational reality, because education is the preparation of life, and it aims to develop the citizenship values of these young people who are the foundation of the future and the hope of life. They can be proud of their homeland, and aware of the facts around them. All this will be done through educational process, which is one of the pillars of education and citizenship.

The educational media aims at establishing facts, as well as to create a cultural awakening, and affect the mentality of secondary school students and their levels of thinking. The education media means using the school and community media to strengthen the relations between the school and the educational authorities in order to achieve the values of citizenship. The goals of educational media are varied, such as indicated by Dulaimi (2011), including:

Education: through identifying facts and cultural growth within the scope of education in line with the objectives of the Ministry of Education, and to introduce educational content aimed at developing the values of school and community citizenship among secondary school students.It is a combination of education and information through cooperation, and serve educational planners, teachers, curriculum specialists, educational, administrative and technical affairs. In addition, the educational information provides abundance of data, information and educational news to achieve the concept of educational development, and disperse educational values as citizenship, which to be done in a hidden manner. It also changes the behavior of the secondary school students to positive behavior towards society and education by providing a more aesthetic and more useful way of reforming traditional educational systems, and allowing students to think freely and exchange information at various educational levels and planting educational values. This is especially done with the widespread use of modern technology, disseminating information and knowledge very quickly, and adopting this knowledge resulting in the formation of attitudes and behavior modification among secondary students.

The educational media is one of the most important educational tools and an important tool in developing sustainable education. This tool enables students to learn about the knowledge and culture of the community, develop their deep sense of citizenship responsible. Educational school media are varied, including video, audio, and reading. Among the most prominent of these, as mentioned by Ahmed (2008), are:

- Computer: By employing the Internet to refer to national concepts related to citizenship, promote self-learning, and learn how to employ the internet to broaden the horizon and perceptions, create the creative spirit of students, and invest their free time.
- School wall magazines: it is done within the school, under the responsibility of students as a free purposeful activity within the walls of the school. It contains all that matters the students. It can be expressed by symbols and drawings in a manner attracting students and interesting to them.
- School Radio: Prepared by students and supervised by teachers. Under the instructions of the Ministry of Education, the school radio begins with Royal National Anthem, then Surah Al-Fatiha (Holy Quran), and then indicating an article of the Jordanian constitution. It also includes programs of reinforcing the citizenship values of students of different stages that can build up their listening skill.
- School library: It is the most media places in the school through promoting curriculum and has the largest role in changing the behavior of students to positive.
- School exhibitions: shows the student productions of citizenship values, through national celebrations that emphasize these values.
- Field visits, seminars and lectures: organized by the Ministry of Education to the most known areas with a history, as well as receiving well-experienced lecturers who are known in their work to disseminate the citizenship values.These seminars are usually held in a wide place as school's theater by which the students can express their opinions freely and confidently.

Hence, the study concludes that the various media have the greatest role in promoting the values of citizenship among high school students especially since these means are available to all within the tasks assigned to the

educational process. It also plays a clear and active role in serving educational institutions for deepening the concept of school and values. It has various functions that serve secondary students in particular, including:

Educational Function: Promote education by collecting and classifying information to ensure that secondary school students are upscale. The role of the community education is to clarify the social role of the students and their cultural characteristics, and to invite them to adhere to the values of community citizenship in order to achieve the concept of social control and trust among the individuals themselves, besides the cultural function. The educational media will preserve the cultural identity of the society by inheriting the desired qualities such as justice, equality, cooperation, patriotism, and pride in its heritage. With the tension of life, the divergence of interests, and the existence of repressed conflicts in individuals, the recreational function of any individual will come up as a function of educational information. Devani (2008).

The study finds that through these functions coordination and cooperation between educational institutions such as school can be done, to achieve the goals of education, and to ensure that values of citizenship are taught to high school students in words and behavior. The school is one of the educational institutions,which aims to spread the values of citizenship among high school students in terms of respect, consideration of individual differences, encouraging cooperative work, training students to dialogue and discussion, and teaching them national affiliation by encouraging them to respect the values of citizenship.

The sources of citizenship values are the same of that Islamic legislation: Holy Quran as a book of heaven revealed on Prophet Muhammad (peace be upon him); a holistic approach to all aspects of life, as includes many verses and each verse contained positive or negative values. The second source: the Prophet's Sunnah is all that is narrated from the Prophet Muhammad (peace be upon him) in terms of saying, doing, deciding, or an attribute that is congenital. The third source is consensus, which means determination and perfection. The measurement as the fourth source of the values of citizenship is a measure of something mentioned in the Holy Quran or Sunnah. Ghamdi (2015)

The values of citizenship are clarified when the school curriculum is consistent with the applied reality in representing the sources of the values of citizenship through the role of the teacher and its relationship with secondary students. This relationship is based on mutual trust, respect for others, justice and equality. The secondary stage teacher plays a major role in representing high school students in the values of citizenship, implanting the spirit of belonging to their homeland, and cooperating with parents in emphasizing these values. The impact of these values on individual level is reflected in the formation of high school students, At social level, the values of citizenship serve to consolidate society, bring people together, and safeguard the security and stability of society.

The study finds that through dissemination of citizenship values among secondary students, it has the greatest impact in deepening loyalty and belonging to the homeland and school, despite the differences of religion, culture and ethnicity, all melted into the crucible of one nation. The awareness of citizens in general, and secondary students in particular, of the current events concerning their country, their attention to problems facing the country, and respect for political power, he should be able to self-control, giving priority to national interest over his one, show feelings of tolerance with others anywhere, or anytime, inside or outside the country, with members of the homeland or with expatriates considering them as citizens, and show his behavior and ethics towards his homeland.This will be considered the real citizenship of the secondary student.

Citizenship has many dimensions, including:

- Political:feeling of individual of loyalty and belonging to homeland.
- Cultural: preserving the national identity through what are provided by the country to citizens.
- Economic: as providing basics of life for citizens.
- Cognitive: preserving national identity that to be supported at Arab and global level.
- Social:to show critical thinking skills, the ability to solve problems, peaceful coexistence with others, accept and work with them.
- Values: represent the principles of freedom, justice, equality and democracy. Sacrament (2010)
- Human: humanization of human, openness to others, acceptance of human brotherhood with them.
- Development: global openness to others and learn and review different cultures.

The study concludes that the secondary school teacher is an example for students in influencing their orientation toward true citizenship and values, developing a sense of allegiance to the country and its property, and avoiding

the wrong practices towards the country and educational institutions.

The values of citizenship will be grown such as a small child who is brought up in the arms of his parents; covering him with family care. These values will be developed at first through the family, the school, and university. The role of educational institutions is no longer limited to knowledge and science, but it is necessary to develop citizenship values of secondary school students through establishing their behaviors within the school learning environments, by dimensions of entrenchment value of citizenship.

2. Entrenchment Value of Citizenship Includes

- Cognitive dimension: identifying the effective citizen, enabling him to live peacefully in society, respecting others, and preserving their rights by not deviating from social controls such as religion, customs, traditions, and prevailing customs.
- Skills dimension: to let secondary school students acquire criticism thinking, problem-solving scientifically, focusing on rationality and logic in saying and doing. Hamid (2010).

Any society is having multinational people, cultures and knowledge. Citizenship is established here in its widest form through peaceful coexistence with others, avoiding conflicts, and all that harms the interest of the country. This is in addition to belonging dimension through national identity, responsibility and national duties, and observance of God Almighty such as justice and equality, whatever non-religious bias, and emphasis on religious values.

It is also possible to employ different teaching strategies by the secondary school teacher in praising these values of citizenship and applying them by all workers in educational institutions as educational forms that have the largest role in achieving citizenship.

At the same time, secondary school students need to understand their rights and duties towards their country and learn the basics of successful dialogue and exchange views.They will be allowed to express their views, participate in decision-making, teach them how to be an example to others, give priority of national interest over theirs, and participate in morning school's radio, national celebrations and events.They are required to preserve school property, which is one of the facilities of the country. This can only be done by qualified teachers who offer them advice and guidance and teach them the citizenshipto the interest of their country and theirs.

The school has been the primary reference in the transfer of knowledge and science through its distinguished well-experienced teachers.They have the largest role in the development of citizenship values.At present time, knowledge is varied with resources.In addition, modern technology is used by all educational institutions. The school is no longer solely responsible for the development of the values of citizenship. A meaningful educational media to keep abreast of educational developments and develop the values of citizenship among high school students in preparation for their admission to institutions of higher education has become urgent. Lotfi, Magda (2011).

The teacher in charge is the one who does and develops the students' attitudes toward the true values of citizenship. They teach, spread a culture of peace, cooperate, respect others, work for the country, supervise and guide students to prepare leaders proud of their homeland and cherish it. This can only be done through the development and promotion of democratic values among students. The teacher is the one who faces students daily, both inside and outside the classroom, and deals with them. At this stage, high school students also need autonomy and security. Hence, he must play an active role in promoting the values of citizenship to them to achieve the required level.

Through the work of one of researchers in the Ministry of Education, he noted that the educational media does not play its practical role in promoting the values of citizenship among high school students. The role of educational media in certain situations, such as announcement of secondary school's result, negatively affected the and reduced the attitudes of secondary school students towards the values of citizenship, and increased student orientation at this critical stage of education towards the deviant values, as a result of cultural openness, and lack of awareness of the values of citizenship, making them do not pay attention to these values.

The importance of the study has been defined as discussed above, which presents the role of educational media in promoting the values of citizenship among high school students in Zarqa Education Directorate II from the viewpoint of their teachers.

3. Problem of the Study

The problem of the study is to answer the following question: What is the role of educational media in promoting the values of citizenship among high school students from the viewpoint of their teachers?

4. Objective and Questions of the Study

The study aimed to identify the role of educational media in promoting the values of citizenship among high school students from the viewpoint of their teachers.

To achieve this goal, the study's following questions were answered:

Q. 1: What is the role of educational media in promoting the values of citizenship among high school students from the viewpoint of their teachers?

Q. 2: Are there statistically significant differences in the role of educational media in promoting the values of citizenship among high school students from the viewpoint of their teachers due to gender variable?

Q. 3: Are there statistically significance differences in the role of educational media in promoting the values of citizenship among high school students from the viewpoint of their teachers due to specialization variable?

Q. 4: Are there statistically significance differences in the role of educational media in promoting the values of citizenship among high school students from the viewpoint of their teachers due to experience variable?

5. Importance of Study

It is hoped that the following entities will benefit from the results of this study:

- Educational policy makers by highlighting the activation of the role of educational purposeful media that to be included within the objectives of the Ministry of Education.
- The Ministry of Education through defining the strengths and weaknesses of the role of educational media in educational institutions in general, and students in secondary schools in particular.
- Teachers of the Ministry of Education in public schools by focusing on the establishment of community and life communication between educational media and high school students.

6. Definitions of the Study

The study definitions are defined as follows:

Educational media:

In language: know something. Bustani (1988)

Idiomatically: a means to be used to produce news and information. The means that are used within the school and community to inform students about the issues of their community. Dulaimi (2011)

Citizenship: derived from homeland where the individual lives. Bustani (1988)

Idiomatically: A trait acquired by a person that give him the right to participate in parliamentary and municipal elections if meets the requirements and satisfy their multiple needs, enabling them to be loyal for their.

Values of citizenship: standards and provisions extracted from the Islamic religion, aimed at controlling the behavior and thinking between the individual and country in which he grew up that to be translated it into reality in order to reach the formation of a good person and a cohesive society.

Zarqa Education Directorate II: The official authoritythat supervises the secondary government schools in Zarqa Governorate.

7. Limits of the Study

Human: Male and female teachers of secondary public schools in Zarqa Education Directorate II.

Venue: Public secondary schools in Zarqa Education Directorate II.

Time: The study was limited to male and female teachers of public secondary schools in Zarqa Education Directorate II for the academic year 2016-2017

8. Previous Studies

Reference was made to a number of previous Arab and foreign studies that dealt with the role of educational media in promoting the values of citizenship.

8.1 ArabicStudies

A study of (Al-Qasim&Ashour, 2015) entitled, "The Role of Public Schools' Principals in Irbid Governorate in employing Educational Media to Enhance Students' National Belonging", aimed at identifying the role of public schools' principals in Irbid Governorate in employing educational media to enhance the national belonging of the students. To achieve the objectives of the study, the descriptive approach was used. A questionnaire was

distributed to a random sample consisted of 697 male and female teachers, and 63 of male and female principals.The results showed that the estimates grade of the sample in employing educational media were medium. There were statistically significance differences of for principals and other differences for the benefit of female principals, and no differences due to qualification and experience variable.

A study of (Gedori, 2014) entitled, "The role of educational media in developing performance of high school students educationally and culturally", aimed at defining the impact of educational media represented by the role of the Syrian Educational Satellite channel in developing students' performance educationally and culturally. The researcher used a questionnaire distributed to 800 students. The results showed that there were no statistically significant differences in the impact of educational media due to gender and specialization variables.The sample members approved to a large extent on the impact of educational media in developing their performance educationally and culturally.

A study of (Mohammed, 2013) entitled, "The status quo of educational media in secondary stage from perspective of teachers and students in Sudan", aimed to identify the status quo of educational media in secondary stage from perspective of teachers and students in Sudan. The descriptive approach was also used. The results showed that educational activities in secondary education in Sudan were weak.

A study of (Sanani, 2012) entitled, "The role of educational media in establishing moral values from viewpoint of secondary school teachers in Medina" aimed at identifying the role of educational media in establishing moral values from viewpoint of secondary school teachers in Medina. The study's sample consisted of 624 teachers.A questionnaire was used.The results showed that there were statistically significant differences due to variable of years of experience, qualification, specialization. The fifth factor (the role of educational media in establishing the value of obedience to ruler ranked first, but forth factor (sincerity at work) ranked second, and (establishing value of patience), ranked third, and the second factor (establishing the value of fulfillment in covenant) ranked fourth, but the first factor (establishing the value of Promotion of Virtue and Prevention of Vice) ranked fifth as to agreement of members of the study.

8.2 Foreign Studies

A study made by (Son, 2010) aimed at defining the assessment of citizenship education in secondary education in Britain from the viewpoint of teachers and students.The researcher used a descriptive approach. The first tool was questionnaire, and the second was interview.The results showed that the methods of acquiring citizenship in the students related to their selection of appropriate methods for their evaluation of citizenship.The quality of teacher can define the attitudes of students towards it.

A study by (Ovadia, 2001) aimed at detecting the differences in the degree of citizenship values among secondary school students in the United States of America according to gender, class, and raceconcepts. This was made through the role of media education within the school. The sample consisted of 4969 students, and the results of the study showed that the degree of citizenship values among students ranged between high and medium, and there were no differences depending on gender, class (specialization), or race variables.

A study by (Yates, 2002) examined the goal of revealing the future of media education in developing the values of citizenship in schools from perspective of teachers in the state of Georgia, USA.The sample consisted of 96 male and female teachers; chosen deliberately from 20 schools.The results showed high positive perceptions of the role of media education in developing the values of citizenship.

8.3 Position of Current Study Among Previous Studies

The previous Arab and foreign studies were used in terms of theoretical literature, tool used, and how to select the study methodology. This study dealt with the role of educational media in promoting the values of citizenship among high school students, which is not discussed by any other studies within the knowledge of researchers.

9. Method and Procedures

The study applied descriptive approach within the following procedures:

9.1 Study Sample

The members of the study are all male and female teachers of public secondary schools in Zarqa Education Directorate II for the academic year 2016-2017.They were 250 teachers, selected from secondary public schools located within Zarqa Education Directorate II.This is shown in the following table:

Table 1. Distribution of study members by gender, specialization and experience

Gender	Specialization	Humanity		Scientific	
Gender	**Experience**	**Frequency**	**Ratio %**	**Frequency**	**Ratio %**
Males 100	From 1 to 5	7	2.8%	14	5.6%
	From 6 to 10	16	6.4%	32	12.8%
	More than 1 1	13	5.2%	18	7.2%
Females 150	From 1 to 5	23	9.2%	1 8	7.2%
	From 6 to 10	30	12.0%	57	22.8%
	More than 1 1	10	4.0%	12	4.8%
Total		99	39.6%	151	60.4%

9.2 Tool Stability

To verify the stability of the questionnaire, the internal consistency coefficient (Alpha-Kronbach)was found, and the stability coefficient was 0.94.

9.3 Tool Validity

The questionnaire was presented to ten arbitrators in the field of jurisdiction, to ensure the tool in terms of construction,and language integrity and clarity.The observations of all arbitrators were taken.

9.4 Tool Variables

The study included the following variables:

Independent variable: the role of educational media.

Dependent variable: the degree of response of male and female teachers.

Medium variable: It has three levels

Gender: male and female.

Specialization, and experience

9.5 Statistical Processing Methods

To realize the goals of study, the Statistical Package for Social Sciences (SPSS) was used to analyze the data and obtain the results as follows:

- Frequencies and percentages to describe characteristics of the study members.
- Arithmetical averages and standard deviations to identify responses of the sample members on each of section of questionnaire.
- Cronbach's Alpha coefficient to verify the stability of the questionnaire.
- T-test for independent samples to define the significance of differences between two independent groups.
- One-way ANOVA analysis to define significance of differences between more than two independent groups.

10. Study Results

The results of the study are presented below:

10.1 Results Relevant to Question (1): What is the Role of Educational Media in Promoting the Values of Citizenship among High School Students from Viewpoint of Their Teachers?

This question was answered by calculating the arithmetical averages, the standard deviations and the order of the teachers' approval grades on the role of the educational media in promoting the values of citizenship among secondary students. The results are defined in the following table

Table 2. Arithmetical averages, standard deviations and order of response grades of members on paragraphs relating to the role of educational media in promoting the values of citizenship among secondary school students in descending order, according to arithmetical average

No.	Paragraph	Arithmetical Average	standard deviation	Approval Degree	Order
5	Inviting always to student dialogues that support the values of citizenship	3.39	1.171	Medium	1
18	Clarifying historical facts	3.36	1.137	Medium	2
19	Highlight the importance of the school role in promoting citizenship values	3.26	1.104	Medium	3
3	Encourage participation in national events	3.24	1.127	Medium	4
2	Promoting national belonging	3.22	1.073	Medium	5
28	Take advantage of technology in promoting citizenship values	3.22	1.193	Medium	5
13	Emphasis on national behavior	3.21	1.133	Medium	7
11	Linking the school curriculum to citizenship values	3.20	1.190	Medium	8
10	Encourage national initiatives	3.19	1.124	Medium	9
12	Promoting social justice	3.17	1.168	Medium	10
7	Emphasis on respecting VIPs of country	3.16	1.154	Medium	11
17	Taking care of student activities that reinforce the values of citizenship	3.16	1.123	Medium	1 1
25	Directing instructions and systems.	3.16	1.211	Medium	11
6	Encourage students to engage in volunteer work within the school	3.14	1.094	Medium	14
23	Highlighting on educational problems	3:14	1.203	Medium	14
24	Strengthen loyalty to leadership	3.14	1.181	Medium	14
27	Establishing national historical values	3.14	1.174	Medium	14
9	Calling for peaceful coexistence with other, especially that number of expatriates is increased	3.13	1.156	Medium	18
4	Warning of deviant values	3.12	1.137	Medium	19
20	Call for making school exhibitions that develop the values of citizenship	3.12	1.188	Medium	19
8	Clarify qualities of effective citizen	3.05	1.141	Medium	21
21	Rooting of national identity	3.05	1.265	Medium	21
26	Remind students of national heritage	3.03	1.158	Medium	23
15	Introducing non-class programs that promote citizenship values	3.02	1.212	Medium	24
16	Link school to community events	2.98	1.185	Medium	25
14	Ensure students to maintain public property	2.96	1.200	Medium	26
29	Praise the educational role of the school	2.96	1.233	Medium	26
22	Modifying student behavior	2.93	1.233	Medium	28
1	Encourage students to abide by national obligations	2.92	1.228	Medium	29
30	Guiding and advising parents on how to deal with developmental characteristics of their children	2.9 1	1.265	Medium	30
General average		**3.12**	**0.714**	**Medium**	

The results of the arithmetical averages of paragraphs concerning the role of educational media in promoting the values of citizenship among high school students ranged between (2.91-3.39); all with medium approval. Paragraph 5 (Inviting always to student dialogues that support the values of citizenship) scored the highest arithmetical average by (3.39), while paragraph (30) (Guiding and advising parents on how to deal with developmental characteristics of their children) scored the lowest average by (2.91). The total number of paragraphs obtained an average of (3.12) with medium degree of approval. The following scale was used to

indicate the average responses of the sample to the degree of approval.

Arithmetical Average	Degree of approval
4.2 and more	Very High
From 3.4 to less than 4.2	High
From 2.6 to less than 3.4	Medium
From 1.8 to less than 2.6	Weak
Less than 1.8	Very Weak

10.2 Results Related to the Question (2): Are There Statistically Significant Differences in the Role of Educational Media in Promoting the Values of Citizenship among High School Students from the Viewpoint of Their Teachers Due to Gender Variable?

This question was answered by calculating the arithmetical averages and standard deviations of teachers' approval grades for the role of educational media in promoting the values of citizenship among secondary students due to gender variable, and using the T-test to define the significance of differences between these averages, as shown in the following table:

Table 3. Results of "T-Test" for independent samples to define The significance of differences in arithmetical averages of responses degrees of study members to educational role of media in promoting values of citizenship among secondary school studentsdue to gender variable

Gender	No.	Arithmetical Average	Standard deviation	"T" Value	Freedom Degrees	Significance Level
Males	100	2.93	0.576	-3.512	248	0.001
Females	150	3.25	0.768			

The results showed that there were statistically significant differences in the role of educational media in promoting the values of citizenship among high school students from viewpoint of their teachers due to gender variable.The arithmetic mean show these differences in favor of females.

10.3 Results Related to Question (3): Are There Statistically Significant Differences in the Role of Educational Media in Promoting the Values of Citizenship among High School Students from the Viewpoint of Their Teachers Due to Specialization Variable?

This question was answered by calculating the arithmetical average and standard deviations of teachers' approval degrees for the role of educational media in promoting the values of citizenship among secondary students due to specialization variable, and using T-test to define the significance of differences between these averages.The results are shown in the following table.

Table 4. Test "T" for independent samples to find the significance of differences in arithmetic averages scores results Approval of teachers in the educational role of the media in promoting the values of citizenship among secondary school students according to specialization variable

Gender	No.	Arithmetical Average	Standard deviation	"T" Value	Freedom Degrees	Significance Level
Human sciences	151	3.22	0.579	2.622	248	0.009
Scientific	99	2.98	0.864			

The results showed significant differences in the degree of teachers' approval of the role of educational media in promoting the values of citizenship among high school students due to specialization variable.

10.4 Results Related to Question (4): Are there Statistically Significant Differences in the Role of Educational Media in Promoting the Values of Citizenship Among High School Students from Viewpoint of their Teachers due Experience Variable?

This question was answered by calculating the arithmetical averages and standard deviations of the role of educational media in promoting the values of citizenship among high school students from viewpoint of their

teachers according to experience variable. The results are as shown in the following table.

Table 5. Mathematical averages and standard deviations of teachers' approval grades on the role of educational media in promoting the values of citizenship among secondary school students depending on experience variable

Years of Experience	No.	Arithmetical Average	Standard Deviation
From 1 - 5	62	3.14	0.966
From 6-10	135	3.17	0.316
More than 11	53	2.98	1.029

In order to determine the significance of these differences, ANOVA test was used. The results are as shown in the following table.

Table 6. Analysis of variance test to determine significance of differences in degrees of teachers' approval on the role of educational media in promoting the values of citizenship among secondary school students depending on experience variable

Variance Source	Total squares	Freedom Degrees	Squares Average	"P" Value	Level of significance
Between groups	1.442	2	0.721	1.420	0.244
Within groups	125.344	247	0.507		
Total	**126.785**	**249**			

The results showed that there are no statistically significant differences in the role of educational media in promoting the values of citizenship among high school students due to experience variable between male and female teachers regardless of their different experiences.

11. Results Discussion

11.1 Discussion of the Results Related to Question (1): What is the Role of Educational Media in Promoting the Values of Citizenship Among High School Students from Viewpoint of their Teachers?

The results of the arithmetical averages of paragraphs concerning the role of educational media in promoting the values of citizenship among high school students ranged between (2.91-3.39); all with medium approval. Paragraph 5 (Inviting always to student dialogues that support the values of citizenship) scored the highest arithmetical average by (3.39), while paragraph (30) (Guiding and advising parents on how to deal with developmental characteristics of their children) scored the lowest average by (2.91). The total number of paragraphs obtained an average of (3.12) with medium degree of approval.

This result attributed to that the goal of any educational institution is to increase the culture of dialogue through educational media, due to its positive impact on the personality of secondary school students, and increase the values of their citizenship. These dialogues are based on fundamental and strong pillars such as constructive criticism and participation in decision-making. These dialogues reduce conflicts between different students, such as discrimination. Instead, it provides a mutual respect, self-confidence and positive communication between them and officials and corrects their mistakes. These dialogues aimed to strengthen the values of citizenship, create a conscious aware generation that can fight subversive ideas to realize progress and development.

11.2 Discussion of the Results Related to Question (2): Are there Statistically Significant Differences in the Role of Educational Media in Promoting the Values of Citizenship Among High School Students from Viewpoint of their Teachers Due to Gender Variable?

The results of statistical averages and standard deviations showed statistically significant differences in the role of educational media in promoting the values of citizenship among secondary school students from viewpoint of their teachers due to gender variable.Arithmeticalaverages showed that these differences were in favor of females. The study attributed this result to the fact that female teachers are more likely to carry the profession of education than male teachers, and that the abundance of passion makes them more committed to teaching the values of citizenship among high secondary students and that they practice it more effectively and with a higher sense of citizenship. Emphasis on promoting civic values in the school day in practical behaviors, illustrated by participation in national events and celebrations, and participation in civil society institutions.

11.3 Discussion of the Results Related to Question (3): Are there Statistically Significant Differences in the Role of Educational Media in Promoting the Values of Citizenship Among High School Students from Viewpoint of their Teachers Due to Specialization Variable?

The results showed that there were statistically significant differences in degree of teachers' approval on the role of educational media in promoting the values of citizenship among high school students due to specialization variable.The arithmetical average show that these differences were in favor of humanity specializations. This result is come as humanity specializations focus on values of citizenship; the nature of school curriculum imposes these citizenship values, as well as those most scientific disciplinesof practical and mathematical applications and chemical reactions are far from linking the school curriculum with reality and values of citizenship.

11.4 Discussion of the Results Related to Question (4): Are there Statistically Significant Differences in the Role of Educational Media in Promoting the Values of Citizenship Among High School Students from Viewpoint of their Teachers due to Experience Variable?

The results showed that there are no statistically significant differences in the role of educational media in promoting the values of citizenship among high school students due to experience variable between male and female teachers regardless of their different experiences. This result is attributed to the routine of educational institutions with regard to expertise in scientific disciplines and humanities, similarity of male and female schools in terms of daily school routines. They have no desire to renew, or participate in promoting the citizenship values of secondary school students.

12. Recommendations

Based on the findings above, the study recommends the following:

- Realizing the goal of education through the institutions of the Ministry of Education by educational media.
- Activating the role of educational media to develop the values of citizenship among high school students.
- Making studies similar to this study with respect to students of higher education institutions to continue developing the role of educational media in promoting the values of citizenship among postgraduate students.

References

Ahmed, A. (2008). *Educational Media and its Role in Education*. Amman: Dar Kunouz Al-Marifa.

Azmi, Mezna, Rumeidi, & Khaled (2011). The Role of Teachers in Developing Citizenship Values among High School Students in Kuwait. *Journal of Education at Kuwait University, 99*(25), c2, 175-205.

Bu, T., Saad, E., Yahi, & Samia (2016). The role of the school in developing the values of citizenship among learners: Middle and secondary education stage as a model. *Human and Social Sciences Journal, University of QasidiMarbah, Wargla, Algeria, 32*(2), 91-103.

Bustani, P. (1988). *Muheet Al-Muheet*. Lebanon: Library of Lebanon.

Devani, A. (2008). *Educational Media, Concept, Areas, Activities and Arts*. Alexandria: Dar Al Wafaa.

Dulaimi, A. R. (2011). *Educational Media*. Amman: Dar Al-Masira.

Ghamdi, A. (2015). The Role of Teacher of Islamic Education in Promoting Values of Citizenship among High School Students in Taif. *Journal of Education, Azhar University: Egypt, 2*(165), 783-812.

Gidori, S. (2014). The role of Educational Media in Developing the Performance of High School Students in Education & Culture. *Al-Quds Open University Journal for Research and Studies, Palestine,* (34), 399-427.

Hameed, J., & Ben, M. (2010). The Role of Education in Establishing the Concept of Citizenship. Jouba Magazine, Saudi Arabia, *Abdul Rahman Al-Sudairy Foundation,* (26), 130-166.

Lotfi, M. (2011). *Educational Information Technologies*. Amman: Dar Osama.

Mohammad, Q., & Mohammad, A. (2016). The Role of Principals of Public Schools in Governorate of Irbid in Employing Educational Media to Enhance Citizenship Belonging of Students. *Al-Quds Open University Journal for Educational and Psychological Studies, Palestine, 4*(15), 389-429.

Mohammed, A. (2013). Status Quo of Educational Media in Secondary Stage from Perspective of Teachers and Students in Sudan. *Jerash Journal for Research and Studies, 15*(Special Issue), 91-105.

Mohammed, S. (2010). Education and Culture of Citizenship Development. *Journal of the Association of Modern Education, 3*(8).

Ovadia, S. (2001). Race, Class and Gender Differences in High school Seniors, Values: Applying Interaction Theory in Empirical Analysis. *Social Science Quarterly, 82*(1), 340-356.

Sanani, A. M. (2012). *The Role of Educational Media in Establishing Moral Values from Viewpoint of Secondary School Teachers in Medina*. Unpublished Master Thesis, Saudi Arabia: Islamic University of Medina.

Son, R. (2010). Citizenship In Secondary Education In England. Research Paper In Education. *Journal of Philosophy of Education, 25*(4), 457-478.

WaladGweel, K. (2014). Secondary Role in Socialization of Adolescent Student. Social Studies - Al-Basira Center for Research. *Consultancy and Educational Services - Algeria, 16(*2), 9-22.

Yates, B. (2002). Media Education's Present and Future: A Survey of Teachers. *Studies in Media & Information Literacy Education, 2*(3), 1-3.

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Computer Hardware Components Ontology

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Abstract

A computer system consists of Hardware components that integrate with each other .The purpose of this paper is to create the hardware components of a computer system by formalizing a number of concepts that represent the knowledge of this dolman. Description logic anddefensible logic are used in this paper to achieve our goal.

Keyword: central processing unit (CPU), Memory, input/output devices(I/O) devices

1. Introduction

Ontology is a body of formally represented knowledge is based on a conceptualization: the objects, concepts, and other entities that are assumed to exist in some area of interest and the relationships that hold among them (Genesereth & Nilsson, 1987). Ontology is an explicit specification of a conceptualization. The term is borrowed from philosophy, where Ontology is a systematic account of Existence. For AI systems, what "exists" is that which can be represented. When the knowledge of a domain is represented in a declarative formalism, the set of objects that can be represented is called the universe of discourse. This set of objects, and the describable relationships among them, are reflected in the representational vocabulary with which a knowledge-based program represents knowledge. Thus, in the context of AI, we can describe the ontology of a program by defining a set of representational terms. In such ontology, definitions associate the names of entities in the universe of discourse (e.g., classes, relations, functions, or other objects) with human-readable text describing what the names mean, and formal axioms that constrain the interpretation and well-formed use of these terms. Formally, ontology is the statement of a logical theory. (Gruber, 1993; Fridman & Hafner, 1997).Computer Hardware Components has many parts that connected to each other's to make a full computer.In Computer Hardware Components ontology we will formal explicit description of concepts in a Computer Hardware Components of discourse (classes […]), properties of each concept […] (slots […]), and restrictions on slots (facets […])".The objective from this paper is to support the sharing and reuse of formally represented knowledge among others related problems.

2. Ontology of Computer Hardware Components:

By using the top-down method we divided the concepts of the CHC (**Computer Hardware Components)** into three parts:

A) CPU

B) Memory

C)I/O devices

The classes above have a subclasses and a set of instances for example: Memory class is divided to two subclasses which are: Main and Secondary Memory. Figure (1) is a hierarchical graph of the ontology Computer Hardware Components concepts. Which the rectangles are represent the concepts and edges are represent the relations.

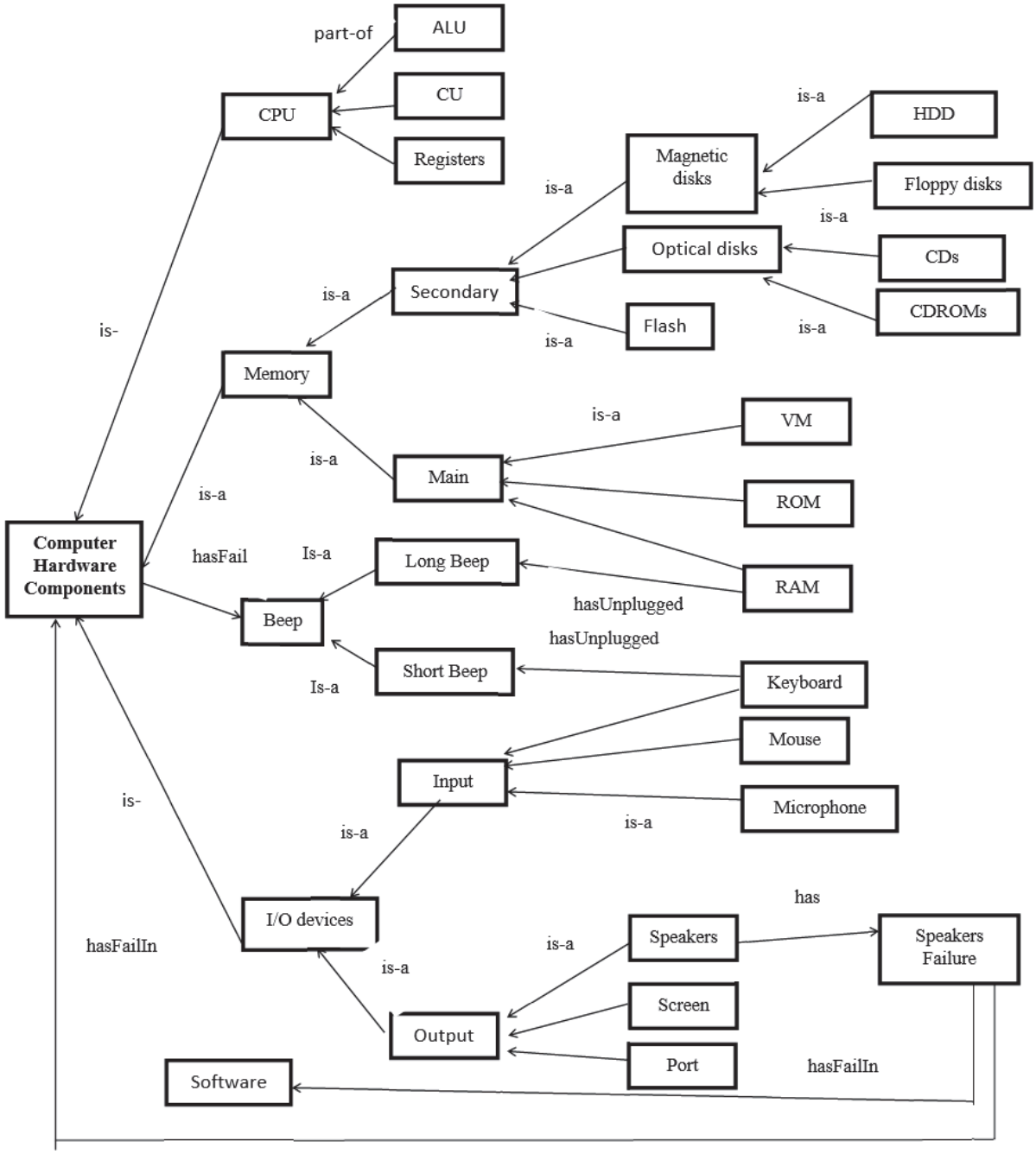

Figure 1. Hierarchical graph of the ontology

2.1 Description Logics and Its Representation

Description Logics DL is a family of formalisms based in first-order +logic for knowledge representation; they are considered to be the most important formalism for the representation of knowledge, unifying and providing logic base for traditional systems in this area (frames, semantic networks, object-oriented representations, semantic data models and systems of types). Description Logics is used to design systems that have a language to define a KB (Knowledge Base), and tools to make inferences on the basis set (Baader et al., 2003). With Description Logics knowledge representation takes place through functional approach, i.e., precise specifications are provided of functionalities to be given by knowledge base and of the inferences to be made (Paulo & Karina, 2011). We will describe one of the most important and influential description logics, called ALC. Other description logics are best understood as restrictions or extensions of ALC.

2.2 The Description Logic ALC

A description logic theory consists of statements about concepts, individuals, and their relations. Individuals correspond to constants in first-order logic, and concepts correspond to unary predicates. Concepts can be named concepts or anonymous (composite) concepts. Named concepts consist simply of a name, say "human", which will be mapped to a unary predicate in first-order logic. Composite concepts are formed from named concepts by use of concept constructors, similar to the formation of complex formulas out of atomic formulas in first order logic. In ALC, we have the Boolean constructors:

- conjunction ∏, which is binary,
- disjunction ⊔, which is binary
- negation ¬ , which is unary

Hence, if C and D are concepts, then C ∏ D, C ⊔ D, and ¬C are also concepts.

ALC statements relate named or anonymous concepts by means of one of the following:

- inclusion ⊑ ,
- inverse inclusion ⊒
- equivalence ≡

Also, ALC contains a Special concepts and which are:

- ⊤ (aka top, Thing, most general concept)
- ⊥ (aka bottom, Nothing, inconsistent concept)

They used as abbreviations for:

- (A ⊔ ¬A) for any concept A
- (A ∏ ¬A) for any concept A

The Role expressions in DL is–, an example Loves–which mean Loves(Y, X) that mean Y is love X and the secondrole is ∘ ,example, hasParent∘hasBrother , which mean X has parent Z and Z has brother Y.

A Knowledge Base (KB) in Dlis just a TBox plus an Abox and which often written as K = {T, A}. theTbox is a set of axioms like ∏,⊔,≡,⊑ , ⊒ and theAbox is a set of facts like, (HappyParent(John).

3. Ontology of Computer Hardware Components by Description Logics

As we see in the previse section, the knowledge base in DL are consist of Abox and Tbox, inthis section we will write a part of the Computer Hardware Components by using the Description Logics as graph 2:

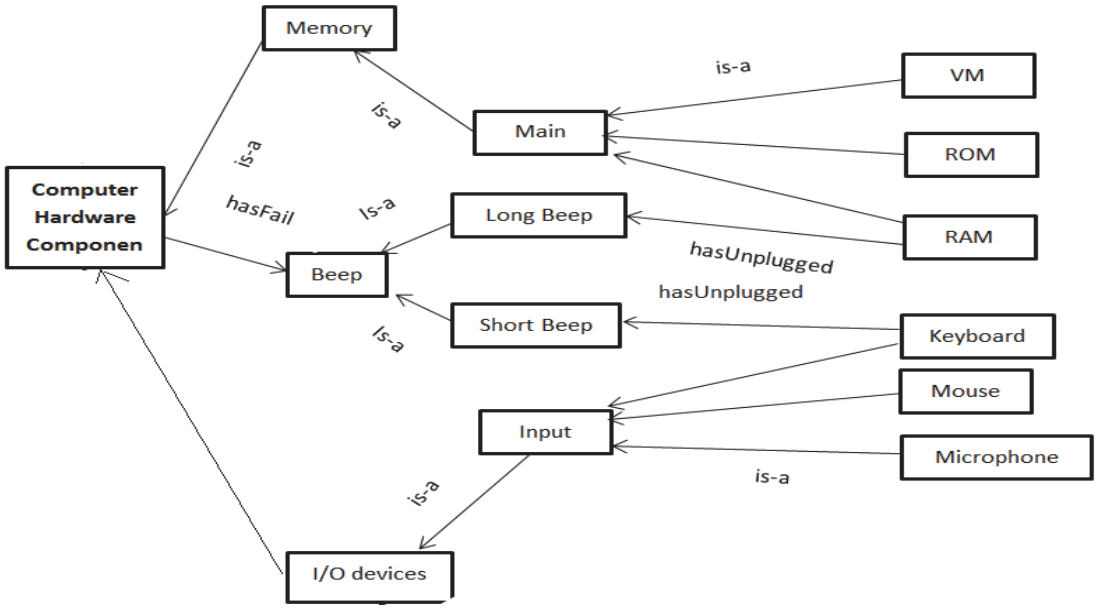

Figure 2. Part of ontology hierarchical graph in DL

TBox :

$$\text{Beep} \equiv \exists \text{hasFailure.CHC} \quad (1)$$

$$\text{LongBeep} \sqsubseteq \text{Beep} \quad (2)$$

$$\text{ShortBeep} \sqsubseteq \text{Beep} \quad (3)$$

$$\text{LongBeeb} \equiv \exists \text{hasUnplugged .Ram} \quad (4)$$

$$\text{ShortBeeb} \equiv \exists \text{hasUnplugged .Keyboard} \quad (5)$$

The Axioms from the TBox in natural language is:

(1) The Beep is a Failure in the Hardware components.

(2) Long Beep is a Beep.

(3) short Beep is a type of Beep

(4) The Long Beep is appearing when the Ram slot is unplugged correctly.

(5) Short Beep it is appearing when the Keyboard is unplugged correctly in its port.

From Tbox we can make automaticreasoning suchas:

From 1 &4 we could derive If thereis a Beep in the Hardware this is because of the Ram isUnplugged:

$\exists$hasBeep. HCH≡hasUnplugged.Ram

From 1 & 5 could derive the Beep in the hardware can be appear because of the Keyboard is unplugged correctly:

$\exists$hasBeep. HCH≡hasUnplugged.Keyboard

And from 1 & 4 & 5 we could derive when the Hardware has aBeep this is because there isunpluggedin the Ram or the Keyboard:

$\exists$hasBeep.CHC $\sqsubseteq$ hasUnplugged.Ram $\sqcup$ hasUnplugged.Keyboard

4. Defensible Reasoning

Classical reasoning for logic-based KR (Knowledge Representation) systems is in general, monotonic. That is, there is an assumption in these systems that there is complete information about a domain. This means that they generally cannot deal with any new information arising which contradicts with the current information. This is not an appropriate model for reasoning in many applications. Therefore, alternative non-monotonic systems have been investigated which can reason under uncertainty or with incomplete information. Defeasible reasoning is one particular model for implementing non-monotonic reasoning. It is concerned with representing and reasoning with defeasible (nonstrict) facts about a domain. The defeasible counterpart of the strict fact: “All birds fly” is the defeasible fact: “Most birds fly” (or the alternative phrasing “Birds usually fly”)(Moodley, Meyer & Varzinczak, 2012).

In Computer Hardware Components there is some non-monotonic reasoning that can’t describe in DL so we need to use the Defeasible reasoning to work with it like:

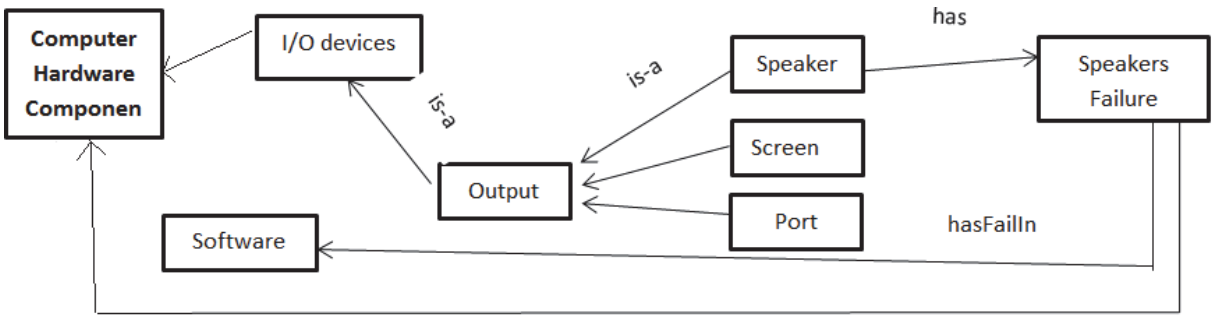

Figure 3. Part of ontology hierarchical graph in Defeasible Logic

The Speakers Failure is a Hardware Failure but it’s also can appear from a software Failure so here we have some exaptation and itsnon-monotonic, we can’t say(SpeakersFailure $\sqsubseteq$ $\exists$hasFailure.HW) because of its also

can be from the Software but we can writeSpeakers $\sqsubseteq$ Output because of the Speakers is a output device .
In (Moodley, Meyer & Varzinczak, 2012) the authors proposed algorithms to converts the Defeasible reasoning to Classical reasoning to representing in DL .they propose a defeasible subsumptionoperator ($\tilde{\sqsubseteq}$) which mean a 'supraclassical' to the classical subsumption operator ($\sqsubseteq$) in DLs, example: C $\tilde{\sqsubseteq}$ D where C and D may be complex ALC concepts and this will solve the issue because of this is mean the most typical C's are also D's.

By this operator we can write (SpeakersFailure $\tilde{\sqsubseteq}$ $\exists$hasFailure.HW), and (SpeakersFailure $\tilde{\sqsubseteq}$ $\exists$hasFailure.SW).

The algorithm begins by performing a classical transformation of the input KB. Essentially this amounts to rewriting all defeasible statements in the KB as their classical counterparts and all classical statements into a specific normal form. In our Ontology Let K be the input of transformKB

$$\mathrm{K} = \begin{cases} \mathrm{SpeakersFailure} \tilde{\sqsubseteq} \exists\, \mathrm{hasFailure.HW} \\ \mathrm{SpeakersFailure} \tilde{\sqsubseteq} \exists\, \mathrm{hasFailure.SW} \\ \mathrm{Speakers} \sqsubset \mathrm{H.W} \\ \mathrm{Speakers} \sqsubseteq \neg \mathrm{S.W} \end{cases}$$

If we execute the procedure for K we get K $\sqsubseteq$:

$$\mathrm{K} = \overset{\sqsubseteq}{\begin{cases} \mathrm{Speakers} \sqcap \neg\, \mathrm{H.W} \equiv \bot \\ \mathrm{Speakers} \sqcap \mathrm{S.W} \equiv \bot \\ \mathrm{Speakers\ Failure} \sqsubseteq \exists\, \mathrm{hasFailure.HW} \\ \mathrm{Speakers\ Failure} \sqsubseteq \exists\, \mathrm{hasFailure.SW} \end{cases}}$$

This is done by the first definition(transformKB) by the author of(Moodley, Meyer & Varzinczak, 2012)and the second definition which is(Ranking):Let K $\sqsubseteq$ be the classical counterpart of some defeasible KB: A ranking for K $\sqsubseteq$ is a total preorder on the elements (axioms) in K $\sqsubseteq$, with axioms higher up in the ordering interpreted as having a higher exceptionality or importance.

Finally, by 3ed definition (Exceptionality) its specify a sub-procedure called exceptional ($\mathcal{E}$) which computes a more exceptional (specific) subset $\mathcal{E}$of some input set of sentences $\mathcal{E}$.the output of the 3ed definition will be as follow:

$$\mathcal{E}_1 = \begin{cases} \mathrm{Speakers} \sqcap \neg\, \mathrm{H.W} \equiv \bot \\ \mathrm{Speakers} \sqcap \mathrm{S.W} \equiv \bot \\ \mathrm{Speakers\ Failure} \sqsubseteq \exists\, \mathrm{hasFailure.SW} \end{cases}$$

The output from these algorithms will be like:

Dmax = {Speakers $\sqcap \neg$ H.W $\equiv \bot$

Speakers$\sqcap$S.W $\equiv \bot$ }

D2 = { SpeakersFailure $\sqsubseteq$ $\exists$hasFailure.SW}

D1 = { SpeakersFailure $\sqsubseteq$ $\exists$hasFailure.HW}

Dmax represents the infinite rank which contains the classical (non-defeasible) statements from the KB.and D2 is represents the more specific of the input that mean the one have a higher ranking and D1 represents the lowest ranking. The output will give apriority for each defeasible statement and the one which have the high priority will look about firstly, the priority are given by the specification ,the concept with more specification it will have a high priority, Which mean the $\exists$hasFailure.SW is more specific than the hasFailure.HW so in DL when we have a SpeakersFailure then it's first will check the SW of the speakers and if the Software are work well then it will check the Hardware of the speakers.

5. Conclusion

In this paper we create the ontology of the computer hardware components and we formalizing a number of concepts by using description logic and defeasible logic. We can use the ontology and the formalization tosupport the sharing and reuse of formally represented knowledge among others related problems.

References

Baader, F., Calvanese, McGuinness, D., Nardi, D., & Patel-Schneider, P. F. (2003). *The Description Logic Handbook: Theory, Implementation and Applications.* Cambridge University Press.

Fridman, N., & Hafner, C. D. (1997). The State of the Art in Ontology Design. *AI Magazine,18*(3),53-74.

Genesereth, M. R., & Nilsson, N. J. (1987). Logical Foundations of Artificial Intelligence.Morgan Kaufmann, Los Altos, CA.

Gruber. (1993). Toward principles for the design of ontologies used for knowledge sharing.

Moodley, K., Meyer, T., & Varzinczak, I. J. (2012). A defeasible reasoning approach for description logic ontologies. SA Institute for Computer Scientists and Information Technologies (SAICSIT) Conference, Pretoria, South Africa, 1-3 October 2012.

Paulo, A. L., & Karina, P. (2011). Description Logics as information resource: as example of its application in cardiology. Rio de Janeiro.

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Social Network Site Usage by Small- and Medium-Sized Businesses: Understanding the Motivations and Barriers

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Abstract

This paper contributes to a growing body of research on the process by which small- and medium-sized businesses (SMBs) adopt social network sites (SNSs) as part of their business strategies. If SMBs make use of SNSs, they could potentially compete with big corporations, flattening the marketplace**.** Open-ended online survey questions were used to collect data from 24 different social media experts in the Hashemite Kingdom of Jordan. Jordan was selected for this study because 90% of its adult Internet users are active on SNSs, a percentage that surpasses many emerging and developed countries. This research project identifies (a) relative advantage, (b) community demand, and (c) interactivity as motivating factors for SNS adoption. The survey results also reveal that (a) top management belief, (b) firm readiness, (c) negative comments and reviews, and (d) a low level of awareness are barriers to SNS adoption by SMBs in Jordan. The present study should prove to be particularly valuable to academics and business managers to formulate their business strategies regarding SNS adoption, and to pave the way for more research to assess likely changes.

Keywords: barriers, Information technologies adoption, Motives, small to medium-sized enterprises, Social Network Sites

1. Background

Social network sites (SNSs) help firms target more engaged customers, despite excluding a few due to their inability to stay engaged (Culnan, McHugh, & Zubillaga, 2010). Furthermore, firms use SNSs as a platform to help them construct human relationships through online communication, enabling them to conduct data analyses of these interactions, ascertain their performance, and improve areas of concern (Gandomi & Haider, 2015). In the context of small- and medium-sized businesses (SMBs) in particular, SNSs help small businesses stand out from the competition, including big firms that have established marketing channels. For small businesses, SNSs are among the best approaches to gain marketing collateral at an affordable cost; by using SNSs, they can stay engaged with their customers and build their businesses with no need to spend money on expensive graphics to market themselves (Nobre & Silva, 2014). Because of SNSs interactivity, firms are beginning to consider them more effective tools than traditional media and websites in building relations with the public (e.g., Kelleher & Miller, 2006; Kent, 2008; Sweetser & Metzgar, 2007). Businesses are able to reach out to the larger market segments that use such social sites. For instance, through Facebook, clients are able to air their views regarding company services, giving firms the opportunity to respond to their concerns and rectify those hitches. However, unplanned usage of SNSs could harm firms' reputation through unattended negative comments and feedback about businesses products and services (MessageLabs, 2007). In fact, despite the common benefits that SNSs offer to SMBs, a literature review highlights a list of barriers that hinder adoption, such as privacy and security issues, regulation concerns, and top management belief. The key motivations and barriers will be reviewed in detail below.

1.1 Framing Organizational SNS Adoption

Different studies discussed SNS usage among SMBs in the context of marketing, entrepreneurship (e.g., Tiago & Veríssimo, 2014), and performance outcomes (e.g., Ainin, Parveen, Moghavvemi, Jaafar, & Shuib, 2015). The research community has generally passed over the distributed nature of SNSs. It has given little attention to the identification of motivating factors and barriers that could affect the SNS adoption process. In addition to this, previous studies mainly highlighted SNS implementation success and the adoption of related critical success factors (e.g., de Araújo & Zilber, 2016; Ainin, Parveen, Moghavvemi, Jaafar, & Shuib, 2015, Zeiller & Schauer,

2011). Those studies emphasized post-adoption factors. Inherent in the research are businesses that have already utilized SNS technology (Garverick, 2014). As a result, potential barriers that prevent selection have not been studied in depth. To fill these gaps, the current study is an attempt to explore these key adoption factors and pave the way for more research to assess likely changes. This study will use the Diffusion of Innovation (DOI) theory developed by Rogers (2003) to explain the main technological factors involved in the spread of this technology. The network externalities theory will serve as a basis to explain the main environmental factors. Finally, literature on adoption will be used to analyze organizational factors and adoption barriers.

The term *network externalities* refers to the value added to a product of service as a result of an increased number of customers (Shapiro, Varian & Becker, 1999). Farrell & Klemperer (2007) found that when a specific product or service is adopted by different users, this popularity encourages potential consumers to do the same, thus increasing the adoption numbers. The network effect was first applied to empirical telecommunication studies (e.g., Squire, 1973; Rohlfs, 1974; Kahn & Shew, 1987; Einhorn, 1993; Panzar & Wildman, 1995; Barnett & Kaserman, 1998; Crémer, 2000; Yannelis, 2001; Mason & Valletti, 2001; Gandal, Salant, & Waverman, 2003; Shy, 2001). The same concept could be applied to SNSs among SMBs. With the increase of users' interaction on SNSs, a community demand developed for methods of communication among current and potential consumers and with SMBs. This encouraged SNS adoption among SMBs.

This study aims to integrate both the DOI and network externalities theories as well as current literature into one coherent framework. According to this framework, key adoption factors will be simply divided into two inclusive sets: motives and barriers. We believe these two groups encompass the determinants needed to understand SNS adoption in the context of Jordanian SMBs (see Figure 1). The following sections will provide an overview of the main constructs in the framework.

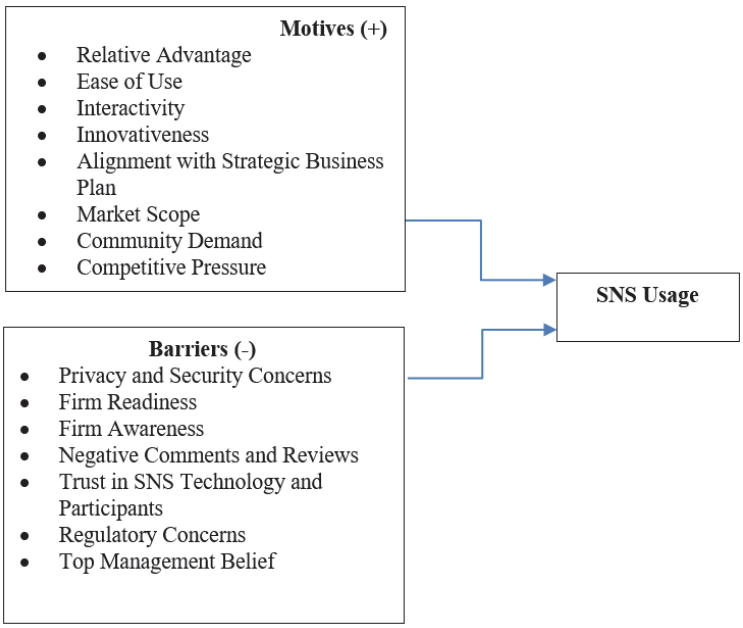

Figure 1. Framework for SMB Adoption of SNS Services

1.2 Motivation for SMBs to Adopt SNS Usage

Relative Advantage: Rogers (2003) defined *relative advantage* as the level of acceptance of new innovations due to their being perceived as exceeding the suppressed idea. Rogers (2003) indicated that acceptance would be more likely if the innovation was considered to have relative advantage. Many previous studies showed that relative advantage is the main factor for SMBs in adopting new information and communication technology (ICT) innovations (e.g., see Shah Alam, Ali & Jani, 2011; Elmazi, Vukaj, Gega, & Elmazi, 2011). According to Wanyoike, Mukulu, and Waititu (2012), SNSs make the work easy, reduce costs, satisfy the customers, and improve productivity. From an ICT innovation perspective, the relative advantages of SNSs are noticeable.

Ease of Use: The likelihood of adoption will decrease if the innovation is complex to use (Rogers, 2003). Davis (1989) defined *ease of use* as the level of ease experienced in using a system. Many studies showed that ease of

use is positively related with technology adoption among SMBs. Mirchandani & Motwani (2001), Daniel & Grimshaw (2002), and Grandon and Pearson (2004), among others, suggested that applications that are easier to use are more likely to be adopted than complex ones. In fact, popular social networking sites are designed to be user-friendly.

Interactivity: Liu and Shrum (2002) defined *interactivity* as "the degree to which two or more communication parties can act on each other, on the communication medium, and on the messages and the degree to which such influences are synchronized" (p. 54). Since social media became popular, studies have taken an interest in examining the strategies behind online constituencies' relationships (Smith, 2010). Researchers such as Kelleher and Miller (2006), Kent (2008), and Sweetser and Metzgar (2007) pointed out that due to the interactivity features that SNSs provide, SNSs and blogs were more effective than traditional media and websites in building relations with the public. Saffer, Sommerfeldt & Taylor (2013) explained that Facebook and Twitter were more effective in relationship-building communication than websites lacking interactivity features. The presence of organizations and businesses on SNSs alone is not enough (Cone, 2008); the interaction between the organization and its consumers makes the difference. Jo and Kim (2003) showed that relationships can be cultivated through interactivity and involvement. Interactivity provides better feedback for firms, encouraging responsiveness and a flow of information between the parties (Sundar, Kalyanaraman, & Brown, 2003; Kietzmann, Silvestre, McCarthy, & Pitt, 2012). Social media usage is influenced positively by interactivity (Odoom, Anning-Dorson, & Acheampong, 2017), which in its turn influences SMBs' adoption of SNSs.

Innovativeness: *Innovativeness* occurs when an organization's receptivity toward new ideas is a key factor in the adoption decision (e.g., see Lin & Jeffres, 1998; Marcati, Guido, & Peluso, 2008). Many studies (Rogers & Shoemaker, 1971; Leung & Wei, 1998; Lin & Jeffres, 1998) investigated how this factor plays a major role in ICT innovation adoption. Marcati et al. (2008) argued that receptiveness toward new ideas was a key factor in SMBs' innovation adoption on a firm level. A number of authors have considered the positive effects of this factor (e.g., Hirschman, 1980; Alshamaila, Papagiannidis, & Li, 2013; and Rogers, 2003). It plays an effective role in decision-making, especially in SMBs (Marcati et al., 2008).

Alignment of SNS Use with Business Strategy: Firm managers want adopted innovations to be compatible with their companies' values and strategic technological needs (Rogers, 2003). Henderson and Sifonis (1988) defined this factor as the effective linkage between the strategic ICT plan and the strategic business plan. Several studies have highlighted the importance of SNS alignment with the strategic business plan. Burn and Szeto (2000) argued that a firm's success not only relies on the ICT strategy but the business strategy, as well, and close alignment between the two. Broadbent and Weill (1993) stated that a more effective process of alignment between the two can be achieved by increasing the dialogue between business and ICT managers. Other researchers, such as Bharadwaj (2000) and Armstrong and Sambamurthy (1999), studied the importance of ICT strategy alignment with the strategic business plan.

Market Scope: Zhu, Kraemer, & Xu (2003) defined *market scope* as the horizontal extent of a company's operations. Several studies have established that market scope can play a key role in technology adoption. For example, Lee and Whang (2004) examined globalization's influence on SMBs' intention to adopt e-business. Hsu, Kraemer, & Dunkle (2006) argued that the more global a firm is, the greater its diversity and volume of e-business use will be. Xu, Rohatgi, and Duan (2007) found a positive relation between globalization and Internet adoption. This argument presented a firm's market scope as a potential factor for SNS adoption among businesses.

Community Demand: Carmichael, Turgoose, Gray, Todd, & Nadin, (2000) defined *community demand* as customers' feedback and demand, both of which are key factors in SMBs' innovation adoption. Poon and Swatman (1999) and Hart and Saunders (1998) highlighted that customer pressure is one of the key motivating factors behind SMBs' ICT innovation adoption. In general, a review of previous studies indicates that most SMB ICT adoption comes as a result of this pressure (Carmichael et al., 2000; Kula & Tatoglu, 2003; Ifinedo, 2011). At least half of the adults around the world use SNSs, and Jordan was placed no.1 on a Pew Research Center survey of adult Internet users and smartphone owners who use SNSs (Poushter, 2016). This—in line with the network externalities theory—suggests that community demand is a potential factor for SNS adoption among businesses in Jordan.

Competitive Pressure: *Competitive pressure* refers to the kind of pressure exerted on businesses by their industry competitors that pushes the adoption of new ICT innovation as a trade-off for maintaining its competitiveness (Martins, Gonçalves, Oliveira, Cota, & Branco, 2016; Ifinedo, 2011). Looi (2005) viewed external pressure as pressure from competitors resulting in environmental uncertainty and leading to an increase in industries' innovation adoption. SMBs' adoption of ICT innovation may be a result of pressure from their customers, partners, and competitors (Poon & Swatman, 1999; Hart & Saunders, 1998). Gatignon and Robertson (1989) argued that

intense competition between businesses pushes them to look for new ways of promoting themselves, like ICT adoption. This factor may be one of the better predictors of ICT innovation acceptance (Gatignon & Robertson, 1989; Looi, 2005; Jeyaraj, Rottman, & Lacity, 2006; Chong & Pervan, 2009; Huang, Janz, & Frolick, 2008).

1.3 Barriers to SNS Adoption

Privacy and Security Concerns: Privacy and security are two main issues that are usually linked to SNS usage. Teo, Ranganathan, & Dhaliwal (2006) found that security was an essential factor affecting ICT innovation implementation (i.e., e-commerce); hackers breaking into companies' systems play a negative role. As a result of this concern, some firms do not encourage e-commerce. In addition, some firms believe that the basic structures of e-commerce cannot guarantee safety and protection. When it comes to privacy, Messerschmidt and Hinz (2013) wrote that the use and adoption of any given technology depend on its privacy level. They also stated that a company's level of adoption depends on to what extent this technology is reliable and trustworthy. Martins et al. (2016) found that even when companies are aware of SNSs' high level of security, they still have concerns about accepting the risks of adopting new technologies.

Firm Readiness: Iacovou, Benbasat, and Dexter (1995) define *organizational readiness* as "the availability of the needed organizational resources for technology adoption" (p. 467). Zhu and Kraemer (2005) suggested that technology readiness involved basic technological structures, technical skills, and appropriate systems. Mehrtens, Cragg, & Mills (2001) and Zhu et al. (2003) argued that the readiness of a business—both physically and in terms of ICT knowledge—was a key factor in ICT adoption. Iacovou et al. (1995), Al-Qirim (2008), and Ramdani, Kawale, & Lorenzo (2009) discussed this factor from a financial point of view, as well as organizational IT sophistication and expertise. Many other studies showed that SMBs' possession of previous expertise had a positive relationship with adopting new ICT innovations (Cragg & King, 1993; Chwelos, Benbasat, & Dexter, 2001; Caldeira & Ward, 2002).

Low Level of Awareness: *Awareness,* which is essential for technology adoption, refers to the extent to which a target population is conscious of an innovation and has a general idea of what it entails (Schmidt, Johnston, Arnett, Chen, & Li, 2008). Several studies investigated the impact of awareness on the adoption of e-commerce in general (e.g., see Molla & Licker, 2005; Dinev & Hu, 2007). Molla and Licker (2005) studied ICT innovation adoption of e-commerce in developing countries. The study showed that firms in developing countries might be late in adoption of new ICT innovations because those firms were not aware of the benefits. As a result, they would not take the risk of adopting new technology. SNSs fall into the category of new ICT innovation, which means that firms may not be fully aware of their benefits.

Negative Comments and Reviews: The main element of this category is *word of mouth*, which Hennig-Thurau, Gwinner, Walsh, & Gremler (2004) defined as the negative or positive feedback available to the public via the Internet, given by potential, current, or past consumers about a product or service provided by a company. Through a survey, Werbler and Harris (2008) found that 61% of respondents confirmed their preference of consulting online reviews, blogs, and consumers' feedback before purchasing new products or services. Some studies focused on the influence of negative feedback on consumers' perceptions. MessageLabs (2007) stated that negative comments posted by staff were easy to find online. Park and Lee (2009) concluded that negative feedback had a stronger influence than positive. Some SMBs fear the damage that may result from negative feedback and, as a result, SMBs might choose not to use SNSs.

Regulatory Concerns: Martins et al. (2016) defined *regulatory concerns* as the legal protection concerns regarding online business or legislation gaps. According to Haywood (1981), regulatory concerns may affect the use of technology. Regulatory concerns are divided into taxation, legal protection, and business law support (Hsu et al., 2006). Several studies investigated the connection between regulatory concerns and innovation and to what extent those concerns affected innovation (e.g., Kuan & Chau, 2001; Haywood, 1981). Rationally speaking, government initiatives and activates are essential components of ICT use, making it unlikely for businesses to be left entirely unprotected. Regulatory concerns may exist regarding SNS diffusion among SMBs, especially in developing countries, which usually lag behind in formulating regulations for emerging technologies.

Top Management Belief: Several studies have shown that top management support plays a vital role for SMBs in adopting new ICT innovations (e.g., see Grover, 1993; Sila, 2013; Jeyaraj et al., 2006; Ramdani et al., 2009). Ramdani et al. (2009) found that the manager's point of view affects which systems enterprises adopt. Walsh (1988) showed that the development of top management's "belief structure" is affected by the environment on which managers base their inferences. These beliefs play a big role in the organizational strategies, decisions, and behaviors of these managers (Shrivastava, 1983). Other studies, such as Hambrick and Mason (1984), suggest that top management's values and cognitive bases reflect organizational choices. Either way, there is a clear

relationship between the top management's beliefs and their decisions about ICT innovation.

2. Methodology

2.1 Research Design

The prominent research method in research designs for adoption and diffusion is a quantitative approach using questionnaires (Williams, Dwivedi, Lal *&* Schwarz*,* 2009; Wang, Fu & Duan, 2011). Rogers (2003), however, preferred diversity in research design over extensive usage of a one-go survey, in order to avoid any inadequacy in research designs. Wang et al*.* (2011) stated that to get a better understanding of the complicated and emerging issues included in ICT adoption and diffusion, new research should be conducted to investigate other theories. Wang et al. (2011) also held that more qualitative research, including interviews and action research, should be supported.

The specific objective of this study was to investigate the determinants of SNS decision-making by SMBs and to what extent each determinant affects these decisions. This study therefore conducted qualitative research to achieve deeper analysis of the factors. Open-ended surveys are a form of data collection for qualitative research, generally in the form of a text box in a survey (SurveyMonkey, 2017). This type of question has the necessary flexibility to fully extract respondents' opinions, and the results of this research can pave the way for more empirical quantitative studies. As Johnston (2014) suggested, ". . . open-ended questions also enable the researcher to follow the narrative of thought of respondents and to gauge the respondents' intensity of thought as they express their thoughts and ideas in their own words" (p. 26). To explore the impact of motivating factors and barriers to SMBs' adoption of SNSs while remaining time-efficient and cost-effective, the researcher chose to use an online qualitative survey.

2.2 Data Collection and Analysis

In a qualitative study like this one that depends on experts' opinions, the definition of the word expert is essential. The term expert is used by Feigenbaum and McCorduck (1983) to refer to a person inferential and rooted in experiential knowledge that was built through a repertory of working hours in combination with academic knowledge. The opinions of experts who use their expertise and ability to answer research questions is of great value (Arlene & Kosecoff, 1985). Experts chosen for this study belong to various social and economic contexts and work as social media strategists, client servicing managers at digital marketing agencies, and freelancers. In addition, directors of digital media in public and private organizations. Experts who works with social media agencies or as a freelance usually deal with more than two SMBs clients; while directors of digital media in public and private organizations usually work on full time basis for one organization; for a full list, see Table 1. The experts selected to participate in the research are key to our results because the study is based on their opinions (Ashton, 1986; Bolger & Wright, 1994; Parente et al., 1994). According to Okoli and Pawlowski (2004) to verify expert panels' reliability, there are some fundamental points researchers need to consider. First, they must identify experts' skills, topics of interest, and SNS knowledge. Second, the selected experts' profiles must relate to the identified topics. Thus, in this study, the experts were selected using a LinkedIn profile search. Jordan as the place of work was an essential condition.

The researcher first conducted a pilot study with five experts to verify whether the questions were clear in their intent and meaning. The questions were revised accordingly. A set of 24 experts participated in this study. Invitations containing the link to the online survey were sent to participants who manage firms' official pages and profiles on SNSs, and accordingly, the researcher received a clear idea about what makes firms adopt or choose not to adopt SNSs in their businesses. Respondents were encouraged to complete the survey in a quiet environment where they were able to concentrate without interruption. In the first section of the survey, the social media specialists were asked about, how many SMBs they served and how SMBs use SNSs in their businesses in general (Table 1, Table 2). In table 2, experts were allowed to choose more than one option. In the second main section of the survey, respondents were asked to select up to three choices from a list of the main motive factors and barriers identified by the literature as influences on SMBs' decision-making, and then to provide, in the box, their opinions about each factor they selected.

According to Miles and Huberman (1994), the analysis procedure is divided into three steps: "data reduction," "data display," and "conclusion drawing/verification." In this research project, data management and analysis followed this path. The main purpose for summarizing collected data is condensing it (Robson, 2002; Saunders, Lewis & Thornhill, 2007), but data analysis focuses on organizing it for the sake of drawing conclusions from it.

The findings of the open-ended surveys were used to refine the initial framework model as well as show the reality of SNS adoption in SMBs in Jordan. This kind of research is useful for understanding how SNS experts feel and think about SNS adoption based on their experience. An exploratory qualitative study makes forming flexible

discussion channels with the participants easier. The discussion had a methodological advantage in that experts were anonymous and not dominated by any singular opinions.

3. Findings and Discussion

Table 1 presents the results obtained from the survey for the number of SMBs that have social media specialists to supervise their accounts on SNSs. OF the social media specialists, 29.17% (7 individuals) supervise from 1 to 2 SMBs; 17 specialists, or 70.83 %, supervise more than 3 SMBs.

Table 1. Number of SMBs with Experts Supervising Their Sites on SNSs

Answer Choices	Responses	
1–2 SMBs	29.17%	7
> 3 SMBs	70.83%	17
	Answered	24

Table 2 shows the summary statistics for the most prominent uses of SNSs by the companies. There are three answer choices: advertising and marketing, making sales online, and after-sales services and support. The results show that the highest percentage of SNS use is for advertising and marketing (95.83%, or 23 responses). In comparison with the other choices, this is rather a remarkable result. The percentage of SNS use for making sales online is 33.33%, as it is for the after-sales services and support choice. This indicates that most SMBs in Jordan use SNSs primarily for delivering their customers more information about products and their benefits, and perhaps for introducing or reminding customers about the brand itself.

Table 2. What Are the Most Prominent Uses of SNSs by SMBs?

Answer Choices	Responses	
Advertising and marketing	95.83%	23
Making sales online	33.33%	8
After-sales services and support	33.33%	8

3.1 Motivation

The chart (Figure 2) shows the main motivating factors of using SNSs in SMBs. The 17 respondents believed that relative advantage was the main motivating factor. It was followed by 13 respondents who listed community demand. Interactivity came in third place with 12 participants, and 6 participants believed that pressure from competitors was an important motivating factor. Perceived ease of use, market scope, innovativeness, and alignment with firm business plans were rated the least important factors.

Relative Advantage: One of experts (EXPs)' highest-rated motivations was relative advantage. The most common advantage was the low cost required to use SNSs to reach audiences (EXPs 2, 5, 6, 7, 9, 11, 14, 17, 19, 20, 21, 23 & 24). According to EXP 23, "For a small company, the main goal is cost reduction." EXP 24 cited the benefits of digital marketing due to the low costs, in addition to the advantage of having more complete and easier coverage, whereas (EXP 7) sees that the main goal is to have a bigger coverage at a lower cost. Whether to provide follow-up services (EXP 3), reaching target audiences in a more effective and innovative way (EXPs 9, 12), or reaching the highest number of agents possible in a shorter time and less costs (EXP 17) SNS platforms are more effective. According to EXP 9, "Through social media platforms, you can reach the targeted audience with low cost unlike other advertising methods such as radio and television, which makes e-marketing an effective and better method." SMBs are more likely to adopt new innovations once they perceive them to offer a relative advantage (Rogers, 2003). EXP 17 explained that SNSs enable SMBs to change their marketing theme constantly, which gives firms an opportunity to refresh their campaigns in a shorter time and less costs. Others EXPs like EXPs 9, 11, 14, and 20 highlighted that using SNSs had more benefits in e-commerce and advertising than traditional methods.

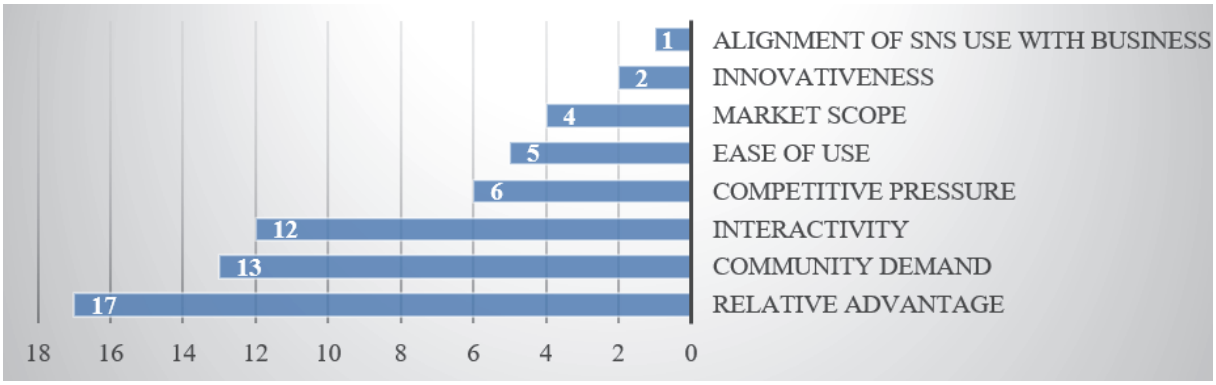

Figure 2. Motivation Factors

Community Demand: Most EXPs chose community demand as a motivation for using SNSs because most users have at least one form of SNS platform that they use (EXP 1 and 2). Exp 10 states that the number of Internet users has increased in Jordan, while EXP 5 stated that the percentage of SNS users is increasing. In fact, international statistics indicate that the percentage of active SNS users among adult Internet users in Jordan is of 90%, thus surpassing many developed countries like the United States (71%), Russia (85%), and France (57%) (Poushter, 2016). EXP 4 stated that "in Jordan, the number of Facebook users is significantly high' almost 5.300.000, [so] successful promotion campaigns could be achieved through SNS advertisements." EXP 5 stated that due to the increased SNS users, promoting products and services using SNSs makes delivering accurate product information easier. and EXP 16 argued that it offers companies the opportunity to discover people's needs. According to EXP 13, "Companies and firms must be present on social media platforms due to the increased number of users and their relocation of interactivity in the virtual world." EXP 14 said that "Due to increasing number of [SNS] users every day, companies cannot neglect the users' orientation; thus they have to adapt." As a result, the increasing number of users and the relocation of their interactivity into the virtual world form a new community orientation and demand that businesses cannot neglect.

Interactivity: EXPs 5, 8, 13 and 17 explained that using multimedia posts like videos and images to explain product usage or provide information by interacting with the users is more effective than traditional methods. EXPs 1 and 12 said that users found it easier to communicate with the companies through SNS platforms than through other means. Thus, the opportunity to post an image, video, or comment and enabling users to interact with it through commenting and sharing can motivate SMBs to adopt SNSs. EXP 17 stated that SNSs have the ability to change their themes or messages easily and via many mediums to deliver marketing messages and concepts to the customers. Social media platforms allows the companies to directly contact customers and engage them in group discussions (EXP 19). According to EXPs 20 and 24, SNSs consist of images, sounds, and videos, which are powerful influences on the way customers perceive and understand the intended ideas. EXPs 22 and 23 believe that the speed and easiness of spreading content are factors that affect SNS adoption positively.

3.2 Barriers

The chart (Figure 3) shows the main barriers factors of using Social Network Sites in SMBs. From this chart, it can be noticed that top management belief was highly chosen. 17 participants belief that top management belief is the main barrier for using SNS in SMBs. Level of awareness about SNS, firm readiness and negative comments/ reviews come in the second, third and fourth places in order. Whereas 4 participants selected regulation concerns and 3 selected privacy and security. None of the respondents chose the barrier "no trust in SNS" as a significant one.

Top management belief: One of the barrier factors in SNS adoption is the top management belief, which is manifested in two major categories: either lack of technological information and awareness of SNS benefits, or the perceived idea that SNS is of no use or their lack of interest or desire of change. EXP 1, 2, 3,4,14 were sure that the CEO's insufficient information regarding SNS and its way of function is a top factor in refusing SNS adoption. Most of the firms' CEOs do not give much attention or they start at later stage which negatively affects their business (EXP 11). EXP 5, 9,11,13,17 and 18 indicated that some managers believe that SNS adoption is of no use and that the presence of sales and accounting employees is enough (EXP 9). EXP 13 said that managers are not convinced of the financial return of digital marketing with less cost and they believe that direct communication

with the users is more effective. EXP (17, 19) state that if those who are responsible in the companies such as managers and CEOs despise SNS or perceive it as a waste of time then, they will not know the advantages of SNS, especially the ones who are old in age (EXP 17). Some managers are not even aware of the SNS which causes a great problem for the marketing department (EXP 20).

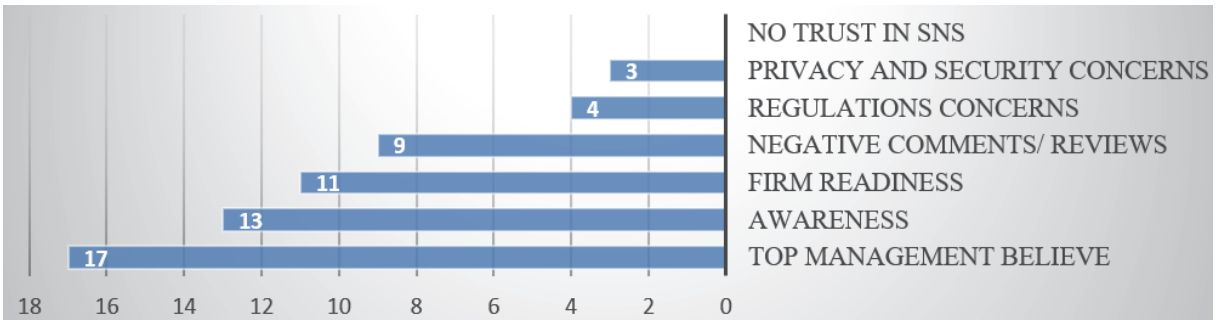

Figure 3. Barriers

Readiness: Most EXPs connect readiness with the use of a social media specialist. EXP 3 states that although the number of people working in this field is quite high, there is no experience of competencies, thus many companies prefer not to adventure in it. EXP 4, 6, 7 and 11 argue that due to the lack of awareness towards the benefits of SNS platforms, many companies would have to hire an expert or work with an external specialist which will add to its cost, thus lowering the level of SNS adoption choice by SMBs while EXP 15 believes that companies are not fully equipped for this function with the means needed and well-formed plan for using SNSs in order to succeed. EXP 19 states that many companies do not make the effort to sign contracts with experts and they do not desire to invest in support tools. Some companies get disappointed with the results of SNS, thus, they will lose faith in SNS and stop using it (EXP 21). The lack of experts in some companies is another burden (EXP 22). Understandably, readiness factor is a common barrier that usually hinders small businesses from ICT innovation adoption. EXP 24 states that due to the development of the electronic marketing, managers find it difficult to establish a specialized department.

Fear of negative comments and reviews: In this field, negative comments and reviews could affect the company's image negatively. EXP 11 and 13 believe that the negative comments left by users could damage the company's image if it is not handled properly. EXP 13 believes that a successful digital marketing director can use these errors in favor of the company; to attract the attention of the customers in a creative way, while EXP 5 states that the advertisements posted in SNS platforms need a detailed study by a group of experts to exclude any errors that may occur since these will be available for users of all ages, thus the fear of these errors merging after the advertisement has been launched prevent SMBs from SNS adoption. EXP 10 states that lack of trust increases the barrier of fear, which in return affects SNS adoption by SMBs negatively.

Awareness: The lack of knowledge regarding the importance of SNS and how to develop it in the right way leads to the perceived barriers. Some firms lack the ability to create successful plans for the social media networks (EXP 3). EXP 4 and 9 think that the need of a SNSs expert is one of the barriers that make companies uncertain of the benefits of SNSs; such as the costs needed for developing a successful social media channel, or the experts' salary which is perceived by many CEO's as too high just for managing an SNS platform for the company. EXP 4 perceives the ignorance of companies of SNSs platforms' benefits as a major problem, especially in an era where most of the internet users are on SNSs. EXP 6 thinks that this uncertainty towards SNS adoption comes from the poor understanding of modern tools and techniques. According to EXP 19, some companies believe that SNSs are complementary for the traditional marketing methods and they seek applying similar strategies for the traditional ones. Other companies perceive SNS as means of entertainment (EXP 21) or do not even trust it (EXP 22, 23).

4. Variations in Experts' Opinions

It's worth mentioning that deeper comparison between experts opinion could reveal some variation in their opinions, which in turn could pave the way for more investigations. For instance, firms' concern regarding the cost lies in the fact that the costs of social media outweigh the potential benefits for our company (EXP 5)**.** EXP 12 believes that some clients are committed for three months only and they cancel the contract or divert the money somewhere else such as vouchers which comes as an obstacle for the company. EXP. 9 argues that this occurs as a result for misunderstanding of the online marketing on the SMBs part, and they confuse it with the basic concept

of companies in the marketing field. EXP 5 disagrees since he believes that when a professional expert handles the social media marketing, the income will overcome the costs.

Most experts did agree upon the fact that SNS provide multimedia tools such as; video, audio and pictures, which enable conveying the companies message in an easier and more attractive way (Exp 5, 8 and 13), while others (Exp 1, 6, 12, 19 and 24) did not perceive interactivity as the multimedia tools, rather they believe that SNS paves the way to communicant and connect with current and potential customers in a more direct and open manner, enabling others to comment and take part in the discussion. Exp 17 and 22 see that campaigns based on SNS have a more flexible range of changing the content or message intended. This disparity in experts' point of view regarding interactivity factor is due to the differences in the company's need and marketing plan, whether base on SNS fully or just as an additional support.

Some experts elect the easiness of SNS use as a main factor for SNS adoption. Exp 21 believes that due to the ease of use, in many cases the managers think that firms SNS page supervision can be processed by anyone. Thus, according to this statement, there is no need for social media experts or agency. This case can rise many debates since looking at the barriers sides, some experts state that a lot of SMBs postponed adopting SNSs due to the lack of social media experts e.g. Exp3. This variation in experts opinions could partially explained that different SMB have different level of need to SNSs. Some SMBs may need SNSs for simple marketing activities, while other SMBs are seeking for advance promotion campaigns for their products and services. Thus, an ambiguity is created regarding this factor, and more research with more detailed SMBs classification could lead for further results. Finally, one of the differences between experts regarding the regulatory concern is the fear of the absence of settled laws that regulate using the social network sites in Jordan (expert 24). According to expert 24, the problem relies in the firms' concern of the online marketing that is not governed by certain laws which makes it easier to violate or copy the firm product by the competing companies. Expert (13, 23) are concerned with the issue of copying ideas and products as a result for employees' lack of experience in using pictures or items illegally leads the company to be legally questioned. And this, according to expert 13, forms a big concern for some SMBs managers in terms of using social network in their business. EXP 12 believes that sometimes they get many rejected advertisements because social media platforms such as Facebook & Instagram have their own regulations that are changeable and sometimes unpredictable which wastes their time and efforts. Again, it can be noted that different firms with different interests and activities could expose the firms to different regulation concerns which therefore, call for more examinations.

5. Discussion

The research results are summarized in Table 3, based on the evidence collected. Discussion of the results will be presented in this section. Despite the high percentage of Jordanian active users on SNSs, discussions of SNSs adoption among SMBs in Jordan have not reached the level of clarity of more mature areas of ICT innovation adoption. Based on network externalities theory, this research project offers evidence that environmental factor such as community demand factor is significant. Accordingly, SNSs adoption is not limited to factor related to the organizational and technological contexts. Motivation and barrier framework in this study has proven holistic enough to explore SNSs adoption. Among the initial factors, this study has been able to demonstrate the impact of 7 of them on SMBs.

Fresh ICT innovations are generally expected to bring major advantages and add value to a firm. For that reason, relative advantage is regularly used as a main determinant in technology adoption literature (Alshamaila_et al., 2013). Perceived ease of use, market scope, and competitive pressure are not always strong enough motivators for technology implementation. The increasing number of SNS users and the relocation of their interactivity into the virtual world (EXP 14) have led to changes in local community shopping behavior. As a result, community demand has emerged as a key environmental factor that pushes SMBs to adopt SNSs. For that reason, more understanding and more awareness among SMB managers about local community trends in SNSs are important to the adoption decision. This finding highlights the significant role of social media marketing companies and social media experts in **raising awareness** and engaging customers. Even though SMBs are often initially attracted to SNSs by the interactive features they provide, top management belief is still a key factor in SNS rejection. Low awareness levels and fear of negative comments and reviews are the main concerns of businesses and managers in supporting SNS adoption. SMBs may have concerns about sudden, unpredictable changes in SNSs' strategies that could negatively affect their image. Managers may also feel that their companies are not yet ready for SNS adoption. In fact, managers' fears and concerns can sometimes be rational. Social media experts and social media marketing firms must make more efforts to increase awareness among managers about the benefits of using SNSs for businesses and how to deal with negative reviews and comments.

Table 3. Summary of Findings

Factor	Support	Experts
Motivations	**Motivations**	**Motivations**
Relative Advantage	High	2, 3, 5-7, 9- 12, 14 , 15, 17, 19 -24
Ease of Use	--	10, 15,20-22
Interactivity	High	1, 5, 6, 8, 12, 13, 17, 19, 20, 22- 24
Innovativeness	--	2, 15
Alignment Business Strategic Plan	--	16
Market Scope	--	3, 6, 7, 24
Community Demand	High	1, 2, 4, 5, 7, 10, 13, 14, 16, 19, 21, 23, 24
Competitive Pressure	--	4, 11, 13, 17, 18, 22,
Barriers	**Barriers**	**Barriers**
Readiness	High	3, 4, 6, 7, 8, 11, 15, 19, 21, 22, 24
Privacy and Security Concerns	--	2, 10, 15
Firm Awareness	High	1, 3, 4, 6, 8, 9, 10, 18, 19, 21, 22, 23, 24
Negative Comments and Reviews	High	5, 8, 10, 11, 13, 14, 20, 21, 24
Trust in SNS Technology and Participants	--	
Regulatory Concerns	--	12, 13, 23, 24
Top Management Belief	High	1, 2, 3, 4, 5, 7, 9, 11, 13, 14, 16, 17, 18, 19, 20, 22, 23

6. Conclusion

SNSs offer opportunities to SMBs to get their message out as a result of their unique interactive features. But for all of their potential, there's still a lot of vagueness out there among business about SNSs. SNSs still remain under examined by researchers and underused by firms as a tool for improving business strategies. In fact, many firms have been slow to adopt new technologies because of perceived barriers and challenges. In the case of SNS adoption among firms, issues such as firms' readiness, top management belief, and fear of negative comments and reviews could seriously inhibit usage among SMBs. This research project aims to explore the main motivations and barriers for adoption of SNSs. This study provides significant implications and benefits to the researchers, managers, and social media companies in formulating improved strategies for SNS adoption. Social media marketing firms may help to clarify how SMBs can deal with negative reviews and comments, which, in turn, can affect SMBs' confidence. In addition, social media experts need to raise awareness about the benefits of SNSs to SMBs that are unsure about whether social media can help their businesses. Experts need to help SMBs reap the advantages that SNSs provide such as interactivity and capitalize on the fact that the great percentage of shoppers stay on SNSs for long periods of time. Although this approach is useful for business-related decision analysis, the scope of this study is limited in terms of generalizability. However, these research findings provide the following insights for future research. Further work could build on this study by both validating the existing factors identified in this research project and exploring whether other determinants emerge. Further qualitative and quantitative study to examine SNS adoption in different industries and sectors in other countries is recommended.

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References

Ainin, S., Parveen, F., Moghavvemi, S., Jaafar, N. I., & Mohd Shuib, N. L. (2015). Factors influencing the use of social media by SMEs and its performance outcomes. *Industrial Management & Data Systems*, *115*(3), 570-588. https://doi.org/10.1108/IMDS-07-2014-0205

Al-Qirim, N. (2008). The adoption of eCommerce communications and applications technologies in small businesses in New Zealand. *Electronic Commerce Research and Applications*, *6*(4), 462-473. https://doi.org/10.1016/j.elerap.2007.02.012

Alshamaila, Y., Papagiannidis, S., & Li, F. (2013). Cloud computing adoption by SMEs in the north east of England: A multi-perspective framework. *Journal of Enterprise Information Management*, *26*(3), 250-275. https://doi.org/10.1108/17410391311325225

Araújo, J. B. D., & Zilber, S. N. (2016). What factors lead companies to adopt social media in their processes: Proposal and test of a measurement model. *BBR. Brazilian Business Review*, *13*(6), 260-290.

http://dx.doi.org/10.15728/bbr.2016.13.6.5.

Arlene, F., & Kosecoff, J. (1998). How to Conduct Surveys: A step by step guide.

Armstrong, C. P., & Sambamurthy, V. (1999). Information technology assimilation in firms: The influence of senior leadership and IT infrastructures. *Information systems research*, *10*(4), 304-327.

Ashton, R. H. (1986). Combining the judgments of experts: How many and which ones?. *Organizational Behavior and Human Decision Processes*, *38*(3), 405-414. https://doi.org/10.1016/0749-5978(86)90009-9

Barnett, A. H., & Kaserman, D. L. (1998). The simple welfare economics of network externalities and the uneasy case for subscribership subsidies. *Journal of Regulatory Economics*, *13*(3), 245-254. https://doi.org/10.1023/A:1008029120462

Bharadwaj, A. S. (2000). A resource-based perspective on information technology capability and firm performance: an empirical investigation. *MIS quarterly*, 169-196. https://doi.org/10.2307/3250983

Bolger, F., & Wright, G. (1994). Assessing the quality of expert judgment: Issues and analysis. *Decision support systems*, *11*(1), 1-24. https://doi.org/10.1016/0167-9236(94)90061-2

Broadbent, M., & Weill, P. (1993). Improving business and information strategy alignment: Learning from the banking industry. *IBM systems Journal*, *32*(1), 162-179. https://doi.org/ 10.1147/sj.321.0162

Burn, J. M., & Szeto, C. (2000). A comparison of the views of business and IT management on success factors for strategic alignment. *Information & management*, *37*(4), 197-216. https://doi.org/10.1016/S0378-7206(99)00048-8

Caldeira, M. M., & Ward, J. M. (2002). Understanding the successful adoption and use of IS/IT in SMEs: an explanation from Portuguese manufacturing industries. *Information Systems Journal*, *12*(2), 121-152. https://doi.org/ 10.1046/j.1365-2575.2002.00119.x

Carmichael, C., Turgoose, C., Gray, M. O., Todd, C., & Nadin, S. (2000). Innovation and SMEs: The case of South Yorkshire, UK. *Industry and Higher Education*, *14*(4), 244-248.https://doi.org/10.5367/000000000101295147

Chong, S., & Pervan, G. (2009). Factors influencing the extent of deployment of electronic commerce for small-and medium-sized enterprises. *IGI Global*. https://doi.org/ 10.4018/jeco.2007010101

Chwelos, P., Benbasat, I., & Dexter, A. S. (2001). Empirical test of an EDI adoption model. *Information systems research*, *12*(3), 304-321.

Cone (2008). Business in social media study. Retrieved December 14, 2015, from http://onesocialmedia.com/wp-content/uploads/2010/03/2008_business_in_social_media_fact_sheet.pdf

Cragg, P. B., & King, M. (1993). Small-firm computing: motivators and inhibitors. *MIS quarterly*, 47-60. https://doi.org/ 10.2307/249509

Culnan, M. J., McHugh, P. J., & Zubillaga, J. I. (2010). How large US companies can use Twitter and other social media to gain business value. *MIS Quarterly Executive*, *9*(4).

Daniel, E. M., & Grimshaw, D. J. (2002). An exploratory comparison of electronic commerce adoption in large and small enterprises. *Journal of Information Technology*, *17*(3), 133-147.

Daniel, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS quarterly*, 319-340. https://doi.org/ 10.2307/249008

Dinev, T., & Hu, Q. (2007). The centrality of awareness in the formation of user behavioral intention toward protective information technologies. *Journal of the Association for Information Systems*, *8*(7), 386.

Einhorn, M. A. (1993). Biases in optimal pricing with network externalities. *Review of Industrial Organization*, *8*(6), 741-746. https://doi.org/10.1007/BF01024295

Elmazi, I., Vukaj, H., Gega, E., & Elmazi, L. (2011). Information technology and its effects in SME. The case of Albania. *International Journal of Management Cases*, *13*(4), 291-298. https://doi.org/10.5848/APBJ.2011.00139

Eurostat. (2017). Social media - statistics on the use by enterprises. Retrieved from http://ec.europa.eu/eurostat/statistics-explained/index.php/Social_media_-_statistics_on_the_use_by_enterprises

Farrell, J., & Klemperer, P. (2007). Coordination and lock-in: Competition with switching costs and network

effects. *Handbook of industrial organization*, *3*, 1967-2072. https://doi.org/10.1016/S1573-448X(06)03031-7

Feigenbaum, E. A., & McCorduck, P. (1984). *The fifth generation* (p. 52). London: Pan Books.

Gandal, N., Salant, D., & Waverman, L. (2003). Standards in wireless telephone networks. *Telecommunications Policy*, *27*(5-6), 325-332. https://doi.org/10.1016/S0308-5961(03)00026-0

Gandomi, A., & Haider, M. (2015). Beyond the hype: Big data concepts, methods, and analytics. *International Journal of Information Management*, *35*(2), 137-144. https://doi.org/10.1016/j.ijinfomgt.2014.10.007

Garverick, M. L. (2014). Motives and Barriers to Cloud ERP Selection for SMEs: A Survey of Value Added Resellers (VAR) Perspectives. Dissertation, Georgia State University.

Gatignon, H., & Robertson, T. S. (1989). Technology diffusion: an empirical test of competitive effects. *The Journal of Marketing*, 35-49. https://doi.org/10.2307/1251523

Grandon, E. E., & Pearson, J. M. (2004). Electronic commerce adoption: an empirical study of small and medium US businesses. *Information & management*, *42*(1), 197-216. https://doi.org/10.1016/j.im.2003.12.010

Grover, V. (1993). An empirically derived model for the adoption of customer-based interorganizational systems. *Decision sciences*, *24*(3), 603-640. https://doi.org/10.1111/j.1540-5915.1993.tb01295.x

Hambrick, D. C., & Mason, P. A. (1984). Upper echelons: The organization as a reflection of its top managers. *Academy of management review*, *9*(2), 193-206. https://doi.org/10.5465/AMR.1984.4277628

Hart, P. J., & Saunders, C. S. (1998). Emerging electronic partnerships: antecedents and dimensions of EDI use from the supplier's perspective. *Journal of Management Information Systems*, *14*(4), 87-111. https://doi.org/10.1080/07421222.1998.11518187

Haywood, C. F. (1981). Regulation, structure and technological change in the consumer financial services industry. *Regulation of Consumer Financial Services. Cambridge, MA: Abt Books*, 163-167.

Henderson, J. C., & Sifonis, J. G. (1988). The value of strategic IS planning: understanding consistency, validity, and IS markets. *MIS quarterly*, 187-200. https://doi.org/ 10.2307/248843

Hennig-Thurau, T., Gwinner, K. P., Walsh, G., & Gremler, D. D. (2004). Electronic word-of-mouth via consumer-opinion platforms: what motivates consumers to articulate themselves on the internet? *Journal of interactive marketing*, *18*(1), 38-52. https://doi.org/ 10.1002/dir.10073

Hirschman, E. C. (1980). Innovativeness, novelty seeking, and consumer creativity. *Journal of consumer research*, *7*(3), 283-295. https://doi.org/10.1086/208816

Hsu, P. F., Kraemer, K. L., & Dunkle, D. (2006). Determinants of e-business use in US firms. *International Journal of Electronic Commerce*, *10*(4), 9-45.

Iacovou, C. L., Benbasat, I., & Dexter, A. S. (1995). Electronic data interchange and small organizations: Adoption and impact of technology. *MIS quarterly*, 465-485. https://doi.org/ 10.2307/249629

Ifinedo, P. (2011). An empirical analysis of factors influencing Internet/e-business technologies adoption by SMEs in Canada. *International Journal of Information Technology & Decision Making*, *10*(04), 731-766. https://doi.org/10.1142/S0219622011004543

Jeyaraj, A., Rottman, J. W., & Lacity, M. C. (2006). A review of the predictors, linkages, and biases in IT innovation adoption research. *Journal of Information Technology*, *21*(1), 1-23.

Jo, S., & Kim, Y. (2003). The effect of web characteristics on relationship building. *Journal of Public Relations Research*, *15*(3), 199-223. https://doi.org/10.1207/S1532754XJPRR1503_1

Johnston, P. (2014). *Exploring New Types of Motives in Social Media* (Doctoral dissertation, Kent State University).

Kahn, A. E., & Shew, W. B. (1986). Current issues in telecommunications regulation: Pricing. *Yale J. on Reg.*, *4*, 191.

Kaplan, A. M., & Haenlein, M. (2010). Users of the world, unite! The challenges and opportunities of Social Media. *Business horizons*, *53*(1), 59-68. https://doi.org/10.1016/j.bushor.2009.09.003

Kelleher, T., & Miller, B. M. (2006). Organizational blogs and the human voice: Relational strategies and relational outcomes. *Journal of Computer-Mediated Communication*, *11*(2), 395-414. https://doi.org/10.1111/j.1083-6101.2006.00019.x

Kent, M. L. (2008). Critical analysis of blogging in public relations. *Public Relations Review*, *34*(1), 32-40.

https://doi.org/10.1016/j.pubrev.2007.12.001

Kietzmann, J. H., Silvestre, B. S., McCarthy, I. P., & Pitt, L. F. (2012). Unpacking the social media phenomenon: towards a research agenda. *Journal of Public Affairs*, *12*(2), 109-119. https://doi.org/10.1002/pa.1412

Kuan, K. K., & Chau, P. Y. (2001). A perception-based model for EDI adoption in small businesses using a technology–organization–environment framework. *Information & Management*, *38*(8), 507-521. https://doi.org/10.1016/S0378-7206(01)00073-8

Kula, V., & Tatoglu, E. (2003). An exploratory study of Internet adoption by SMEs in an emerging market economy. *European Business Review*, *15*(5), 324-333. https://doi.org/10.1108/09555340310493045

Leung, L., & Wei, R. (1998). Factors influencing the adoption of interactive TV in Hong Kong: Implications for advertising. *Asian Journal of Communication*, *8*(2), 124-147. https://doi.org/10.1080/01292989809364766

Lin, C. A., & Jeffres, L. W. (1998). Factors influencing the adoption of multimedia cable technology. *Journalism & Mass Communication Quarterly*, *75*(2), 341-352. https://doi.org/10.1177/107769909807500209

Liu, Y., & Shrum, L. J. (2002). What is interactivity and is it always such a good thing? Implications of definition, person, and situation for the influence of interactivity on advertising effectiveness. *Journal of advertising*, *31*(4), 53-64. https://doi.org/10.1080/00913367.2002.10673685

Looi, H. C. (2005). E-commerce adoption in Brunei Darussalam: a quantitative analysis of factors influencing its adoption. *Communications of the Association for Information Systems*, *15*(1), 3.

Marcati, A., Guido, G., & Peluso, A. M. (2008). The role of SME entrepreneurs' innovativeness and personality in the adoption of innovations. *Research Policy*, *37*(9), 1579-1590. https://doi.org/10.1016/j.respol.2008.06.004

Martins, J., Gonçalves, R., Oliveira, T., Cota, M., & Branco, F. (2016). Understanding the determinants of social network sites adoption at firm level: A mixed methodology approach. *Electronic Commerce Research and Applications*, *18*, 10-26. https://doi.org/10.1016/j.elerap.2016.05.002

Martins, J., Goncalves, R., Pereira, J., Oliveira, T., & Cota, M. P. (2014, June). Social networks sites adoption at firm level: A literature review. In *Information Systems and Technologies (CISTI), 2014 9th Iberian Conference on* (pp. 1-6). IEEE. https://doi.org/ 10.1109/CISTI.2014.6876910

Mason, R., & Valletti, T. M. (2001). Competition in communication networks: pricing and regulation. *Oxford Review of Economic Policy*, *17*(3), 389-415. https://doi.org/10.1093/oxrep/17.3.389

Mehrtens, J., Cragg, P. B., & Mills, A. M. (2001). A model of Internet adoption by SMEs. *Information & management*, *39*(3), 165-176. https://doi.org/10.1016/S0378-7206(01)00086-6

MessageLabs (2007a). Online social networking: the employer's dilemma. Retrieved 25 March 2008, from http://downloads.messagelabs.com/silikonuk/wss_whitepaper_socialnetworking_legal_a4_final.pdf

MessageLabs (2007b), "Social networking: a brave new world or revolution from hell? Retrieved 27 February 2008, from http://i.i.com.com/cnwk.id/html/iop/messagelabs_socialnetworking.pdf

Messerschmidt, C. M., & Hinz, O. (2013). Explaining the adoption of grid computing: An integrated institutional theory and organizational capability approach. *The Journal of Strategic Information Systems*, *22*(2), 137-156. https://doi.org/10.1016/j.jsis.2012.10.005

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook*. sage.

Mirchandani, D. A., & Motwani, J. (2001). Understanding small business electronic commerce adoption: An empirical analysis. *Journal of Computer Information Systems*, *41*(3), 70-73.

Molla, A., & Licker, P. S. (2005). Perceived e-readiness factors in e-commerce adoption: An empirical investigation in a developing country. *International Journal of Electronic Commerce*, *10*(1), 83-110.

NETconsent Limited (2004), Employee Internet Access: Effective Management of the Whitepapers Organisational Risk, Retrieved 27 February 2008, from www.netconsent.com/Resources/Whitepapers.htm

Nobre, H., & Silva, D. (2014). Social network marketing strategy and SME strategy benefits. *Journal of Transnational Management*, *19*(2), 138-151. https://doi.org/10.1080/15475778.2014.904658

Odoom, R., Anning-Dorson, T., & Acheampong, G. (2017). Antecedents of social media usage and performance benefits in small-and medium-sized enterprises (SMEs). *Journal of Enterprise Information Management*, *30*(3), 383-399. https://doi.org/10.1108/JEIM-04-2016-0088

Okoli, C., & Pawlowski, S. D. (2004). The Delphi method as a research tool: an example, design considerations

and applications. *Information & management*, *42*(1), 15-29. https://doi.org/10.1016/j.im.2003.11.002

Panzar, J. C., & Wildman, S. S. (1995). Network competition and the provision of universal service. *Industrial and Corporate Change*, *4*(4), 711-719. https://doi.org/10.1093/icc/4.4.711

Parente, F. J., Anderson, J. K., Myers, P., & O'brien, T. (1984). An examination of factors contributing to Delphi accuracy. *Journal of Forecasting*, *3*(2), 173-182. https://doi.org/10.1002/for.3980030205

Park, C., & Lee, T. M. (2009). Information direction, website reputation and eWOM effect: A moderating role of product type. *Journal of Business Research*, *62*(1), 61-67. https://doi.org/10.1016/j.jbusres.2007.11.017

Parveen, F. (2012, July). Impact Of Social Media Usage On Organizations. In *PACIS* (p. 192).Peters, K., Chen, Y., Kaplan, A. M., Ognibeni, B., & Pauwels, K. (2013). Social media metrics—A framework and guidelines for managing social media. *Journal of Interactive Marketing*, *27*(4), 281-298. https://doi.org/10.1016/j.intmar.2013.09.007Get rights and content

Poon, S., & Swatman, P. M. (1997). Internet-based small business communication: Seven Australian cases. *Electronic Markets*, *7*(2), 15-21.

Poushter, J. (2016). Smartphone ownership and internet usage continues to climb in emerging economies. *Pew Research Center*, *22*.

Proceedings of the 39th Annual Hawaii International Conference on (Vol. 6, pp. 127a-127a). IEEE. Huang, Z., Janz, B. D., & Frolick, M. N. (2008). A comprehensive examination of Internet-EDI adoption. *Information Systems Management, 25*(3), 273-286.

Ramdani, B., Kawalek, P., & Lorenzo, O. (2009). Predicting SMEs' adoption of enterprise systems. *Journal of Enterprise Information Management*, *22*(1/2), 10-24. https://doi.org/10.1108/17410390910922796

Robson, C. (2002). *Real World Research: A Resource for Social Scientists and Practitioner-Researchers* (2nd ed). Blackwell Publishing: Oxford, UK.

Rogers, E. M. (2003). Diffusion of innovations. Free Press. *New York*, 551.

Rogers, E. M., & Shoemaker, F. F. (1971). Communication of Innovations; A Cross-Cultural Approach.

Rohlfs, J. (1974). A theory of interdependent demand for a communications service. *The Bell Journal of Economics and Management Science*, 16-37. https://doi.org/ 10.2307/3003090

Saffer, A. J., Sommerfeldt, E. J., & Taylor, M. (2013). The effects of organizational Twitter interactivity on organization–public relationships. *Public Relations Review*, *39*(3), 213-215. https://doi.org/10.1016/j.pubrev.2013.02.005

Saunders, M. N. K., Lewis, P., & Thornhill, A. (2000). Research Methods for Business Students: Lecturers' Guide.

Schmidt, M. B., Johnston, A. C., Arnett, K. P., Chen, J. Q., & Li, S. (2008). A cross-cultural comparison of US and Chinese computer security awareness. *Journal of Global Information Management*, *16*(2), 91. https://doi.org/10.4018/jgim.2008040106

Shah Alam, S., Ali, M. Y., & Mohd-Jani, M. F. (2011). An empirical study of factors affecting electronic commerce adoption among SMEs in Malaysia. *Journal of Business Economics and Management*, *12*(2), 375-399.

Shapiro, C., Varian, H. R., & Becker, W. E. (1999). Information rules: a strategic guide to the network economy. *Journal of Economic Education*, *30*, 189-190.

Shrivastava, P. (1983). A typology of organizational learning systems. *Journal of management studies*, *20*(1), 7-28. https://doi.org/ 10.1111/j.1467-6486.1983.tb00195.x

Shy, O. (2001). *The economics of network industries*. Cambridge University Press.

Sila, I. (2013). Factors affecting the adoption of B2B e-commerce technologies. *Electronic commerce research*, *13*(2), 199-236.

Smith, B. G. (2010). Socially distributing public relations: Twitter, Haiti, and interactivity in social media. *Public Relations Review*, *36*(4), 329-335. https://doi.org/10.1016/j.pubrev.2010.08.005

Squire, L. (1973). Some aspects of optimal pricing for telecommunications. *The Bell Journal of Economics and Management Science*, 515-525. https://doi.org/ 10.2307/3003051

Sundar, S. S., Kalyanaraman, S., & Brown, J. (2003). Explicating web site interactivity: Impression formation effects in political campaign sites. *Communication Research*, *30*(1), 30-59. https://doi.org/10.1177/0093650202239025

Surveymonkey. (2017). Conducting Qualitative Research. Retrieved from https://www.surveymonkey.com/mp/conducting-qualitative-research/

Sweetser, K. D., & Metzgar, E. (2007). Communicating during crisis: Use of blogs as a relationship management tool. *Public Relations Review*, *33*(3), 340-342. https://doi.org/10.1016/j.pubrev.2007.05.016

Teo, T. S., Ranganathan, C., & Dhaliwal, J. (2006). Key dimensions of inhibitors for the deployment of web-based business-to-business electronic commerce. *IEEE Transactions on engineering Management*, *53*(3), 395-411. https://doi.org/ 10.1109/TEM.2006.878106

Tiago, M. T. P. M. B., & Veríssimo, J. M. C. (2014). Digital marketing and social media: Why bother? *Business Horizons*, *57*(6), 703-708. https://doi.org/10.1016/j.bushor.2014.07.002

Walsh, J. P. (1988). Top management turnover following mergers and acquisitions. *Strategic Management Journal*, *9*(2), 173-183. https://doi.org/ 10.1002/smj.4250090207

Wang, R., Fu, Z., & Duan, Y. (2011) *Management and Service Science (MASS), 2011 International Conference on*. 12-14 Aug. 2011.

Wanyoike, D. M., Mukulu, E., & Waititu, A. G. (2012). ICT attributes as determinants of e-commerce adoption by formal small enterprises in urban Kenya. *International Journal of Business and Social Science*, *3*(23).

Werbler, C., & Harris, C. (2008). Online consumer reviews significantly impact consumer purchasing decisions, new opinion research corporation survey finds. *Retrieved Oct*, *6*, 2010.

Williams, M., Dwivedi, Y., Lal, B., & Schwarz, A. (2009). Contemporary trends and issues in IT adoption and diffusion research. *Journal of Information Technology*, 24(1), 1-10. https://doi.org/10.1057/jit.2008.30

Xu, M., Rohatgi, R., & Duan, Y. (2007). E-business adoption in SMEs: some preliminary findings from electronic components industry. *International Journal of E-Business Research*, *3*(1), 74. https://doi.org/10.4018/jebr.2007010105

Yannelis, D. (2001). On the simple welfare economics of network externalities. *International Journal of Social Economics*, *28*(4), 344-348. https://doi.org/10.1108/EUM0000000005401

Zeiller, M., & Schauer, B. (2011, September). Adoption, motivation and success factors of social media for team collaboration in SMEs. In *Proceedings of the 11th international conference on Knowledge Management and Knowledge Technologies* (p. 4). ACM.

Zhu, K., & Kraemer, K. L. (2005). Post-adoption variations in usage and value of e-business by organizations: cross-country evidence from the retail industry. *Information systems research*, *16*(1), 61-84.

Zhu, K., Kraemer, K., & Xu, S. (2003). Electronic business adoption by European firms: A cross-country assessment of the facilitators and inhibitors. *European Journal of Information Systems*, *12*(4), 251-268.

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A Hybrid Methodology for Automation the Diagnosis of Leukemia Based on Quantitative and Morphological Feature Analysis

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Abstract

Recent year's witnessed a huge revolution for developing an automated diagnosis for different disease such as cancer using medical image processing. Many researches have been dedicated to achieve this goal. Analyzing medical microscopic histology images provide us with large information about the status of patient and the progress of diseases, help to determine if the tissue have any pathological changes. Automation of the diagnosis of these images will lead to better, faster and enhanced diagnosis for different hematological and histological tissue images such as cancer. This paper propose an automated methodology for analyzing cancer histology and hematology microscopic images to detect leukemia using image processing by combining two diagnosis procedures initial and advance; the initial diagnosis depend on the percentage of the white blood cells in microscopic images affected by leukemia as indicator for the existence of leukemia in the blood smear sample. Whereas, the advance diagnosis classifying the leukemia according into different types using feature bag classifier. The experimental results showed that the proposed methodology initial diagnosis is able to detect leukemia images and differentiate it from samples that do not have leukemia. While, advance diagnosis it is able to detect and classify most leukemia types and differentiate between acute and chronic, but in some cases in the chronic leukemia where the percent of blast cells and shape are similar; it gave a diagnosis of the type of leukemia to the most similar type.

Keywords: leukemia, digital image processing, acute leukemia diagnosis, chronic leukemia diagnosis

1. Introduction

Many novel researches and efforts have been devoted for developing automated systems for detecting and analyzing of microscopic histology images. However, diagnosis traditionally depends on the qualified eye of a pathologist to make judgment from a qualitative perspective. computer automation and diagnosis is now possible with digital image processing (Gonzalez and Woods, 2002). Digital image processing means the process of images by digital computer. This includes detection, sensing, analysis of digital images (Jensen, 1996) (Alhadidi et al., 2006). Which contains limited number of elements named as pixels; these elements have values that represent image (Gonzalez and Woods, 2002). It begins with image acquisition and image enhancement, for the reason that irrelevant details shall be shown and potential highlight parts of details or interest features must be displayed. A lot of digital image steps then applied to digital image such as object classification, segmentation, morphological processing …etc. (Jensen, 1996) (Ablameyko and Nedzved, 2005) (Alhadidi et al., 2007).

Developing an efficient and reliable algorithmic and automated methods, will give a powerful tool which aids in the collection of data, assists researchers in further studies and researches (Hudaib et al,.2017). It ultimately helps with the diagnosis of abnormal tissue changes such as leukemia visual examinations of blood samples are often slow and are also limited by subjective interpretations and less accurate diagnosis. (Brothwell et al., 2003) (Long, et al., 2010) (Adwan et al., 2013) (Alhadidi et al., 2008).

Leukemia is the general term for some different types of blood cancer. The term Leukemia comes from the Greek - leukos which means "white" and aima which means "blood". It refers to the cancer of blood or bone marrow (a place where blood cells are produced). Blood comprises of many components such as red blood cells, white blood cells and platelets. White blood cells are produced in human body to provide immunity. In the case of leukemia, the white blood cells produced in the bone marrow are immature. In other words they are incapable of providing immunity to the body. These immature cells are termed as 'blasts'.

The DNA of immature cells becomes damaged leading to uncontrollable proliferation. Cells produced in the bone marrow are regularly replaced by new cells. In the case of leukemia, the lymphoblasts formed do not die and end up accumulating. Due to this, there is not enough room for the normal healthy cells to occupy. There are four main types of leukemia called: Acute lymphoblastic (lymphocytic) leukemia (ALL), Acute myeloid (myelogenous) leukemia (AML), Chronic lymphocytic leukemia (CLL), Chronic myeloid (myelogenous), leukemia (CML).

Leukemia is further sub-divided based on the marrow that is affected. each type of leukemia:

Acute: Acute leukemia usually develops quickly. The number of leukemia cells increases rapidly, and these abnormal cells don't do the work of normal white blood cells. A bone marrow test may show a high level of leukemia cells and low levels of normal blood cells. People with acute leukemia may feel very tired, bruise easily, and get infections often.

Chronic: Chronic leukemia usually develops slowly. The leukemia cells work almost as well as normal white blood cells. People may not feel sick at first, and the first sign of illness may be abnormal results on a routine blood test. For example, a blood test may show a high level of leukemia cells. If not treated, the leukemia cells may later crowd out normal blood cells.

Automation the analysis of histopathology images have been a very important research subject with the revolution of computer and image processing development. The new tools in image processing have allowed the investigators and scientist to develop techniques that support pathologists in disease diagnosis and classification (Ilyich et al, 2002) (Leong et al., 2003). An overview for the automation of histological image processing is shown in Figure 1.

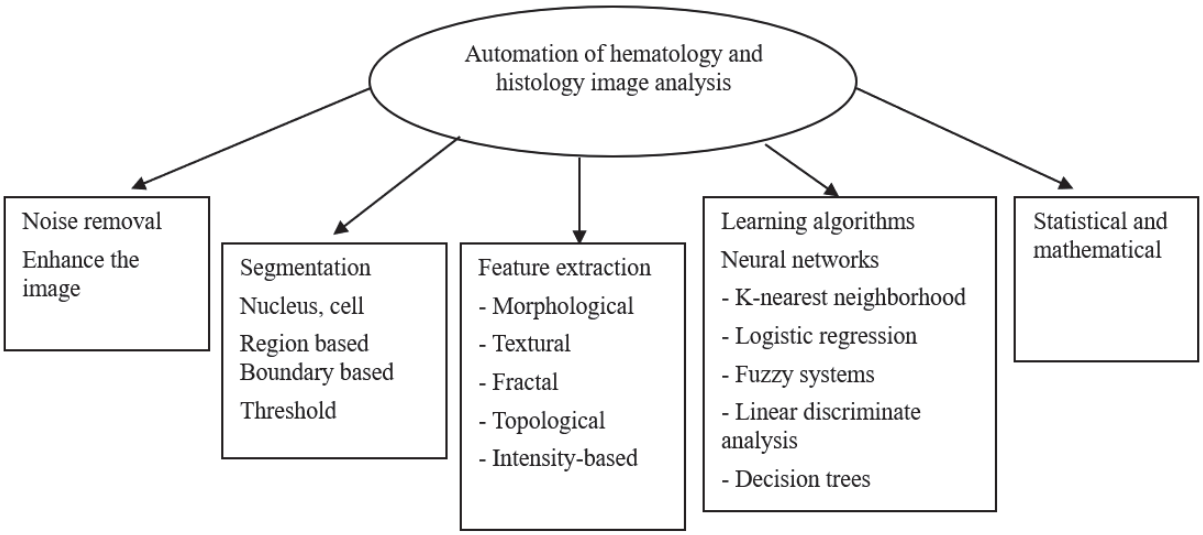


Figure 1. Overview of automation of hematology and histology image analysis

The objective of this paper is to develop automated methodology for the diagnosis of different leukemia types using image processing. It introduces an automated method for diagnosis of blood smear microscopic images for different types of leukemia and this method is tested on samples consisted of 100 microscopic images, the proposed method's starts with the laboratory preparation and ends with the diagnosis of blood smear image whether it contains leukemia or not, after the laboratory preparation is done, the image is preprocessed to enhance them and remove the noise then the color based segmentation applied, after that a set of mathematical calculations are applied to the image to calculate the percent of leukemia cells in the image and finally the diagnosis of the image is done based on the previous phases. It also introduces a new mathematical calculation method for leukemia microscopic images diagnosis that depends on comparing the percentage of leukemia cells.

In order to achieve the objectives of this research, the following steps and procedures were performed; First step was to investigate and study previous methods and researches done in the field of analyzing microscopic histology images and to determine the field that needs more researches and investigations. Second step was data collection from previous patient record of 100 patient, a sample a 100 digital images for both non leukemia and

leukemia cases have been studied. Thirdly A new algorithm was developed to process and automatically diagnose microscopic image of different leukemia types. Fourthly An implementation of the algorithm was done using matlab image processing toolbox. Finally Testing the implemented system with all samples that was selected in step one, storing the results and analyzing them.

The rest of this paper is organized as follows In Section2 we present related work. Section 3 describe the proposed methodology. Section 4 provides some experimental results obtained by the implementing the proposed methodology Finally, Section 5 contain the conclusion and future work

2. Related work

S. Jagadeesh et al. (2013) proposed an image processing based approach to cancer cell prediction in blood samples there proposed solution include the segmentation of the bone marrow aspirate by applying the watershed transformation, selection of individual cells, and feature generation on the basis of texture, statistical and geometrical analysis of the cells. H. B. Kekre et al, 2013 proposed a vector quantization technique for segmentation of blast in acute leukemia images. This method is applied on 115 microscopic images and succeeds with specificity of 90% and sensitivity of 60% to detect abnormal white blood cells. Salim Arslan, 2014, proposed a model color and shape characteristics of white blood cells by defining two transformations and introduce an efficient use of these transformations in a marker-controlled watershed algorithm. Particularly, these domain specific characteristics are used to identify markers and define the marking function of the watershed algorithm as well as to eliminate false white blood cells in a post processing step Subrajeet Mohapatra et, al. 2013 proposing a quantitative microscopic approach toward the discrimination of lymphoblasts (malignant) from lymphocytes (normal) in stained blood smear and bone marrow samples and to assist in the development of a computer-aided screening of ALL. Automated recognition of lymphoblasts is accomplished using image segmentation, feature extraction, and classification over light microscopic images of stained blood films. Accurate and authentic diagnosis of ALL is obtained with the use of improved segmentation methodology, prominent features, and an ensemble classifier, facilitating rapid screening of patients. Experimental results are obtained and compared over the available image data set.

Den et al, (1999) proposed a method to localize WBC by using a simple thresholding approach. Canny edge detector was used followed by a gradient vector flow (GVF) active contour to detect the nucleus and then Zak threshold was used to define the cytoplasm component Liao.

Foran et al. (2013) have reported a method to discriminate among lymphoma and leukemia with a classification accuracy of around 83%. they have developed a distributed, clinical decision support prototype for distinguishing among hematologic malignancies. The system consists of two major components, a distributed telemicros copy system and an intelligent image repository. The hybrid system enables individuals located at disparate clinical and research sites to engage in interactive consultation and to obtain computer-assisted decision support. The method is reported to have successfully worked on 19 lymphopro liferative cases, which is a very small data set to evaluate the performance of the system. Further, the presented method is yet to be validated on ALL cases. Markiewicz et al. (2005) presented a system for automatic recognition of the leukemia blast cells on the basis of the image of the bone marrow aspirate. The recognizing system uses support vector machine (SVM) as the classifier and exploits the features of the image of the blood cells related to the texture, geometry and histograms. Belsare et, al 2012 reviews computer assisted histopathology image analysis for cancer detection and classification. reviews and summarize the applications of digital image processing techniques for histology image analysis mainly to cover segmentation and disease classification methods. He studied different steps to automatically analyze histopathological images for objective diagnosis which assists pathologist in diagnosis and lessen their time for reviewing large number of tissue slide per day. He developed algorithms for automated analysis and evaluation of histology images assists the pathologists in disease diagnosis and also reduces human error.

Mohapatra, et al (2014) improved the all diagnostic accuracy by analyzing morphological and textural features from the blood image using image processing. by proposing a quantitative microscopic approach toward the discrimination of lymphoblasts (malignant) from lymphocytes (normal) in stained blood smear and bone marrow samples and to assist in the development of a computer-aided screening. Madhloom et. al (2011) presented a new method that integrates color features with the morphological reconstruction to localize and isolate lymphoblast cells from a microscope image that contains many cells. Described a method for lymphoblast cells localization and segmentation. Presented algorithm can also be used to detect normal WBC like lymphocytes and monocytes, so it can be used for differential blood count systems. From an end-user point of view, this work can facilitate the laboratory work by reducing the time and cost. Huang et al. 2014 focuses on investigating the potential

correlations between ALIP and AML relapse for early prediction. proposed an ALIP detection method using biopsy image processing in order to investigate the relevance with AML relapse. Thirty-seven patients with AML are examined. The results shows ALIP can be efficiently detected by our proposed method. This research reveals the strong correlations of AML relapse with ALIP. Sadeghian et al. 2009 segment the WBC to its two dominant elements: nucleus and cytoplasm. The segmentation is conducted using a proposed segmentation framework that consists of an integration of several digital image processing algorithms. Twenty microscopic blood images were tested, and the proposed framework managed to obtain 92% accuracy for nucleus segmentation and 78% for cytoplasm segmentation. The results indicate that the proposed framework is able to extract the nucleus and cytoplasm region in a WBC image sample. Demonstrated a proposed framework for segmenting white blood cells using integration of concepts in digital image processing.

Joshi et al (2013) proposed automatic Otsu's threshold blood cell segmentation method along with image enhancement and arithmetic for WBC segmentation. kNN classifier has been utilized to classify blast cells from normal lymphocyte cells. The system is applied for 108 images available in public image dataset for the study of leukemia. This method gives 93% accuracy. Putzu et.al 2013 presents a complete and fully automatic method for WBCs identification and classification from microscopic images. The proposed method firstly individuates WBCs from which, subsequently, are extracted morphological features necessary for the final stage of classification.

Vaghela et, al., (2015) discusses about methods for detection of leukemia. Various image processing techniques are used for identification of red blood cell and immature white cells.

proposed method: shape based features finding is more accurate than other methods for counting leukemic cells and it also gives highest accuracy 97.8 %. To detect different types of geometrical shape of cells like basophils, eosinophil, lymphocytes, monocytes etc. shape based features are used and according to count of immature cells, disease can be diagnosed. Further Optimization can be to enhance image processing as will as to apply processing in the cloud (Al-Sayyed et al,2017)

3. Proposed Methodology

In this paper, an automated methodology for the diagnosis of leukemia is presented. The proposed methodology is divided into four main phases the preprocessing for the image to enhance it and the second is the processing of the image with different image processing technique in order to segment, detect and diagnose different leukemia types in the image. and the second phase is the processing of the microscopic image, third phase is the initial diagnosis which is based on leukemia cells percentage presented in the image and provide initial classification and the last phase is the advance diagnosis which provide a classification of the type of the leukemia depending on the cell features described in Figure 2.

The proposed methodology is discussed by studying different cases of leukemia images and normal tissue images; a sample of one hundred images has been experimented. 50 sample where taken for normal cases and the other 50 images for cases which was previously diagnosed that have different kind of leukemia.

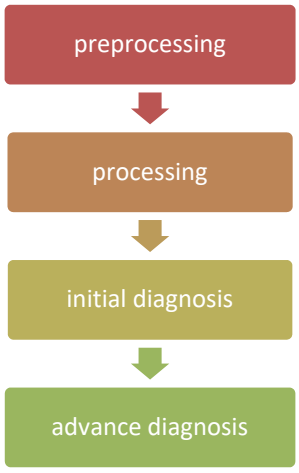


Figure 2. Proposed methodology main phases

3.1 Preprocessing

The preprocessing is an essential phase in microscopic histology image analysis because of the nature and circumstances of the slides preparation, staining and image shooting, which affect the quality of the image as seen in Figure 3 and Figure 4 which shows poor quality images for both normal and leukemia images respectively. The algorithm flow chart that explains preprocess phases is shown in Figure 5. The first step is noise removal by applying fuzzy filter for the colored image to remove noise. The second step is image sharpening and the last step is enhancing the contrast.

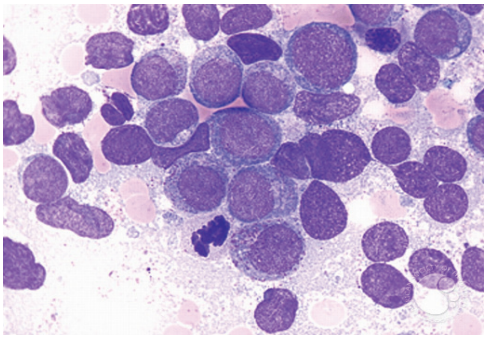


Figure 3. Poor quality microscopic image for acute myeloid leukemia without Maturation

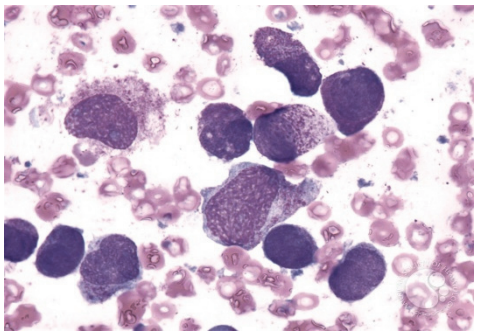


Figure 4. Poor quality microscopic image for hypergranulated acute promyelocytic leukemia

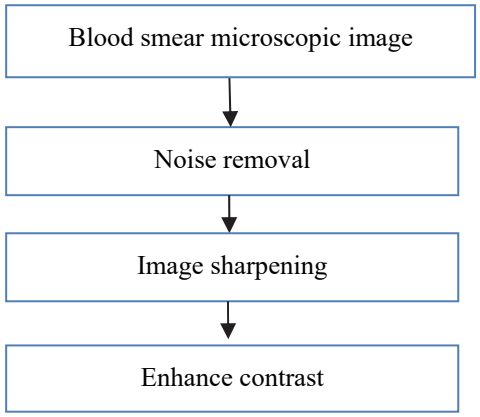


Figure 5. Preprocess of the image from preparation phase

3.1.1 Noise Removal

Noise in microscopic images can occur during image transmission, capture or preparation of the slide images. That's why we need to remove the noise and enhance the image, we have applied fuzzy filter to remove the noise, applying fuzzy filters for noise removal gives great results in many digital image analyses such as microscopic image which overcome some malfunctions of classical filters. In the situation of the microscopic histology images fuzzy filter is very helpful for removing noise as shown in Figure 6. Fuzzy filter that takes the nearest data to remove the noise, it also performs edge preservation.

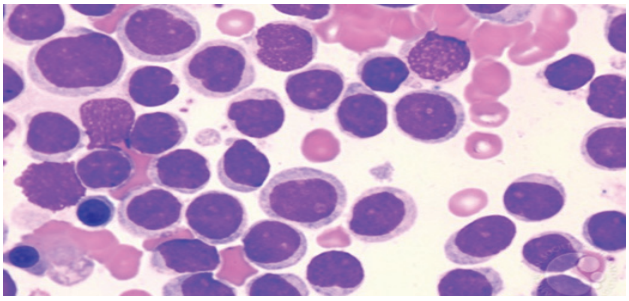


Figure 6. Applying fuzzy filter

3.1.2 Image Sharpening

Because of the fact that all camera's produce soft images as though digital image for the microscopic tissue images that are soft, so there is a need for sharpening these image and to do this we have applied the shock filter as shown in Figure 7, we have chosen shock filter because it is based on the idea to apply it locally either dilation or erosion process, depending on whether the pixel belongs to the influence zone of a maximum or a minimum and this is the case in the leukemia images where there are variation in the image structure. Applying this filter have enhanced the image and produced a sharp discontinuity called shock at the borderline between the objects and the background (Gonzalez and Woods, 2002).

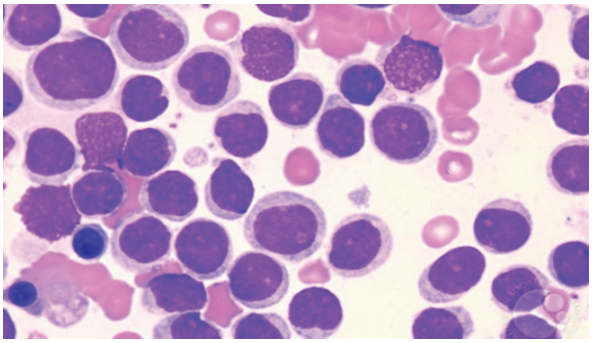


Figure 7. Image after applying shock filter

3.1.3 Enhance Contrast

In light microscopy, the specimen quality does not always lend itself to easy observation and image recording that's why we need to enhance the contrast of the image as the studied images are taken by light microscope. Poor light absorption by the specimen results in extremely small variations in the intensity distribution difference between the specimen and the background. So we need to adjust image intensities to enhance contrast of the images and this is done by applying histogram equalization to the image which computes the probabilities per pixel and further spreads them over the whole band of [0,255] to obtain enhanced contrast, sample images that shows the results after enhancing the contrast are shown in Figure 8.

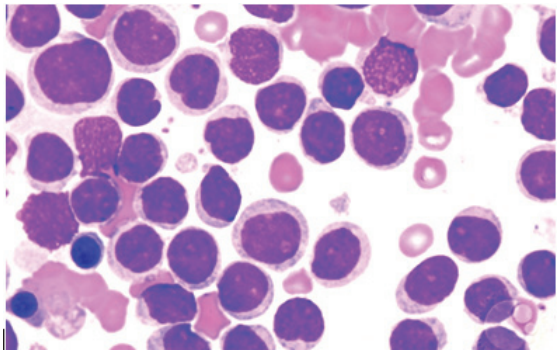


Figure 8. Image with enhanced contrast

3.2 Processing Phase

This phase consist of several steps as shown in Figure 9.the main process in this phase relay on color based segmentation for the purple color which is the stain color for the blast cells that we concern about in leukemia diagnosis

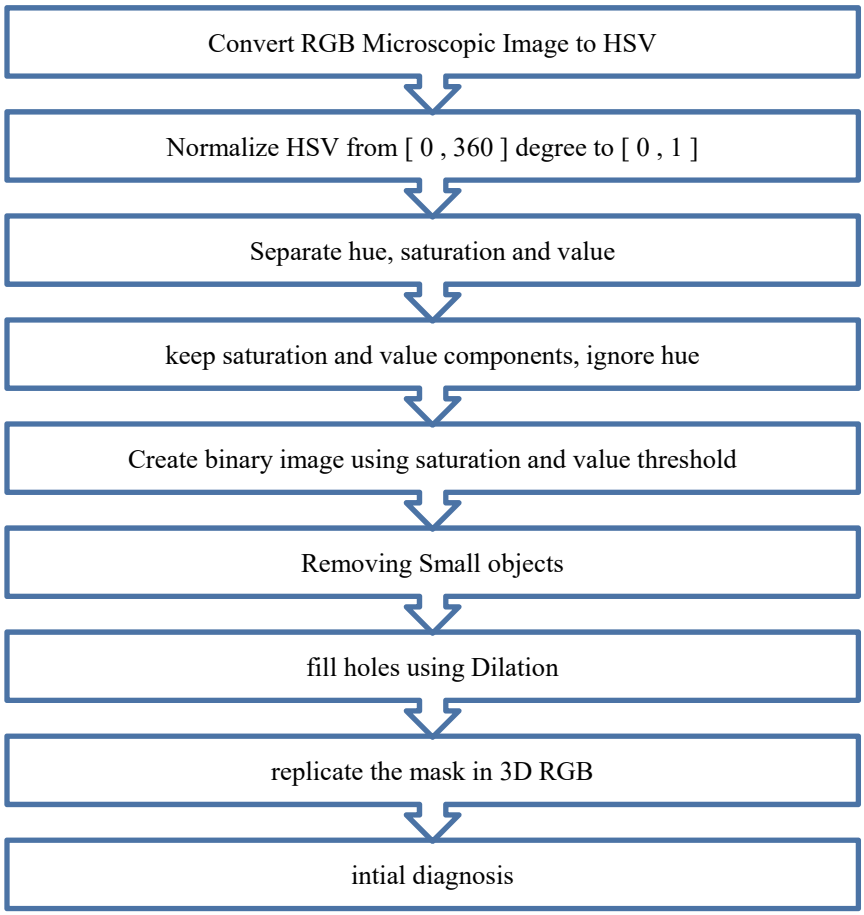


Figure 9. Processing phase main steps

3.2.1 Convert RGB Microscopic Image to HSV

This will return a 3D matrix that has the hue, saturation and value as 2D slices in a 3D matrix. We aim to described colors by their dominant color, followed by attributes such as how washed out or how pure the color is, and how bright or dark the color is. The dominant color is represented by the Hue, the appearance of how washed out or how pure the color is is represented by the Saturation and the intensity of the color is represented by the Value

3.2.2 Normalize HSV from [0 , 360] degree to [0 , 1]

After converting the image into the HSV colour space. It will be converted to double precision and then normalize each component to [0,1]

3.2.3 Separate Hue, Saturation and Value

Each of the hue, saturation and value are separated, Figure 10. Illustrate this step where each component of the image are shown in a single columns. The first image represents the hue, second image the saturation and finally the last image being the value.

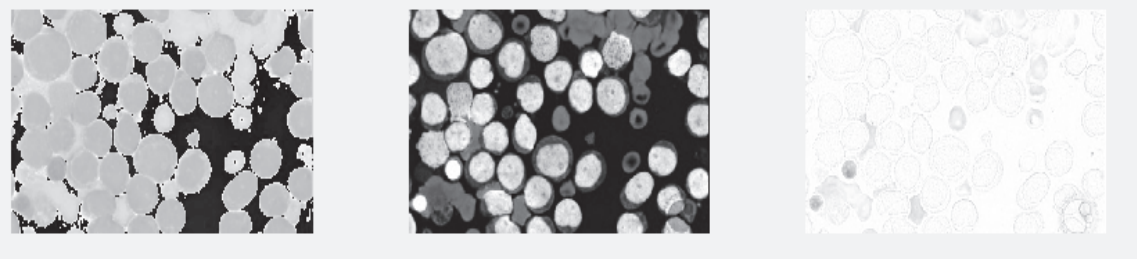


Figure 10. HSV Separate representation for microscopic leukemia image

Since the dominant color in leukemia staining is purple, whether it's a light shade or a dark shade of the colour, so the hue won't help us here. If you look at a HSV color wheel Figure 11.

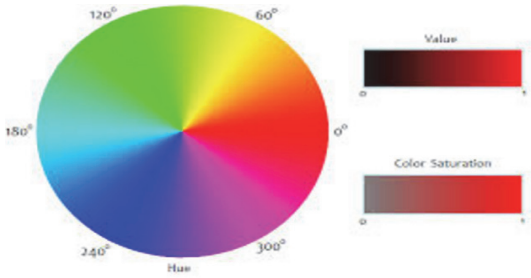


Figure 11. HSV Color wheel

We have Normalize the wheel so that it falls between [0,1] instead of 0 to 360 degrees. The hue is actually represented as degrees due to the nature of the color space, but MATLAB normalizes this to [0,1]. The color purple falls within a hue of [0.6, 0.8], which corresponds image leukemia image shown in previous step the pixels of leukemia cells in the image, they fluctuate between this range. Therefore, we ignore the hue.

What will certainly care about when analyzing leukemia images is the saturation and value components. The purple pixels have a higher saturation than the rest of the background, because the deep purple has a much more pure version of purple than the rest of the background. For moreover the brightness of the dark purple is darker than the background. these two points are used as an exploit to segment out the purple cells of leukemia in the image. The next step then will be to threshold using the saturation and value planes so that any values that are within a certain range are kept while those that are outside are ignored.

3.2.4 Create Binary Image Using Saturation and Value Threshold

As indicating by Ander Biguri 2015 the purple regions have a saturation value between 0.6 and 0.9, while the value component has values between 0.4 and 0.65. Two binary threshold masks are created if the pixel located in the color range. Logical OR are then used to masks them together. The resulted image have two main parts one is above and the other is below the threshold value, these two values will define the foreground and background of the image end each will represent a studied object according to what the image represents.

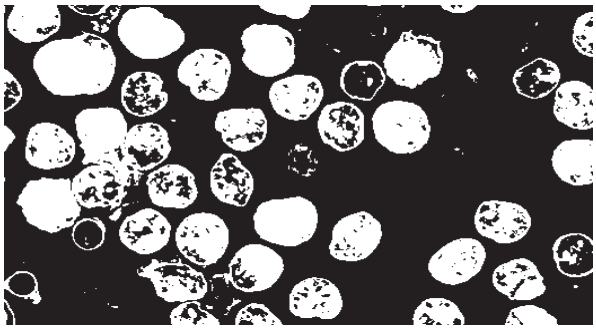


Figure 12. Binary image after applying threshold for microscopic leukemia image

3.2.5 Removing Small Objects

This step aim’s to remove the small objects To do this we used a an opening filter of a small window so that we don't affect the pixels that we want as much. A morphological opening removes isolated pixels that appear in the image, then using structuring element any pixel regions that are as small as the shape that is contained within the structuring element get removed. Because we want to preserve the shape of the leukemia cells and remove any other shape, we used a 3 x 3 disk structuring element to clean these pixels up without affecting the cells of leukemia. See Figure 13.

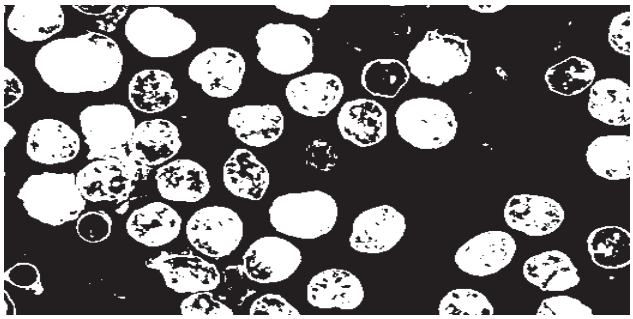


Figure 13. Binary image after removing small objects for microscopic leukemia image

3.2.6 Filling Holes Using Dilation

The Dilation is used to fill the holes because dilation operation uses a structuring element for probing and expanding the shapes contained in the input image. It aims to gradually enlarge the boundaries of regions of foreground pixels to fill holes in leukemia cells. Thus areas of foreground pixels grow in size while holes within those regions become smaller as shown in Figure 14.

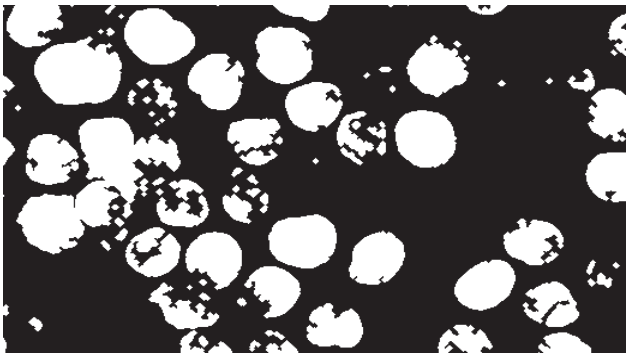


Figure 14. Binary image after filling holes using dilation for microscopic leukemia image

3.2.7 Replicate the Mask in 3D

This step is done so that to mask out the unwanted RGB pixels and only keep the ones we are looking for which is the leukemia cells as shown in Figure 15

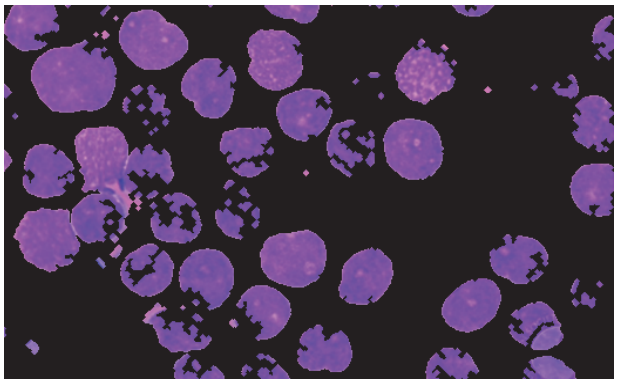


Figure 15. Binary image replicate the mask in 3D for microscopic leukemia image

3.3 Initial Leukemia Diagnosis

The initial leukemia diagnosis relay on the percentage of white blasts percent in the image , To calculate the percentage of leukemia cells we use the binary image because the microscopic image structure that contains many values and this is related to the stain procedure and its values differ from one location to another. Binary image overcomes the limitation because it has only two color values 0 for black and 1 for white. Figure16

The idea of the calculation is based on using the structure of the whole microscopic image and the percentage of the black pixels to the white pixels as an indicator for the presence of leukemia cells. The blood that have leukemia will have a changes in the number of white blood cells as seen in the microscopic images, and it can be noticed that the number stained cells in purple colors in the cases of leukemia is vary according to the type of leukemia, but the major fixed point that any increase in the number of cells indicating the presence of leukemia. thus the white area is larger in case of leukemia than the normal blood cells and as a result the number of pixels that contain the value of one will be larger in leukemia images and smaller in the normal blood smear images,

This step mainly consist of counting the white pixels to be used later in the next step for tissue classification as shown in Figure 16.

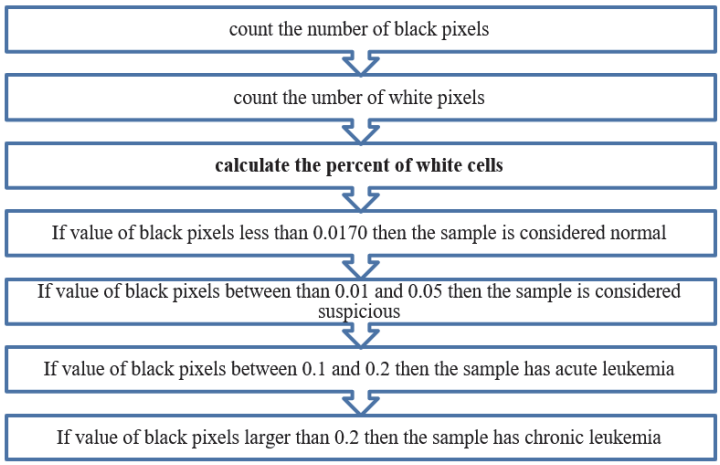


Figure 16. Initial leukemia diagnosis main steps

3.3.1 Count Number of White Background Pixels

The binary image gave us clear values of white pixels that have one value and this makes it easier to count these pixels, the number of white pixels represents the background in image.

3.3.2 Count Number of Black Pixels

The binary image gave us clear values of dark pixels labeled with zero values, and this makes it easier to count these pixels, the number of dark pixels represents the objects in the image.

3.3.3 Initial Diagnosis

The classification is based on the percent of leukemia cells in the microscopic image. The percent is calculated by calculating the percentage of white pixels compared to the percentage of black pixels as shown in equation 1 described below:

$$Percentage\ of\ black\ pixels = \frac{\text{Black Pixels}}{\text{Total number of pixels}} * 100\% \qquad \text{Equation 1}$$

According to the experimental results of normal blood cells analysis and leukemia cells analysis the following categories has been stated for initial diagnosis

If value of black pixels less than 0.0170 then the sample is considered normal

If value of black pixels between than 0.01 and 0.05 then the sample is considered suspecious

If value of black pixels between 0.1 and 0.2 then the sample has acute leukemia

If value of black pixels larger than 0.2 then the sample has chronic leukemia

After the initial diagnosis and in order to determine the specific type of leukemia further analysis is done in the next step

3.4 Advance Leukemia Diagnosis

After determining that the blood smear image has a leukemia and according to the previous steps and after the initial diagnosis performed using the cell percentage in the image the next step is to classify the type of leukemia

according to the features extracted.

Since the leukemia cells differ in shape from one type to another and relay of the leukemia cell shape then, The method that we have used for leukemia classification is Image Category Classification Using Bag of Features; This technique is also often referred to as bag of words. Visual image categorization is a process of assigning a category label to an image under test. The Categories in our experiments contained images representing different types of leukemia.

The first step in the classification phase is to Load Image Sets , the second step is to Construct an array of image sets based on the following leukemia types, to do this we have Used image Set class to help to manage the image data. Since image Set operates on image file locations, and therefore does not load all the images into memory, it is safe to use on large image collections

Each element of the image Sets variable now contains images associated with the particular leukemia type category. E.g. the number of images for leukemia types as well as labels shown in Figure 17, the labels was derived from directory names used to construct the image sets

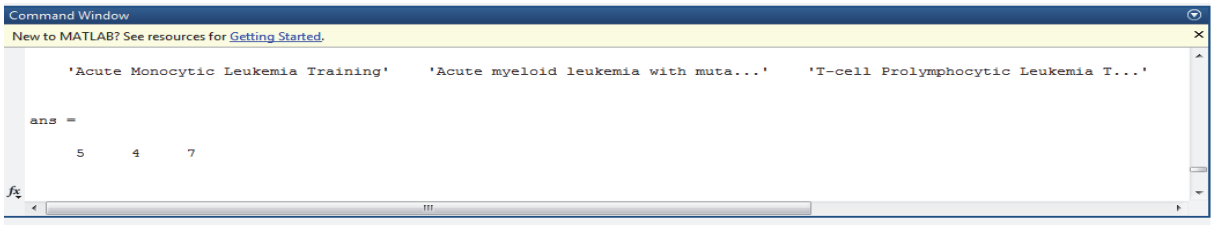


Figure 17. Load leukemia types

The second step is Training and Validation of the Image Sets, Since image Sets above contains an unequal number of images per category, then the first thing here to do was to adjust it, so that the number of images in the training set is balanced. the next step is to Separate the sets into training and validation data. 30% of images from each set for the training data and the remainder, 70%, for the validation data. The split is done Randomly to avoid biasing the results. The result of this step is two arrays of image Set objects ready for training and validation.

The third step is to Create a Visual Vocabulary and Train an Image Category Classifier, since Bag of words is a technique adapted to computer vision from the world of natural language processing. And images do not actually contain discrete words, we first construct a "vocabulary" of SURF features representative of each image category. This step was done using to bag Of Features function, which: extracts SURF features from all images in all leukemia image categories, then constructs the visual vocabulary by reducing the number of features through quantization of feature space using K-means clustering, Figure 18.

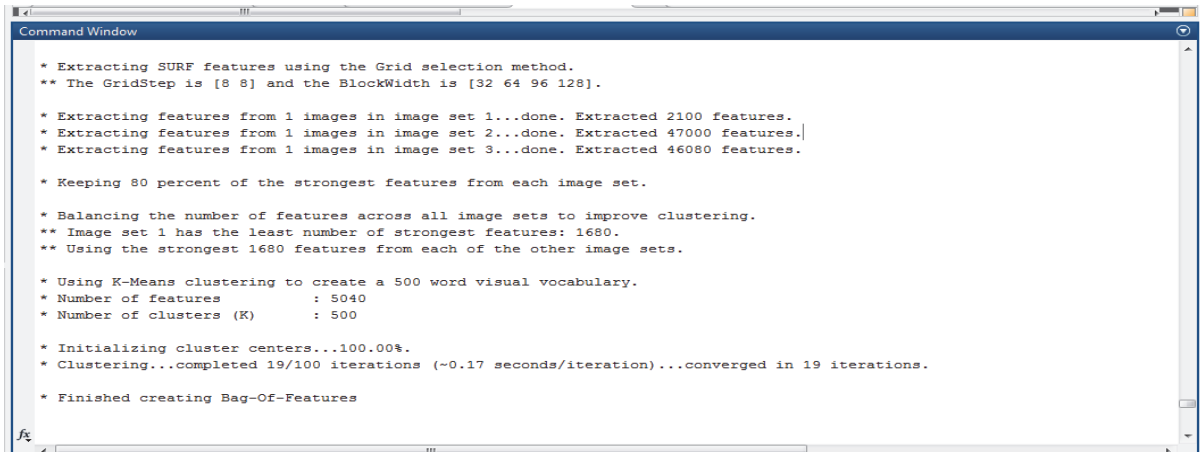


Figure 18. Training and validation of the image sets using bag of features

In the next step a histogram is produced using bag Of Features object that becomes a new and reduced representation of an image. The histogram forms the basis for training a classifier and for the actual image

classification. In essence, it encodes an image into a feature vector. As shown on Figure 19.

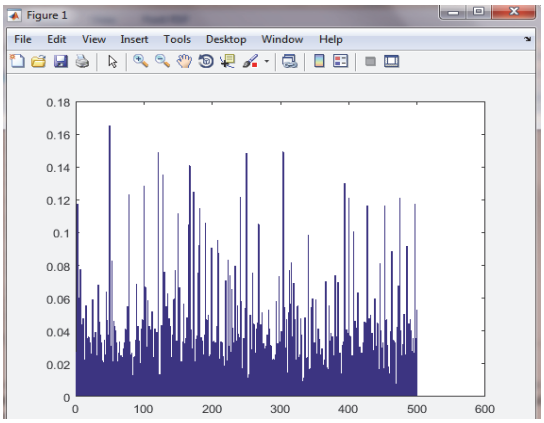


Figure 19. Histogram is produced using bag of Features for microscopic extracted feature

Encoded training images from each category are fed into a classifier training process invoked by the train Image Category Classifier function. this function relies on the multiclass linear SVM classifier from the Statistics and Machine Learning Toolbox™ in MATLAB . The next step is to see the evaluation of the classification according the 30% value of divided leukemia images described above see Figure 20.

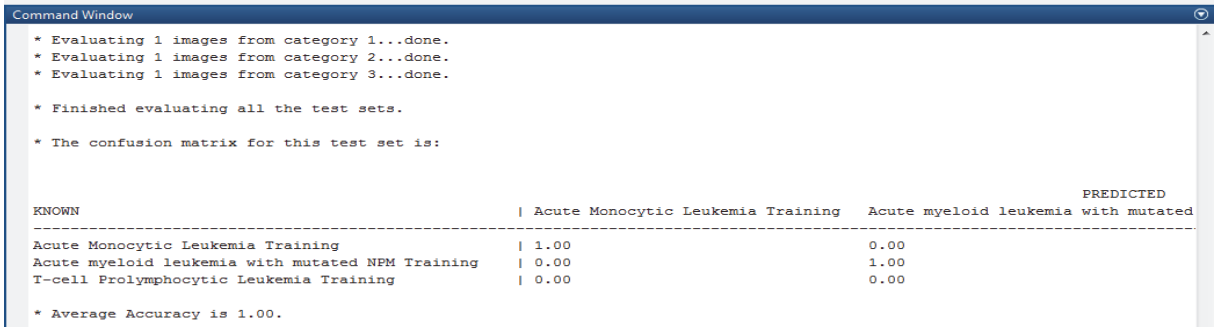


Figure 20. Classification according the 30% value of divided leukemia images

And finally to diagnose the tested image to see the diagnosis results and this will give us the type of leukemia by comparing the features of the image with the trained one, as shown in Figure 21

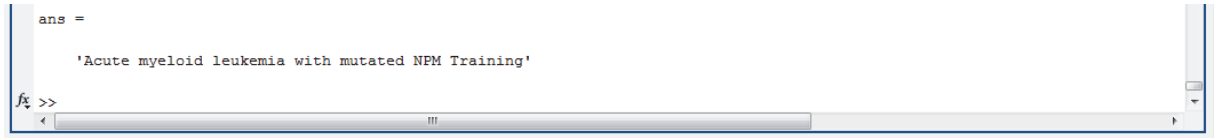


Figure 21. Final classification of leukemia types by comparing the features of the images

4. Experimental Results and Analysis

4.1 Data Description

In order to evaluate the proposed method A dataset of one hundred images for both normal tissue and abnormal tissue have been taken from a will known and specialized pathology and histology university libraries and websites for pathology images e.i. library.med.utah.edu, imagebank.hematology.org, cord.edu, pathpedia, atlases.muni.cz, pathologyoutlines, pathologystudent, eclinpath have been tested by our proposed method. All studied images as documented in the references that were taken from have been clinically tested and examined using blood and bone marrow examination. And correctly diagnosed and classified. The dataset that were chosen to cover cases of tissues and blood film for both male and female and for different age periods.

Fifty images of them were taken for normal cases and the other fifty images contain different leukemia types including the following types: Flower leukemia cells, Chronic Lymphocytic Leukemia, Acute Monocytic

Leukemia, T-prolymphocytic leukemia, Acute myeloid leukemia with mutated NPM1, T-cell prolymphocytic leukemia type 4, T-cell prolymphocytic leukemia – type 3, T-cell Prolymphocytic Leukemia type 2, T-cell Prolymphocytic Leukemia type 1, Hairy cell leukemia, Chronic Myelomonocytic Leukemia, Acute erythroid leukemia, Aggressive NK Cell Leukemia, Acute undifferentiated leukemia-Peripheral Blood, sample image are for Erythrocyte hemophagocytosis Leukemia microscopic image are shown in Figure 22.

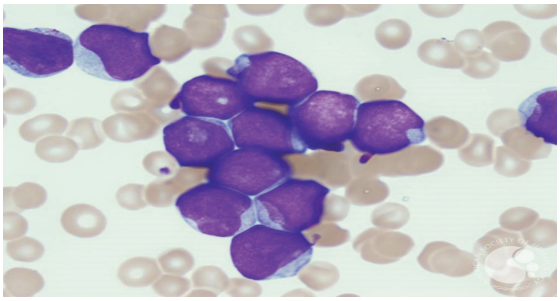


Figure 22. Acute myeloid leukemia with mutated NPM

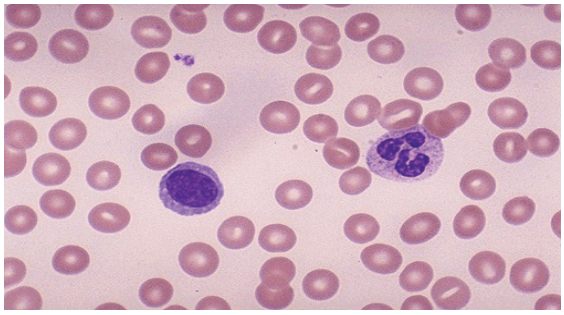


Figure 23. Normal blood sample

4.2 Initial Diagnosis Experiment

The initial diagnosis experiment concern about testing the methodology to be able to distinguish between images that has leukemia and those that don't have leukemia and the ability and accuracy of the system to give the initial diagnosis. The experiment have been performed with different samples and plotting the experimental results for the percentage of leukemia cells in comparing with samples that don't have leukemia have shown that there is a gap between the percentage of white pixels taken from samples that has leukemia and those that don't have leukemia Figure 24 shows the plotted results of 20 sample of both cases.

The system was able to correctly diagnose all tested cases that were correctly stained in the laboratory and taken by digital microscope with both magnification 40x and 100x. after the initial classification and diagnosis the tested images have been tested for the advance diagnosis proposed by this methodology and according to the feature bag.

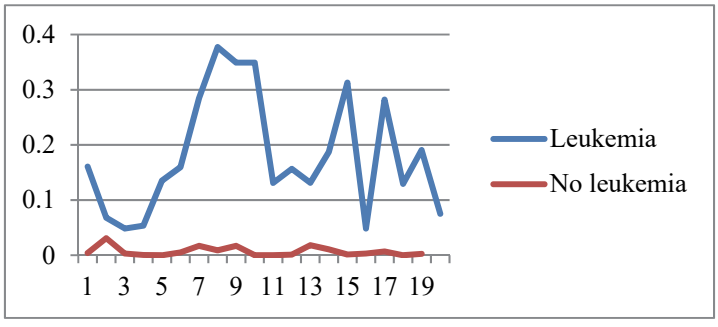


Figure 24. Percentage of black color in both leukemia and non leukemia for the tested 20 images

According to the experimental results of normal blood cells analysis and leukemia cells analysis the following

categories has been stated for initial diagnosis

If value of black pixels less than 0.03 then the sample is considered normal

If value of black pixels between than 0.03 and 0.05 then the sample is considered suspicious

If value of black pixels between 0.1 and 0.2 then the sample has acute leukemia

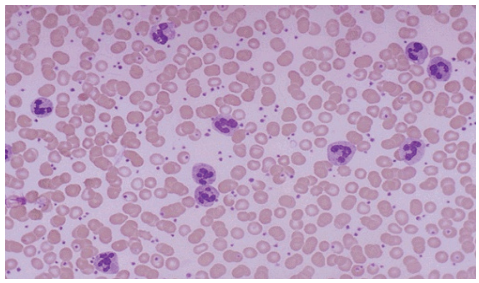
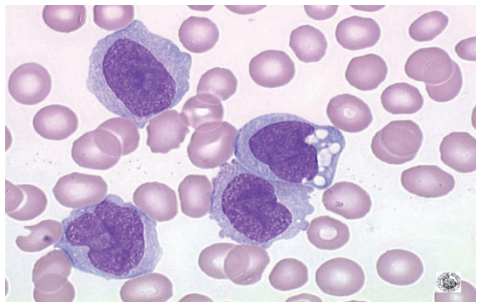
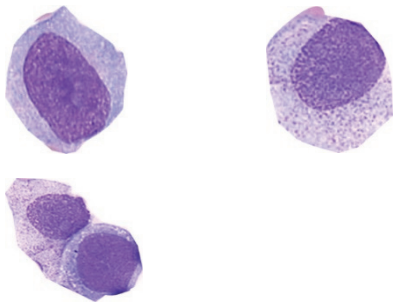
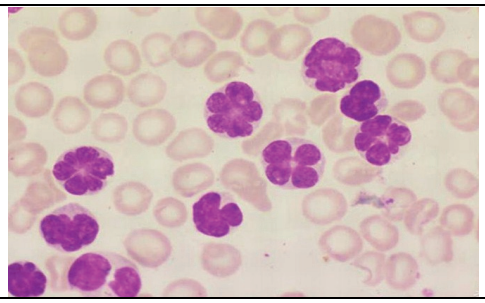
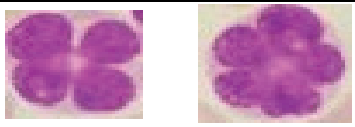
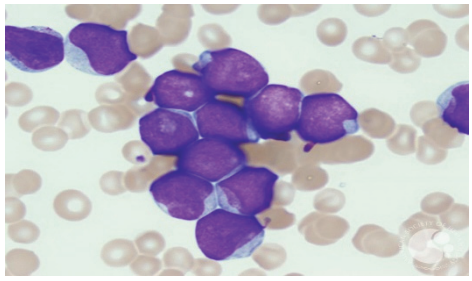
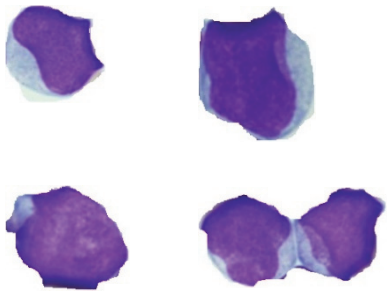
If value of black pixels larger than 0.2 then the sample has chronic leukemia

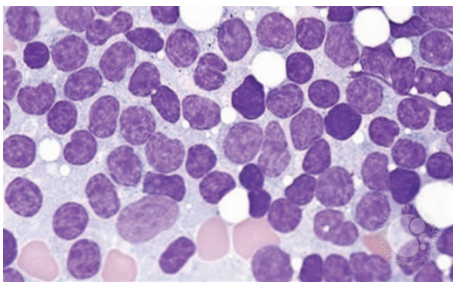
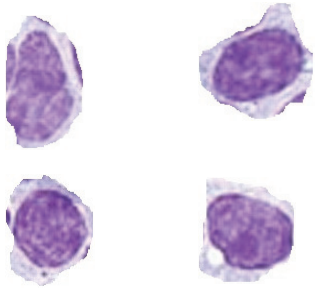
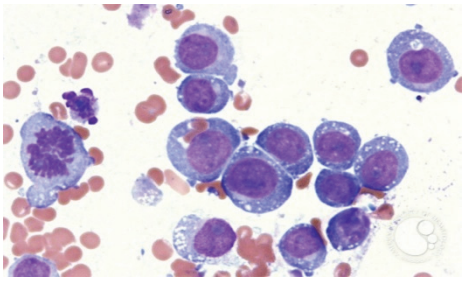
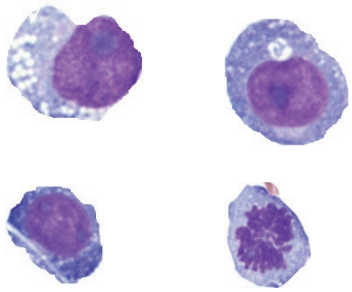
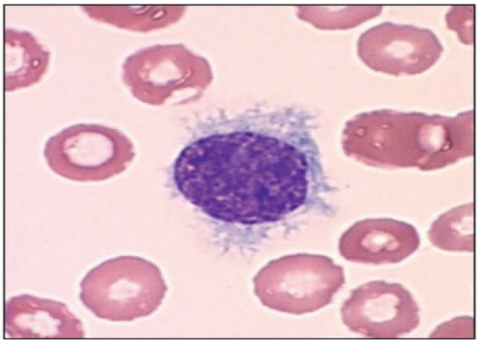
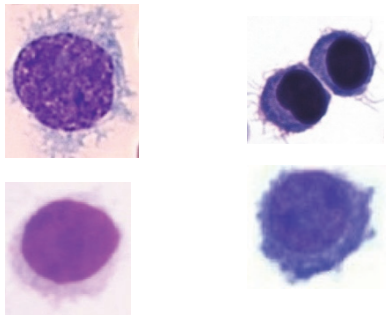
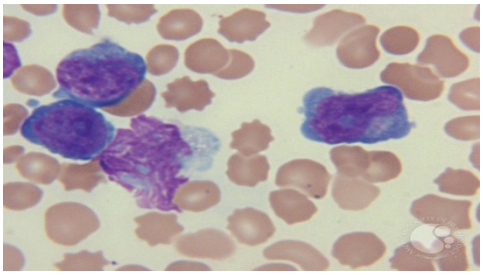
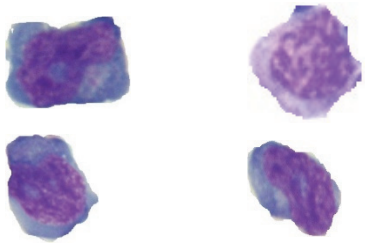
After the initial diagnosis and in order to determine the specific type of leukemia further analysis is done in the next step.

4.3 Advance Diagnosis Experiment

In order to test the ability of the system to classify leukemia a set of trained features has been prepared for the studied leukemia types table 1 illustrate a sample of the trained data and the images take from for the leukemia types.

Table 1. types of leukemia and normal studied and the trained features extracted

Type	Original image	Trained feature
Normal blood smear		
Acute Monocytic Leukemia		
Flower cell Leukemia		
Acute myeloid leukemia with mutated NPM		

Chronic Lymphocytic Leukemia Training		
Erythrocyte hemophagocytosis Training		
hairy cell leukemia		
T-cell Prolymphocytic Leukemia		

The implemented methodology was able give indication for the diagnosis of leukemia in images. The experimental results showed that the proposed methodology was also able to diagnose microscopic images with low resolution as shown in Figure 25. Leukemia.

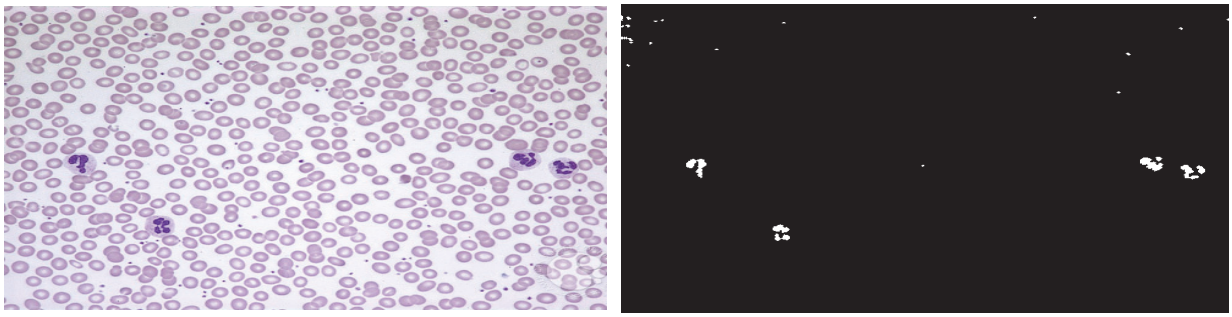


Figure 25. Low resolution microscopic image

The experimental results showed that the proposed methodology was unable to diagnose microscopic images with stained with different color stain's and has connected cells as shown in Figure 26. And gave a value of 0.3677 for white cells percentage

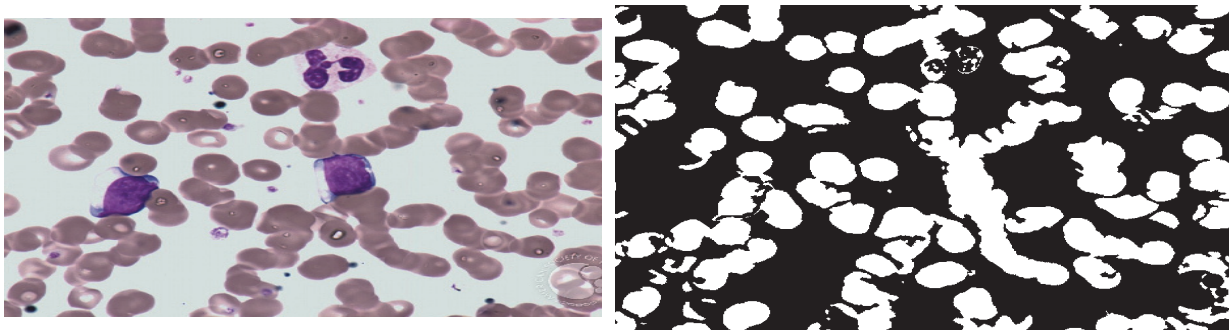


Figure 26. Microscopic image for connected RBC's stained with different stain

5. Conclusion

This paper propose an automated methodology for analyzing cancer histology and hematology microscopic images to detect leukemia using image processing by combining two diagnosis procedures initial and advance; The experimental results showed that the proposed methodology initial diagnosis was able to detect leukemia images and differentiate it from samples that don't have leukemia. in the advance diagnosis it was able to detect and classify most leukemia types and differentiate between acute and chronic but in some cases in the chronic leukemia where the percent of blast cells and shape are similar it gave a diagnosis of the type of leukemia to the most similar type. The initial diagnosis depend on the percentage of the white blood cells in microscopic images affected by leukemia as indicator for the existence of leukemia in the blood smear sample. Whereas the advance diagnosis classifying the leukemia according into different types using feature bag classifier.

References

A B Nobuyuki Otsu (1979). A threshold selection method from gray-level histograms. IEEE Trans. *Sys., Man., Cyber, 9*(1), 62-66. https://doi.org/10.1109/TSMC.1979.4310076.

Amjad, A., Hudaib, H. N. F., Fatima, E. A. A., & Sandi, N. F. (2017). A Survey about Self-Healing Systems (Desktop and Web Application. Scientific Research Publishing.

Basim, A., & Hussam, N. F. (2008). Automation of iron difficiency anemia blue and red cell number calculating by intictinal villi tissue slide images enhancing and processing, Computer Science and Information Technology, 2008. ICCSIT'08. International Conference.

Basim, A., Hussam, N. F., Omar, S. A. (2006). CDNA microarray genome image processing using fixed spot position. *American Journal of Applied Sciences, 3*(2), 1730-1734.

Basim, A., Mohammad, H. Z., & Hussam, N. S. (2007). Mammogram breast cancer image detection using image processing functions. *Information Technology Journal, 6*(2), 217-221.

Belsare, A. D., & Mushrif, M. M. (2012). Histopathological Image Analysis Using Image Processing Techniques: An Overview. *Signal & Image Processing: An International Journal (SIPIJ), 3*(4), August 2012.

Brothwell, D. J., Lewis, D. W., Bradley, G., Leong, I., Mock, D., & Leake, J. L. (2003). Observer agreement in the grading of oral leukemia, Community Dent Oral Epidemiol.

Camargo, J., Caicedo, C., & Gonzalez, F. (2009). Content-based Histopathology Image Retrieval Using a Kernel-based Semantic Annotation Framework.

Capdevielle, O., & Dalle, P. (1994). Image Processing Chain Construction by Interactive Goal Speci_cation, Proceedings of the First IEEE Int. Conf. on Image Processing, 3.

Chan, F., Lam, F., & Zhu, H. (1998), Adaptive thresholding by variation method. IEEE Transactions on Image Processing.

David, J. F., Wenjin, C., & Lin, Y. (2013). Automated image interpretation and computer-assisted diagnostics. *Anal Cell Pathol (Amst), 34*(6), 279-300. https://doi.org/10.3233/ACP-2011-0046

Deng, Y., Kenney, C., Moore, M. S., & Manjunath, B. S. (1999), Peer group filtering and perceptual color image

quantization, to appear in Proc. of ISCAS.

Deng, Y., Kenney, C., Moore, M., & Manjunath, B. (1999). Peer group filtering and perceptual color image quantization.

DeSimone, P. A., Cohen, A. M., & Garofalo, M. C. et al. (2008). Cancer of the rectum. In: Abeloff MD, Armitage JO, Niederhuber JE. Kastan MB, McKenna WG, eds. Abeloff's Clinical Oncology. Pa: Elsevier, pp. 1420–1430.

Dougherty, E., & Lotufo, R. (2003). Hands-on morphological image processing. *Society of Photo Optical, 20*(2).

Fatma, M., & Jaibir, S. (2014). Identification and classification of acute leukemia using neural network." In Medical Imaging, m-Health and Emerging Communication Systems (MedCom), 2014 International Conference on, pp. 142-145. IEEE.

Fernandez, F., & Gonzalez, et al. (2010). Histopathological findings in oral lichen planus and their correlation with the clinical manifestations, Med Oral Patol Oral Cir Bucal.

Gonzalez, R., & Woods, R. (2002). Digital Image Processing, Prentice Hall, Upper Saddle River.

Gorman L. O. (1994), Binarization and multithresholding of document images using connectivity, Graphical Model and Image Processing, 350-365.

Haralick, Shapiro, L. (1992). Survey image segmentation techniques, computer vision graphics and image processing.

Himali, P., Vaghela, L. (2011). Detection using Digital Image Processing Techniques. *International Journal of Applied Information Systems (IJAIS).* ISSN: 2249-0868

Huang, C., Veillard, A., Roux, L., Loménie, N., & Racoceanu, D. (2011). Time-efficient sparse analysis of histopathological whole slide images, Computerized medical imaging and graphics: The official journal of the Computerized Medical Imaging Society, 20.

Ilyich, J., Karapetian, G., Nalibotsky, B., Nedzved, A., & Podoprigora, A. (2002). System of image processing and analysis. Bioscan-IW. Informatics for health care.

Iranli, A., Fatemi, H., & Pedram, M. (2005). Histogram Equalization for Backlight Scaling, University of Southern California Los Angeles.

Jensen, J. R. (1996) Introduction to Digital Image Processing: A Remote Sensing Perspective. Practice Hall, New Jersey.

Johnston, D. A., & Ruifrok, A. C. (2001) Quantification of histochemical staining by color deconvolution, Journal of Urology, Ruifrok AC, Johnston.

Kekre, H. B. et al. (June 2013). Segmentation of Blast using Vector Quantization Technique. *International Journal of Computer Applications (0975 – 8887), 72*(15).

Leong, F. M., Brady, M., & McGee, J. (2003). Correction of uneven microscopy images, J Clin Pathol, 520-530.

Long, X., Clevel, L., & Yao, Y. (2010). Multiclass detection of cells in multicontrast composite images. *Computers in Biology and Medicine, 20*(3), 150-165.

Markiewicz, T., Osowski, S., & Marianska, B. (2005). Automatic recognition of the blood cells of myelogenous leukemia using SVM, Neural Networks, 2005. IJCNN '05. Proceedings. 2005 IEEE International Joint Conference. https://doi.org/10.1109/IJCNN.2005.1556295

Omar, A., Amjad, H., Hussam, N., & Fakhouri, L. A. (2013). Microarray Gene Expression Extraction and Archiving Based on Local Spot Locations, IJCSI Int. J. Comput. Sci.

Rizik, M. H., Al-Sayyed, H. N., Fakhouri, A. R., & Colin, P. (2017) Polar Particle Swarm Algorithm for Solving Cloud Data Migration Optimization Problem. *Modern Applied Science, 11*(8), 98.

Salim, A., Emel, O., & Cigdem, G. D. (2014). A Color and Shape Based Algorithm for Segmentation of White Blood Cells in Peripheral Blood and Bone Marrow Images, Cytometry Part A85A: 480490, 2014.

Sezgin, M., & Sankur, B. (2004). Survey over image thresholding techniques and quantitative performance evaluation. *Journal of Electronic Imaging, 13*(1), 146-165. https://doi.org/10.1117/1.1631315

Subrajeet, M., Dipti, P., & Sanghamitra, S. (2013) An ensemble classifier system for early diagnosis of acute lymphoblastic leukemia in blood microscopic images. Springer-Verlag London 2013.

Supardi, N. Z., Mashor, M. Y., Harun, N. H., Bakri, F. A., & Hassan, R. (2012). Classification of blasts in acute leukemia blood samples using k-nearest neighbour. In Signal Processing and its Applications (CSPA), 2012 IEEE 8th International Colloquium on, pp. 461-465. IEEE, 2012.

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Measuring the Performance of Parallel Information Processing in Solving Linear Equation Using Multiprocessor Supercomputer

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Abstract

Evaluation the performance of the algorithms and the method that is used to implement it play a major role in the assessment of the performance of many applications and it help the researchers to decide which algorithm to use and which method to implement it, it also give indicate of the performance of the hardware that the algorithm is tested over. In this paper we evaluate the performance of solving linear equation application over supercomputer which was implemented and using Message Passing interface (MPI) library. The sequential and multithreaded algorithm for solving linear equations has been experimented too and the results has been recorded, the speedup and efficiency of the algorithm has been calculated and the results showed that the parallel algorithm outperforms other methods with the large size matrix of 8192 * 8192 over the number of processors of 64. For large input size, the results also showed that there is a noticeable decrease in running time as the number of processors increase. But in case of multithreaded the results showed that as the matrix size increase the time required for running the algorithm is rapidly increasing although the number of threads increased. This indicates that the parallel performance over for large matrix input size is better and outperforms other methods.

Keywords: parallel computing, solving linear equation, multithreaded, super computer

1. Introduction

From the beginning of computer invention until today the computers processing has been developed very rapidly a new generation of computer systems sets higher standards with regards to performance, size, price, and usability. Meanwhile, the rapid developments which have occurred in computer hardware and software technology over the last two decades have made computers an essential and indispensable tool for different fields of our daily life (alsayyed et al., 2017) (hudaib et al,. 2007).

Computers continue to develop. In the 1990's, the Parallel Computers has been invented. Parallel computer systems adopt the idea of cooperation by employing multiple processors. The continued development of computer hardware and improvements in the computer price/performance ratio coupled with improvements in the usability and functionality parallel computers have raised the expectations of computers to the point where they appear to believe that any problem and any size model can be solved in short time, regardless of the size or complexity of the problem. Moreover, results are became very fast with parallel computers and they appear within hours instead of weeks or days. Thus, the race between the needs of the user and technological improvements continues to create a demand faster parallel computing (alhadidi et al.,2006).

Large computational problems are divided, separately solved, and integrated into a final solution. Due to the advances in parallel computer architecture, machines with large numbers of processors are now available. Due to this technological progress, some researchers predict that “within a decade, all developments in computer applications and algorithm design will be taking place within the context of parallel computation” Parallel computation has motivated a considerable large number of researches due to advances in solid state, large scale integration of computer Performance, reliability and low cost of such digital devices as microprocessors which have led to the development of multi-processor computer architecture(alhadidi et al.,2007). The concept of parallel processing is a departure from the trend of achieving increases in speed by performing single operations faster. Parallel processing achieves increases in speed by performing several operations in parallel

The high performance parallel computers have variety of hardware architectures that can be classified according

to their way of manipulating the instructions and data. The most important high performance computer categories are as follows: SIMD machines: Single instruction machines that manipulate many data items in parallel. Such machines have large number of processors, ranging from 1,024 to 16,384. Vector processors are one type of SIMD machines. MIMD machines: These machines execute several instruction streams in parallel on different data. There are many kinds of MIMD systems that can be further classified according to their memory taxonomy as shared and distributed memory machines.

Parallel computers are used to solve large computational problems such as matrix multiplication. Matrix multiplication is a computer problem that has large input as many other numerical problems which require a large number of arithmetic operations, such computational problems require parallel computer to fast solve them. Also Many applications to the sciences and engineering require the solution of very large in size linear systems of equations, and in many cases this task has been made feasible on modern computers. so it require super parallel computer to solve it.

Many researches has been done on parallel processing (Pasetto, D., and Akhriev, A. 2011, Maria, et al., 2015, Atif, Muhammad, 2009, Rajalakshmi, 2009 Delic, S., and Z. Juric. 2013) many researches invistigate matrix and linear equation solving and numerical analysis over large number of processors using parallel processing (Scholl, S., Stumm, C., and Wehn, N. 2013, Rajalakshmi, K. 2009 saeed m., et al., 2015),, these researches focus on measuring the performance evolution of parallel processing and differentiate it from sequential analysis and parallelization of the sequential methods many researches discussed parallel algorithms based on Cholesky factorization, Gaussian elimination, LU decomposition, Gauss-Jordan, and many methods gave solution for dense linear systems,

Erich Kaltofen, and Victor Pan proposed Processor Efficient Parallel Solution of Linear Systems over an Abstract Field, The algorithms utilize within a O(log n) factor as many processors as are needed to multiply two $n \times n$ matrices. Maria, et al., 2015 described a study of the Gaussian Elimination Applications, examine the utilizations of Gaussian Elimination technique. They showed that Progressive Gaussian Elimination technique is seen to be more quick, proficient and precise than that of Gaussian disposal strategy. The Gaussian Elimination technique is additionally proper for comprehending straight conditions on work associated processors. Delic, S., and Z. Juric. 2013, proposed a research that discuss some improvements of the Gaussian elimination method for solving simultaneous linear equations. Atif, Muhammad, and Abid Rauf, 2009 proposed an implementation of Gaussian elimination method to recover generator polynomials of convolution codes. Balasubramanya et al., 1994, proposed A new Gaussian elimination based algorithm for parallel solution of linear equations Scholl al., 2013 proposed a Hardware implementations of Gaussian elimination over GF (2) for channel decoding algorithms

This paper evaluate the performance of matrix multiplication and an application to it in solve linear equation on super computer, Gaussian elimination algorithm which is been used for solving a system of linear equations in parallel super computer

2. Overview of Solving Linear Equation Using Gaussian Elimination

The goal of Gaussian elimination are to make the upper-left corner element a 1, use elementary row operations to get 0s in all positions underneath that first 1, get 1s for leading coefficients in every row diagonally from the upper-left to lower-right corner, and get 0s beneath all leading coefficients. Basically, you eliminate all variables in the last row except for one, all variables except for two in the equation above that one, and so on and so forth to the top equation, which has all the variables. Then you can use back substitution to solve for one variable at a time by plugging the values you know into the equations from the bottom up. You accomplish this elimination by eliminating the x (or whatever variable comes first) in all equations except for the first one. Then eliminate the second variable in all equations except for the first two. This process continues, eliminating one more variable per line, until only one variable is left in the last line. Then solve for that variable.

The linear system problem is to find an n-vector x such that $Bx = S$. Given an n x n nonsingular matrix B and an n-vector S.

the Solution of the linear systems $Bx = S$ is very significant and important in scientific and engineering computations. It is necessity for faster solutions in many areas of real-time computing, parallel algorithms, which promise to speedup computations. Programs using p processors should run p times faster than identical programs using only one processor, although a linear speed up might not be possible and the actual speed up is often much smaller.

A linear equations system of matrix B:

B 0,0 X 0 + B 0,1 X 1 +..... + B 0,n − 1 X n − 1 = S 0

B 1,0 X 0 + B 1,1 X 1 +..... + B 1,n − 1 X n − 1 = S 1

B 2,0 X 0 + B 2,1 X 1 +..... + B 2,n − 1 X n − 1 = S 1

B 3,0 X 0 + B 3,1 X 1 +.... + B 3,n − 1 X n − 1 = S 1

B n − 1,0 X 0 + B n − 1,1 X 1 +..... + B n − 1,n − 1 X n − 1 = S n – 1

Where X j are the values to be found and they are unknown, Bi,j and Si are values which are constant,

A practical variant of the problem requires solutions of several linear systems with the same matrix A on the left-hand side. That is, the problem is to find B matrix X = (xi,x2,..., x m) such that

BX = S

where S = (S1, S2……., Sm) is an n x m matrix.

There are many methods for solving the system of linear equations Bx = S. Different methods might require different amounts of work. With a single processor, the complicate time for such problem require O(n3) time of arithmetic operations. The total number of arithmetic operations performed remains the same if using single processor only.

In the system of linear equations that is represented by Bx = S, where B is an N × N nonsingular coefficient matrix, x is an N × 1 unknowns vector and S is an N × 1 known right-hand side vector. When there are multiple right-hand sides, the unknowns are computed for each right-hand side vector one-by-one. According to the solution method applied, the type of the coefficient matrix A, may vary as follows: Dense or sparse, Symmetric or unsymmetric, Positive definite or non-singular

There are different solution methods which work more efficiently depending on the nature of the coefficient matrix A. These methods can be classified into the following two groups although there are methods that utilize the features of both methods:

Direct methods: These methods give the exact solution of a linear system with known number of operations. There are mainly two different approaches in direct solution methods: (1) finding the inverse of the coefficient matrix and multiplying it with the right hand side vector or (2) transforming the coefficient matrix into triangular or diagonal form in order to decrease the coupling between the equations. The first method is seldom used due to the large number of operations. The most commonly used transformation based direct methods are Gauss elimination.

However, if we use parallel system then the total time will be reduced as a result of sharing the work among the processors, even though some additional overhead may be introduced by necessary communication or synchronization among the tasks and processors. Thus, when using an algorithm for solving the system of linear equations on parallel computers, it is natural that an algorithm with the least number of arithmetic operations is first chosen among serial algorithms. The chosen algorithm is then restructured for parallel computers according to their architecture. Among the different algorithms Gaussian elimination is the ideal candidate for parallel computers to solve linear systems.

3. The Gaussian Algorithm for Solving Linear Equation

For a matrix A the Gaussian Algorithm will modify it by making arithmetic operations and transform the matrix from one state to another without changing the solution and this is done either by addition or multiplication, the resulted transformation will be the same and equivalent for the original matrix which is triangular matrix then the vector of the solution will be gotten directly

3.1 Sequential Gaussian Algorithm

The focus of Gaussian Sequential Algorithm to make different operation to the original matrix to obtain equivalent matrix of the linear equations and these transformation will not affect the solution of the linear equations and that's why they are called equivalent, these transformations are mathematical operations i.e. multiplying any matrix raw of a certain equation by a constant nonzero value, equations permutation, adding one equation to the next equation that exists in the matrix (Dumas, and Villard, 2002).

Te number of steps that is required for solving linear equation system with N * N matrix and a vector S of N x 1 is N -1 Step, through the iteration of the algorithm and in any i iteration any non zero value lies below the diagonal in column i are changed by replacing with every j row, where as $i + 1 \leq j < n$, replaced by the sum of row j and – aj,I /ai,i multiplied by row I. (Dumas, 2002)

Gaussian elimination Partial pivoting

In Gaussian elimination through iteration i, the pivot row will be the i row, and this row will be used to in changing all of them on zero values to zero that lies below the diagonal column i.

In iteration i, rows i up to row n − 1 are explored and examined for the row whose column i values have the biggest absolute value after that, they found row is changed by swapping (pivoted) with row i., the Pseudo-code of Gaussian elimination are shown in figure 1.

```
For i ← 0 to n – 1
  {
TEMP ← 0
For j ← i to n – 1
{
  if |a[POSITION [j], i]| > TEMP
TEMP ← | a[POSITION [j], i]|
SELECTED ← j
End if
  }
swap POSITION [i] and POSITION [SELECTED]
for j ← i + 1 to n – 1
{
  t ← a[POSITION [j], i]/a[POSITION [i], i]
for k ← i + 1 to n − 1
  {
a[POSITION [j], k] ← a[POSITION [j], k] − a[POSITION [i], k] × t
}
  }
  }
```

Figure 1. Gaussian elimination Pseudo-code for (pivoting)

3.2 Parallel Gaussian Elimination

For testing the parallel performance on super computer we used the Successive Gaussian Elimination (SGE) algorithm for parallel solution of linear equations proposed by MURTHY, 1995. the SGE algorithm does not have a separate back substitution phase, which requires O(N) steps using O(N) processors or O (log 2 N) steps using O (N3) processors, for solving a system of linear algebraic equations. It replaces the back substitution phase by only one step division and possesses numerical stability through partial pivoting as shown in figure 2. Further, in this paper, the SGE algorithm is shown to produce the diagonal form in the same amount of parallel time required for producing triangular form using the conventional parallel GE algorithm. Finally, the effectiveness of the SGE algorithm is demonstrated by studying its performance on a hypercube multiprocessor system.

Solving a linear equation using Gaussian parallel Algorithm is divided into two parts the first part is the Gaussian elimination part; The main aim of Gaussian elimination is to reduce the upper triangle of the matrix that represent linear system to by a steps elimination to give a coefficient matrix

The estimations of elements are ascertained. The estimation of the variable x n-1 might be ascertained from the last condition of the changed framework. After that it gets to be distinctly conceivable to discover the estimation of the variable x n-2 from the second to last condition and so on. Illustration of the pivot, Zero elements will not changed and Non Zero elements (variables) will not changed.

The Gaussian arranges comprises in successive end of the questions in the conditions of the direct condition framework being comprehended. All the fundamental calculations might be depicted by the accompanying relations

All the Non Zero elements(variables), which are located lower than the main diagonal and to the left of column i are already zero. At i-th iteration of the Gaussian elimination stage the coefficients of column i located lower than the main diagonal are set to zero. It is done by means of subtracting the row i multiplied by the adequate nonzero constant. After executing (n-1) similar iterations the matrix of linear equation coefficients is transformed in the upper triangle form During the execution of the Gaussian, the matrix element, the pivot will be utilized

solving other elements, and the corner to corner component of the turn line is known as the turn component. As it can be noted it is conceivable to perform calculations just if the main component is a nonzero esteem. In addition, if the turn component has a little esteem, then the division and the increase of lines by this component may prompt to aggregation of the computational blunders and the computational insecurity of the calculation. A conceivable approach to maintain a strategic distance from this issue may comprise in the accompanying. At every emphasis of the Gaussian disposal arrange it is important to decide the coefficient with the greatest supreme

4. Parallel Analysis

Parallel Solving linear equation is analyzed according to the number of communication steps, complexity, speed, and execution time.

Communication steps: this includes the number of steps required for data splitting and results gathering. the number of communication steps that are required to scatter the data depends on the number of processors P, which is log p. we need same number of communication steps to gather the results from all processors. Complexity: this is the time required to perform calculations locally on each processor

Speed: this is the communication steps times the speed of the electrical links. Assuming that the speed of electrical links = 250Mb/s, the speed is $2 \times \log p \times 250$ Mb/s.

Execution time: this is the complexity of matrix splitting, matrix operation and substitution + communication time. The communication time depends on the data that is transmitted for each processor in each step.

5. Results and Discussion

In this section we present the result that we obtained for the Performance Evaluation purpose for solving the linear equation problem and the matrix multiplication on IMAN1 Zaina cluster supercomputer on different input size (128, 256, 512, 1024, 2048, 4096, 8192) and running the algorithms in different number of processors (2,4,8,16,32,64), an open MPI library is used in our implementation, The hardware and software (operating system, compiler, MPI) characteristics that are used for implementation are shown in table 1:

Table 4. Hardware and Software characteristics used to for the evaluation

Hardware	Dual Quad Core Intel Xeon, CPU with SMP, 16 GB RAM
Operating system	Scientific Linux 6.4
Compiler, MPI	Open MPI 1.5.4, C Compiler.
Matrix Input Size	(128, 256, 512, 1024, 2048, 4096, 8192)Byte
Number of Processors	1,2,4,8,16,32,64

5.1 Evaluation of the Performance

This section represent the Evaluation of the performance for solving linear equation algorithm a full tables and flow chart for running the Parallel program on super computer results and the results of multithreaded will be presented.

5.1.1 Parallel Run Time Evaluation

For the Run Time Evaluation the solving linear equation algorithm has been evaluated according to different data sizes as shown in figure, the algorithm has evaluated with different input matrix size of (128*128, 256*256, 512*512,1024*1024,2048*2048, 4096*4096, 8192*8192). For number of processors of (2,4,8, 16,32,64) and As shown in the figure for all the processors as the data size increases, the run time increases and this is due to increased number of the matrix elements and the increase number of finding the pivot row of the matrix and the number of splitter elements of the matrix and the increase time required for gathering the elements and finding the solution of the linear equation, as it illustrated from the figure too that runtime for the processor number of 64 was the fastest to solve the linear equation and when processor number is 2 it has the highest run time.

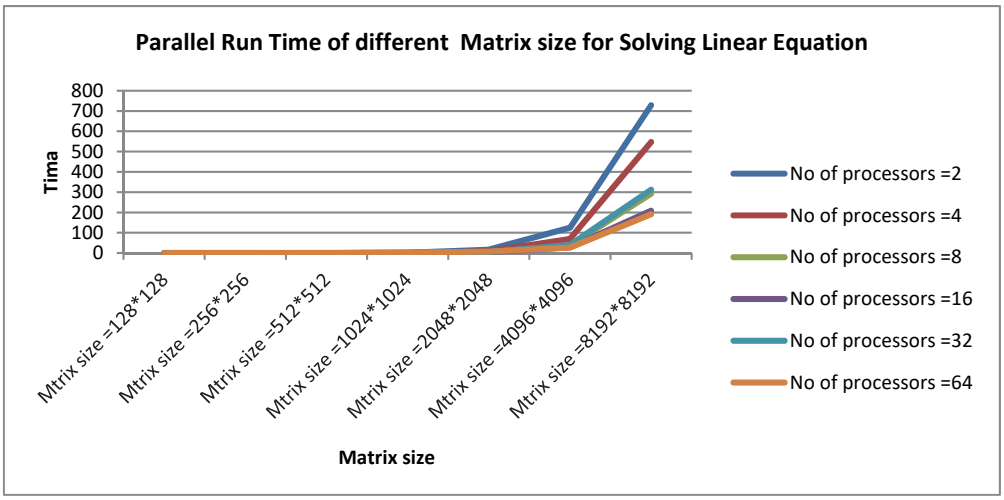

Figure 5. Parallel Run Time of different Matrix size for Solving Linear Equation

Figure 6 and Figure 7 illustrate the run time according to different number of processors (2,4,8,16,32,64). We chose two different data size from small matrix input (128,256,512) and for large matrix input size (1024,2048,4096,8192) the two figures to illustrate the runtime performance evaluation for those two input sizes and illustrate the difference.

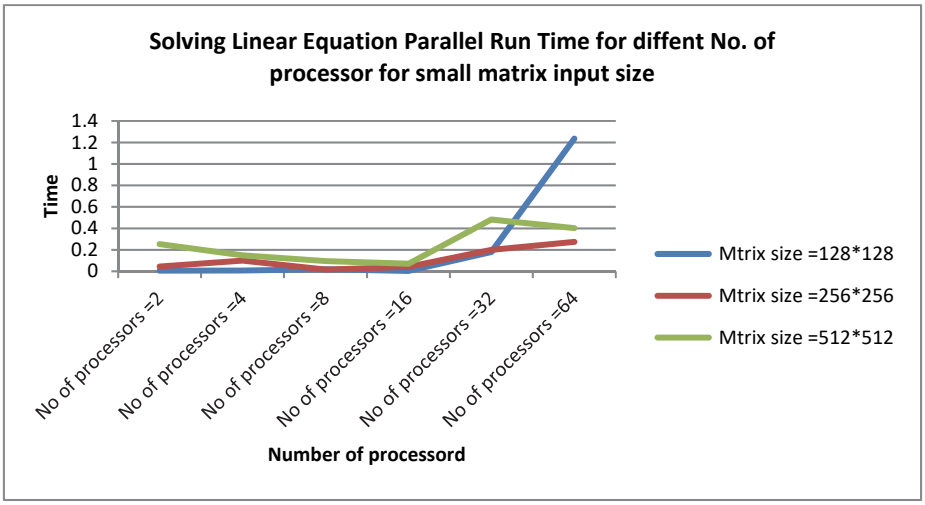

Figure 6. Solving Linear Equation Parallel Run Time for different No. of processor (2,4,8, 16,32,64) for small matrix input size

with the small matrix input size we see that the Run Time the solving linear equation algorithm is for the smallest matrix size of 128*128 and as the number of processors increase that the running time increase and it has the highest running time on number of processors of 64 although it has the smallest size and this is due to that the time required for communication between processor is very high, but when the number of processor was two it has the running smallest time while at number of processor 512 it has the highest running time and this is normal case because with the increase number of matrix size the time will be increased over a small number of processors but in case small matrix size and with the increase number of processor up to 32 and 64 the running time will increase because of the communication overhead increase between processor is very high and the benefits of parallelism are decreased.

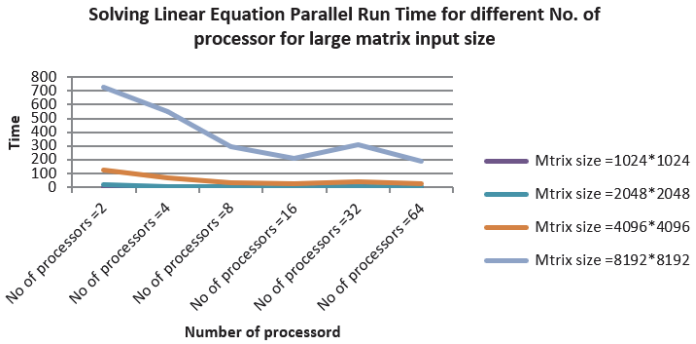

Figure 7. Solving Linear Equation Parallel Run Time for different No. of processor for large matrix input size

for the large matrix input size and over the same number of processors that we test the large input matrix size (1024,2048,4096,8192) over (2,4,8,16,32,64) processors. we see that the Run Time the solving linear equation algorithm for the large matrix size of 8192*8192 and as the number of processors increase that the running time decrease and it has the smallest running time on number of processors of 64 because it has the largest size and this is the result of using parallel processing as the aim of parallel computing is illustrated clearly here and the time required for solving the linear equation was reduced and this running time performance show the power and success of parallel computing in solving linear equations. The figure shows the decrease in running time as the number of processors increase; the largest time was at processor 2 and the smallest time at processor 64. As the number of processors increases, the run time is reduced due to better parallelism, better distribution among the increased number of processors from 2 to 64.

5.1.2 Multithreaded Run Time Evaluation

For the Multithreaded Run Time Evaluation the solving linear equation algorithm has been evaluated according to different data sizes as shown in figure, the algorithm has evaluated with different input matrix size of (128*128, 256*256, 512*512,1024*1024,2048*2048, 4096*4096, 8192*8192). For number of threads of (2,4,8, 16,32,64) and As shown in the figure as the data size increases, the run time increases and this is the result of increasing matrix input size which increase the calculation time needed for solving the linear equation since the complexity time of solving linear equation is very high.

As results show, speedup (execution time of one-threaded sequential algorithm compared with parallel multithreaded algorithm) is almost independent of the number of threads when that number is equal or greater than the number of system processors, which are actually responsible for speedup. In the case of two processors the computation time is almost two times shorter and shows a very slow decreases when the number of threads increases. Reasons for this decrease are heavier thread communication and context switching between multiple threads.

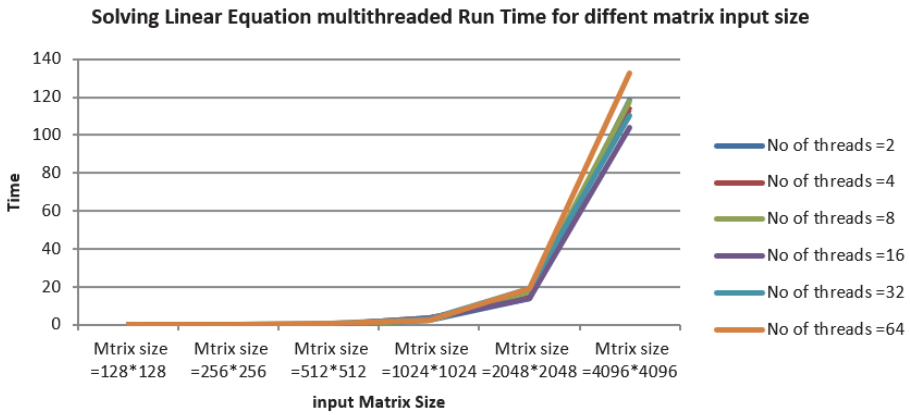

Figure 8. Solving Linear Equation multithreaded Run Time for different matrix input size

5.1.3 Sequential Running Time

For the Sequential Run Time Evaluation the solving linear equation algorithm has been evaluated according to

different data sizes as shown in figure, the algorithm has evaluated with different input matrix size of (128*128, 256*256, 512*512,1024*1024,2048*2048, 4096*4096, 8192*8192). As illustrated in the figure the running time for the Sequential algorithm of solving linear equation is increased rapidly with the increase of matrix size

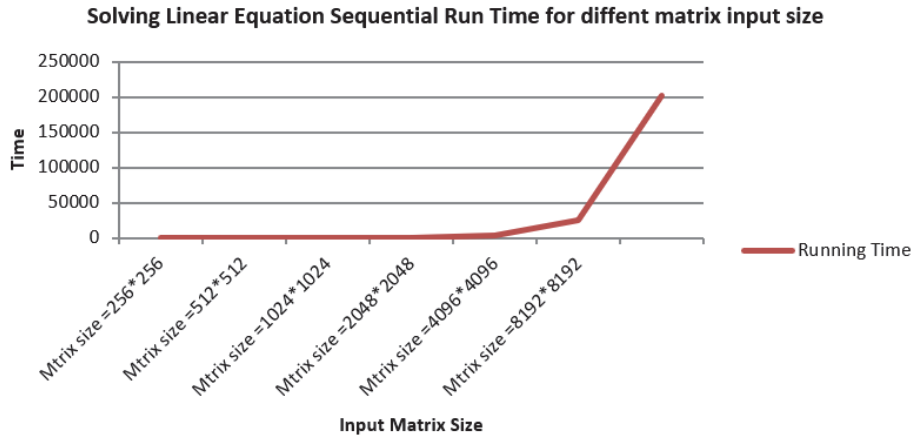

Figure 9. Solving Linear Equation Sequential Run Time for different matrix input size

5.2 Relative Speedup Evaluation

The speedup is the ratio between the sequential time and the parallel time equation 1. the speedup of the implemented algorithm over the different input matrix size and over the different number of processors as shown in figure 10.

Speedup

Relative Speedup = Ts/Tp

Speedup: – p = # of processors – Ts = execution time of the sequential algorithm – Tp = execution time of the parallel algorithm with p processors

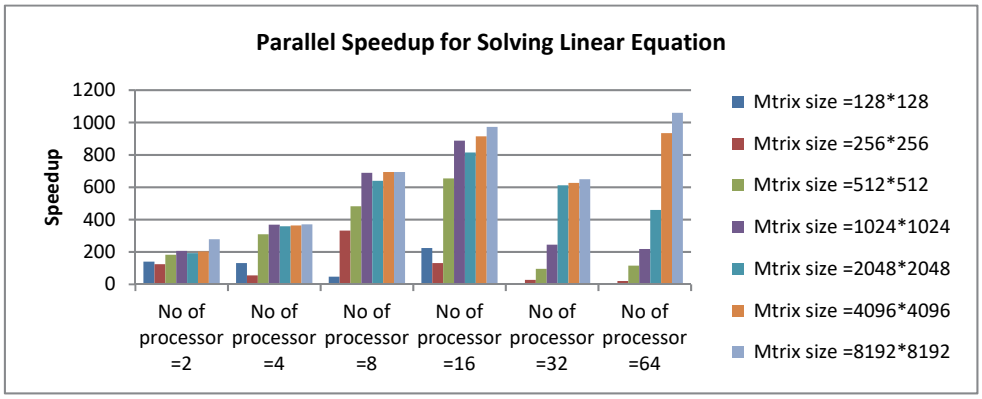

Figure 10. Parallel Speedup for Solving Linear Equation

5.3 Parallel Efficiency Evaluation

Parallel efficiency is the ratio between speedup and the number of processors. the parallel efficiency for the algorithm has been evaluated with different matrix size, the results shown on the figure 11 illustrated that

Efficiency = speedup / number of processors

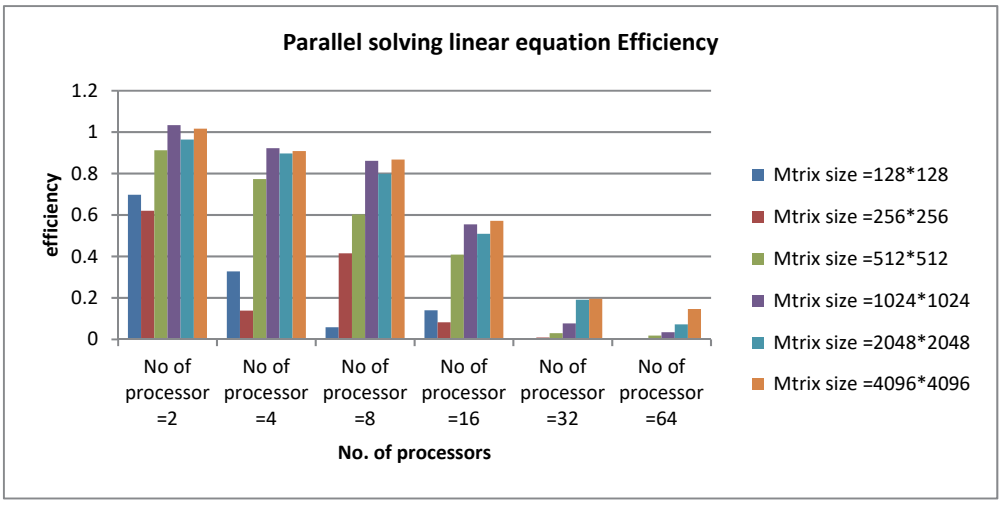

Figure 11. Parallel Efficiency for Solving Linear Equation

6. Conclusion

In this paper we evaluated the performance of solving the linear equation application using parallel and MPI over super computer, and we also evaluated the peformance multithreaded algorithm, we have calculated the pedup and efficiency and the results has shown that the performance of the parallel computing over the large matrix size has outperformed other method with a very high efficiency and small running time. For large input size, the results also showed that there is a noticeable decrease in running time as the number of processors increase

References

Amjad, A. H., Hussam, N. F., Fatima, E. A. A., & Sandi, N. F. (2017). A Survey about Self-Healing Systems (Desktop and Web Application), Scientific Research Publishing

Atif, M., & Rauf, A. (2009, October). Efficient implementation of Gaussian elimination method to recover generator polynomials of convolutional codes. In Emerging Technologies, 2009. ICET 2009. International Conference on (pp. 153-156). IEEE.

Basim, A., Hussam, N. F., & Omar, S. A. (2006). cDNA microarray genome image processing using fixed spot position. *American Journal of Applied Sciences, 3*(2), 1730-1734.

Basim, A., & Hussam, N. F. (2008). Automation of iron difficiency anemia blue and red cell number calculating by intictinal villi tissue slide images enhancing and processing, Computer Science and Information Technology, 2008. ICCSIT'08. International Conference.

Basim, A., Mohammad, H Zu'bi, & Hussam, N. S. (2007). Mammogram breast cancer image detection using image processing functions. *Information Technology Journal, 6*(2), 217-221.

Delić, S., & Jurić, Ž. (2013, May). Some improvements of the gaussian elimination method for solving simultaneous linear equations. In Information & Communication Technology Electronics & Microelectronics (MIPRO), 2013 36th International Convention on (pp. 96-101). IEEE.

Dumas, J. G., & Villard, G. (2001). Computing the rank of large sparse matrices over finite fields. In: CASC'2002 Computer Algebra in Scientific Computing. pp. 22–27. Springer-Verlag.

Dumas, J. G., Gautier, T., Giesbrecht, M., Giorgi, P., Hovinen, B., Kaltofen, E., Saunders, B. D., Turner, W. J., & Villard, G. (2001). LinBox: A Generic Library for ExactLinear Algebra. In: Cohen, A., Gao, X.S., Takayama, N. (eds.) Mathematical Software: ICMS 2002 (Proceedings of the first International Congress of Mathematical Software. pp. 40–50. World Scientific (2002).

Iyengar, S. R. K., & Jain, R. K. (2006). Mathematical Methods, Narosa Publishing House Private. Limited. Retrieved March 1, 2017, from http://www.iman1.jo/iman1/

Kaltofen, E., & Pan, V. (1991, June). Processor efficient parallel solution of linear systems over an abstract field. In Proceedings of the third annual ACM symposium on Parallel algorithms and architectures (pp. 180-191). ACM.

Maria, S., Sheza, N., Sundas, R., Rabea, M., & Rabiya, I. G. (2015). Elimination Method-A Study of

Applications Global Journal of Science Frontier Research: F Mathematics and Decision Sciences, 15(5). Version 1.0 Year 2015 Type: Double Blind Peer Reviewed International Research Journal Publisher: Global Journals Inc. (USA) Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Mohammad, Q., & Khattab, H. (2015). New Routing Algorithm for Hex-Cell Network. *International Journal of Future Generation Communication and Networking, 8*(2), 295-306.

Murthy, K. B., & Murthy, C. S. R. (1994, August). A new Gaussian elimination-based algorithm for parallel solution of linear equations. In TENCON'94. IEEE Region 10's Ninth Annual International Conference. Theme: Frontiers of Computer Technology. Proceedings of 1994 (pp. 82-85). IEEE.

Pasetto, D., & Akhriev, A. (2011, October). A comparative study of parallel sort algorithms. In Proceedings of the ACM international conference companion on Object oriented programming systems languages and applications companion (pp. 203-204). ACM.

Rajalakshmi, K. (2009). Parallel algorithm for solving large system of simultaneous linear equations. *International Journal of Computer Science and Network Security, 9*(7), 276-279.

Rajalakshmi, K. (2009). Proposed a Parallel Algorithm for Solving Large System of Simultaneous Linear Equations

Rizik MH Al-Sayyed, Hussam N Fakhouri, Ali Rodan, Colin Pattinson, 2017 Polar Particle Swarm Algorithm for Solving Cloud Data Migration Optimization Problem. *Modern Applied Science, 11*(8), 98.

Scholl, S., Stumm, C., & Wehn, N. (2013, September). Hardware implementations of Gaussian elimination over GF (2) for channel decoding algorithms. In AFRICON, 2013 (pp. 1-5). IEEE.

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Policy Implementation on the Rice of in Order to Increase Food Stock in Rembang District

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Abstract

Food stock has become a concern of the Government since before the independence days. The Government always seeks to maintain food security so that the community would be sure needs their meal.The development of food security policy since the days of old order up to this time show the concentration of policies that are more or less the same, namely the availability of rice as a staple food. The purpose of this study is to: (1) decsribe and analyze the policy implementation on the rice availability in order to increase food security in Rembang District. (2) Describe and analyze what factors that support and hinder the policy implementation on the rice availability in order to increase food security in Rembang District. (3) Formulate a policy implementation model of rice availability in order to increase food security in Rembang for five years into the future. This research used a qualitative approach and including phenomenological research, with the research instrument of the researchers themselves. Data sources informants specified in purposive sampling, observation and documentation as well as supported by technical discussion. The results of this research indicate in general implementation of the food security policy in particular the rice availability in Rembang has not been implemented to its full potential, as well as the achievement of results. Rice availability policy implementation model proposed, namely: (1) increasing coordination with Regional food security Board optimization of Rembang, (2) Formulating policy areas which are more tangible, a clear change of degree movies, and the support of stakeholders be optimized especially from the head Area, (3) communication is increasingly clear through the medium of a simple but striking. (4) The structure of the organization or the bureaucracy that comes with it's SOP.

Keywords: policy implementation, rice availability, food security, management policy, security and rembang

1. Pendahuluan

Globally, rice is a very important food crop. It is an ancient crop consumed as healthy and staple food by more than half of the world population. Rice is consumed by over 4.8 billion people in 176 countries and is the most important food crop for over 2.89 billion people in Asia, over 40 million people in Africa and over 150.3 million people in America with estimates based on FAO report of 1996. More than 90% of global production occurs in tropical and semi-tropical Asia (Daramola, 2005).

Rice is a staple food for over half of the world's population especially in Asian region. Rice accounts for over 20 percent of global calorie intake (Wailes, 2003). Over 90 percent of the world's rice is produced and consumed in the Asian Region with 6 countries (China, India, Indonesia, Bangladesh, Vietnam and Japan) accounted for 80% in the world's production and consumption. Recently, Asian trend shows the production and export has been increasing but the consumption is decreasing. With growing economic prosperity and urbanization, per capita rice consumption has started to decline in the middle and high-income Asian countries like Japan, Taiwan and the Republic of Korea. But, nearly one-fourth of the Asian population is still poor and has considerable unmet demand for rice such as Afghanistan, North Korea, Nepal and Vietnam. It is in these countries that rice consumption will grow faster. The decreases of rice consumption in Asian region are because of the increases in per capita income that leads income elasticity's of demand for rice as a normal good decreasing as well as westernize in diet.

In ligih of this food security according to Government Regulation no 68 in 2002 about food security are: "The conditions of food to satisfy of the household that is reflected from the availability of foods sufficient, both of

number nor its quality, safe, equitable and affordable". Thus food security is the condition of the food for the correct fulfillment of households and individuals in sufficient amount and quality of a good, safe, affordable, equitable and guaranteed availability. In developing countries such as Pakistan, India and Bangladesh food security policy is focused on the safety and availability of food. In Bangladesh, as stated by the National Strategy for Accelerated Poverty Reduction food policy nationwide.

In Bangladesh, (Mirsha 2010), food security is placed on top priority, alongside the food production in the country. Greater importance that is given to ensure access to sufficient and safe foods is along with everyone all the time to keep active and healthy life. So too in Pakistan food availability policy directed at food availability: i.e. when sufficient amount of food to meet the needs of its inhabitants. The Constitution of Pakistan mentioned in article 38 that the State provides basic necessities including food of its inhabitants.

The two countries is nearly no difference with Indonesia in order to maintain availability and food safety. The problem of food security in both those countries is more or less the same, namely the increase in food production. While in India which has the world's third largest population, food security is quite a concern. National Development Agency of India taking the Mission of food security includes rice, wheat and beans. The Government is trying to increase production of these foodstuffs to third on condition that enough. Conditions in India always pay attention to the availability of the three foodstuffs, namely rice, wheat and beans which became the staple food of the people of India. The Government of India took a policy related to the increased production of rice, wheat and beans are tiered with the primary focus on increasing the production of rice. Thus the Mission of the food security policy has three components.

In Vietnam, Chantal Pohl (2001): "Vietnam's Rice Policy: Recent Reforms and Future Opportunities". In the reform of agricultural policy, to increase productivity, farmers were given various incentives to encourage its productivity, liberated the various types of taxes. For example: taxes land use, irrigation, agricultural machinery import tax. This aims to encourage agricultural productivity.

Similarly, in Thailand, Vikram Nehru (2011): "Thailand's Rice Policy Gets Sticky Thailand's Rice Policy Gets Sticky, "where the Government gives strong support in issuing a policy strategy that will prospect on the farm. One of them through the target expansion of agricultural lands (rice fields) reached 9.2 million hectares.

While in Indonesia the food security has become a concern of the Government since before the independence days. The Government of Indonesia has always strived to maintain food security so that the community would be sure Indonesia needs their necessity. Food security policy developments since the time of old order up to this time show the concentration of policies that are more or less the same, namely the availability of rice as a staple food.

The policy of food security in Indonesia during the old period, Mr. President in that time namely Soekarno take the policy of food security by focusing on the availability and security of the food for the community and especially the civil servants and the military. The policy was taken at that time was the rice self-sufficiency of rice policy program through *Kasimo Plan* (Plan of Kasimo) in 1952 – 1956 rice self-sufficiency program also via sentry of rice program during 1956-1964. (Jonatan Lasa, 2007). The Government of President Sukarno attempted to meet the food needs of Civil Servants and the military as political support, but not so the attention on the community. The price of rice and other foodstuffs could not affordable by the community. Rice in particular is very expensive food for the people (Mears and Moejono, 1981).

Since the beginning of the New Order Regime known as (Orba), food security policy based on the Orthodox paradigm, namely the provision of foodstuff (Food Availability Approach = FAA). The paradigm of the FAA holds that a country's food security is defined by its ability to provide basic food in quantities sufficient for the whole population. The FAA did not pay attention to the aspect of distribution and access to food because this approach assumes that if the food supply is available then the traders will transmit to all areas of the food efficiently and food prices will remain stable in the level can be reached by the whole family (Panjar Simatupang, 2007). National food conditions at the beginning of the new order Government's great concern. The Government at the time it was confirmed that the progress of the country seen from industrial development towards a sophisticated industry will be very dangerous if left agriculture.

The Government of Indonesia in 1996 passed a law on foodstuff, namely Costitutional Laws No. 7 in 1996 about Food. According to the law is defined as a condition where the occurrence of adequacy of food for households that measured from the food necessity in terms of number and quality and also there is a guarantee of top security, equitable and distribution in the ability to buy. The law on the food followed up with government regulations, namely the promulgation of Government Regulation Number 68 year 2002 about food security. The Governmental regulations defining food security is a condition of food to satisfy household food availability are

reflected from hygines, good number of nor quality, secure equitable and affordable. Thus food security is a condition to satisfy with a sufficient amount of food, available at any time in all regions, easily obtained household, safely consumed, and at level an affordable price.

National policy relating to food security includes three aspects: availability, distribution, food diversification and food security. Food security policy is stated in Constitutional Laws No. 12 in 2007 about the National Long-Term Development Plan known as (RPJP N) and Presidential Regulation No.5 in 2010 about National Medium Term Development Plan during 2010 – 2014. This aim for economic development and prosperity, especially in the fields of food, is the creation of self-reliance in the field of food by the end of 2014.It is characterized by increasing people's food security, the improvement of nutritional status of mothers and children in the community that food insecurity, improving access of the poor households to food, preserved and ever-increasing ability self-sufficient in rice and other major food commodities, keep food prices affordable to the lower middle income group society, keeping the exchange rate so that farmers can enjoy prosperity, and increase bargaining power in Indonesia commodities and comparative advantage (comparative advantage) of the Indonesia's agricultural sector in Asia Region and globally. In addition the Affairs of food security also became one of the eleven national priorities within the framework of national development (The National Medium Term Development Plan 2010 – 2014).

One of the results of the Presidential Instruction in Central Java province up to this time (in 2012) is a program of community-based poverty reduction empowerment is one of which is the implementation of a National Community Empowerment Program known as (PNPM) Independent Countryside. This program is one of which the provision of infrastructure in the Village to increase agricultural production, one of which was rice. This activity has been running long enough, and the result is felt has not been optimally felt by the community especially in terms of increased agricultural production, especially rice (Report Description Of Liability abbreviated as LKPJ) the Governor in 2011).

The food security policy of Central Java Province is contained in Long Term Regional Development Plan abbreviated as (RPJPD) document of Central Java province during 2005 – 2025 and Medium-Term Regional Development Plan during 2008 – 2013. In Central Java Province RPJPD 2005 – 2025 about food security policy is directed to: "development of agricultural products, fisheries, marine, forestry and agribusiness system resting on the supported facilities and infrastructure are adequate to ensure the food self-sufficiency and food security".

2. Previous Research

a. Trade Policy and Nigeria Rice Economy

By: Busari Ahmed. O and Idris-Adeniyi K.M, Department of Agricultural Economics and Extension, Osun State University, Osogbo College of Agriculture, Ejigbo Campus, Osun State, Nigeria

Rice is an important crop in the economy of a developing nation like Nigeria. Available statistics have shown that the country is yet to attain self-sufficiency in rice production. Hence, government had to retort to massive importation in order to bridge the supply-demand gap. Rising bills of rice importation over the years have been depleting the country's foreign reserves. This had led to the evolution of three (3) trade policies regime (the pre ban period (1970-1985), the ban period (1986-1995) and post ban period (1997-2010)) by successive government to arrest this trend. This study analyzed the response of domestic production and demand of rice to importation under these policies regime. Secondary data on domestic production, demand and importation of rice from 1970 to 2010 were analyzed with both descriptive and inferential statistical tools. Descriptive analysis results showed that the mean domestic production of rice for pre ban, ban and post ban period were 728.87, 2165.82 and 6293.33metric tons respectively. While the mean domestic demand of rice was 1214.19, 3525.00 and 3931.17 metric tons during the pre-ban, ban period and the post ban period. Analysis of variance (ANOVA) results indicated that there is significant difference in the means of domestic production and demand of rice during these periods. The elasticity coefficients for domestic production and demand for pre and post ban are 0.98, 1.60, -0.15 and 0.14 respectively. The study concluded that government should stimulate expansion of domestic production of rice while phasing out rice importation gradually.

b. The Impact of Rice Production, Consumption and Importation in Nigeria: The Political Economy Perspectives

By: Terwase, Isaac Terungwa; Madu, Abdulrazak Yuguda, Ghazali Shafie Graduate School of Government, College of Law, Government and International Studies, Universiti Utara Malaysia, Sintok, Kedah, Malaysia

Nigeria's population is estimated at 174, 507,539 with the annual growth rate of 2.54%. The country is endowed with enormous mineral and natural resources with vast land adjudged to be the most fertile and suitable for

agriculture. Rice demand and consumption is high among its people irrespective of their region or culture. This paper attempts to investigate the level of the country's production, consumption and importation of rice, with a view to establishing its impact on its economy and development. The methods adopted for obtaining data for the study were purely empirical and secondary. It was found amongst others that; while the level of production of rice is low, the consumption is high and its importation is highly inelastic. It was recommended that, deliberate attempts must be made by government in terms of policy to improve its agricultural base particularly in rice production not only as a substitute for its importation and domestic use, but export as well. This will go a long way in increasing foreign earnings, which can be replicated, and serve to complement the country's economic growth and development.

c. World Rice Demand Towards 2050: Impact of Decreasing Demand of Per Capita Rice Consumption for China and India

By: ALIAS Abdullah, Hajime KOBAYASHI, Ichizen MATSUMURA, Shoichi ITO

Rice is a staple food for over half of the world's population especially in Asian region. Rice accounts for over 20 percent of global calorie intake (Wailes, 2003). Over 90 percent of the world's rice is produced and consumed in the Asian Region with 6 countries (China, India, Indonesia, Bangladesh, Vietnam and Japan) accounted for 80% in the world's production and consumption. Recently, Asian trend shows the production and export has been increasing but the consumption is decreasing. With growing economic prosperity and urbanization, per capita rice consumption has started to decline in the middle and high-income Asian countries like Japan, Taiwan and the Republic of Korea. But, nearly one-fourth of the Asian population is still poor and has considerable unmet demand for rice such as Afghanistan, North Korea, Nepal and Vietnam. It is in these countries that rice consumption will grow faster. The decreases of rice consumption in Asian region are because of the increases in per capita income that leads income elasticity's of demand for rice as a normal good decreasing as well as westernize in diet. The Asian population is growing at 1.8 percent per year at present. Growth in population in this region means the increases on demand for rice (for total consumption but not per capita consumption). So far the annual growth rate for rice consumption in the Asian Region over a period of 48 years (1960 to 2006) has kept pace with the demand, more through yield increase rather than area expansion. Improved varieties have made a significant impact on the demand side in an ever increasing order during this period. The world rice production has more than doubled from 150.8 million tones in 1960 (with Asian production of 134.4 million tones) to 414.7 million tones in 2006 (including the region's production of 364.0 million tones). For almost two decades, from the mid-1960s to the mid-1980s, rice production grew at close to 3% per annum. Slower growth since the mid-1980s has been influenced by both supply and demand factors: sharply lower prices for rice, environmental degradation and over-exploitation of soil and water resources, and a decline in per capita consumption with the rising of household incomes in Asian regions.

d. Efficiency of the Dojima rice futures market in Tokugawa-period Japan

By: Shigeru Wakita; Faculty of Economics, Tokyo Metropolitan University, 1-1 Minami-Osawa, Hachioji-shi, Tokyo, 192-0397 Japan

Co-integration analysis is applied to historical data (1760±1864) from the world's first well-established futures market, in rice at Dojima (in Osaka, Japan). The market shows a strong seasonal character. The summer market was strongly characterized by producers hedging behavior, and may be called a ``commodity-oriented futures market''. On the other hand, the spring and autumn markets in the middle of Tokugawa era were `financial'' markets, characterized by the unbiasedness hypothesis from the theory of rational expectations.

e. The Dojima Rice Market and the Origins of Futures Trading

When Tokugawa Yoshimune became Japan's shogun in 1716, he sought to reform the state's finances. Rice played an important role in his reforms, since it accounted for 90 percent of the government's revenues. The shogun ate also paid the banner men (an important group of samurai who formed the civil and military administrations) fixed amounts of rice each year to secure their support. a Low rice prices in the late 1720s strained the samurai's finances, which had already deteriorated significantly over the previous century. Potentially as a result of several good harvests, the price of rice in 1729 was only 40 percent of what it had been in 1721, and samurai incomes had thus dropped sharply.2 In fact, since 1710 the nominal income of the banner men had fallen by nearly 50 percent, and their real income had also decreased significantly, though less so since other prices had dropped as well. With the development of urban districts, the chonin [merchant/artisan] class gained increasing influence, and the currency economy made so much development as to challenge the supremacy of the land economy. That is to say, a new economic power, viz., the money power of the chonin class, sprang up, besides [sic] the agricultural economic power. Due to this remarkable economic change, it became

impossible for the samurai class to maintain its livelihood under the old economic organization. Nor was it any longer possible for the farmers to support the samurai class. In such circumstances, samurai finally bowed to the new economic power. They either be sought the financial help of chon in or turned chon in themselves. On the other hand, the chon in class gained considerable influence in society by means of its money power.

3. Research Method

The study, “policy implementation on the rice of in order to increase food stock in Rembang District”, is a study that is both specific and holistic. Specifically referred to the subject of research is the bureaucrats (the perpetrators) and the availability of rice fields on the implementer in order to increase food security. Holistic referred to that study in this research not only concerns the socio-economic aspects, but also the public administration. Considering the peculiarities and the subject, the object of the research as well as the nature of the research, then this study using a research approach to qualitative and include the type of phenomenological research. According to Strauss and Corbin (1980), qualitative research is the kind of research that produces inventions that cannot be reached (obtained) by using statistical procedures or by other means and quantification (the measurement).

Strategy approaches or other types of qualitative research used in this study is a naturalistic approach (Lincoin and Guba, 1985; Lee, 1999). Qualitative research according to Strauss and Corbin (2003), is a type of research that produces inventions that cannot be achieved using statistical procedures or with other ways of quantifying (the measurement). Naturalistic research is research that the source of the data retrieved from the situation it is natural (natural setting) or without any manipulation. More researchers are using a method definition (verstehen), as the subject's sense of capture ability/empathetic of informant (emic) which is then ejected back in those thoughts researcher (ethic) about the feelings, motives and thoughts that there is behind the actions of informants.

Through naturalistic approach, researchers can figure out a response and the perception of various backgrounds, such as against the policy actors on the relevant agencies and bodies, the apparatus is on the front-lines bureaucrats involved in the implementation of the policy on the availability of rice in order to increase food security in Rembang District.

To further sharpen the research, then the researcher sets the focus of the research. Focus of the research assignment according to Strauss and Corbin (2007:10) aims to: first, set the focus limits the study of meaning with the focus, determination of research sites that are more feasible. Second, the determination of focus effectively set criteria of inclusions to trawl the information flows in. So necessary because, sometimes, while in the field, Researchers obtained data is pretty good, but if the data retrieved is not relevant to the focus of the research, of course does not mean that data and not noteworthy. How means a focus on research, Moleong (2000) suggested that the focus of the research is very important role in the research that can be used as a means to guide and direct the research. With the direction of the focus of the study, Researchers will be able to know exactly where the data is needed and needs to have the collection.

The research is the qualitative research "it is the determination of the purposive sampling conducted in the informant. Informants were selected to be interviewed are those which, according to the researcher has sufficient information relating to the rice availability in Rembang District. The technique of taking informants was chosen because the information about food security particularly regarding the availability of rice not everyone understands. The source of the data in this study is, the informant; to determine informants in this study considered the background actors, events and processes in accordance with the framework and the formulation of the problem (Miles and Hubermen, 1984; Sugiono, 1993; Moleong, 2000). Since the information from the beginning has been determined (purposive sampling), assuming it has the needed information.

Based on this, then informants in this study was the Informant who are directly involved in the implementation of Government policy in the area of implementation of handling food security particularly regarding the rice availability in Rembang District. Informants were selected in this study was the apparatus or officials have the authority and competence of local government policy in handling the implementation of food security especially concerning the rice availability in Rembang in the field of the rice businessmen, farmers, farmer groups, and provider of pest sprays.

4. Result and Discussion

a. The Process of Rice Availability Policy Assignment

The food security policy stated in government regulation Number 68 in 2002 concerning food security is encapsulated in the situation of reform and the enactment of the new autonomous region runs a little over two

years. Thus the Affairs of food security are a relatively new about 10 years left to the Governments District/City. The process of the determination of the policy at the time wasn't yet fully pay attention to the readiness of the District/City to receive such Affairs. As conditions in the Government Regulation district/city and province has a task as enshrined in articles 13 and 14 this Regulation.

Based on the provisions of article 13 and 14 Government Regulation that the task looks Rembang is not light. The main task in the field of food security was responsible for organizing the food security in this region. Thus Rembang District is responsible regarding food security in its territory, namely by observing some aspect i.e. the availability, distribution, rice affordability, equitable distribution of food, food safety and food diversification. Rembang District Government should be able to afford food availability in particular rice for its inhabitants. Not only provide but rather distribute it throughout all corners of Rembang District at affordable prices by the inhabitants of the poorest. Rembang District Government must also be able to ensure that the food that is consumed the community is safe.

Increased availability of rice policy formulation as defined in Government Regulation No.68 in 2002 in Rembang District is done through the process of planning the construction of a five-yearly and annual development planning. Food security of policy formulation process is done through the process of the preparation of Medium-Term Regional Development Plan known as *RPJMD* and Regional Development Work Plan known as *RKPD*. In the process of preparing RJMD of Rembang during 2010 – 2015 outlined the problems and issues of their respective strategic Affairs, subsequently formulated objectives, strategy, direction and activities policies and programs each affair. Materials used for preparation of RPJMD input comes from Strategic Plan (Renstra) Work Unit (SKPD) Area of the device, which is planning the construction of a five-yearly at the level of the SEGWAY.

In the Medium-Term Regional Development Plan RPJMD of Rembang District load direction development policy as much as 34 Affairs i.e. 26 mandatory Affairs and 8 option Affairs. Food Security Affairs is one of the 26 mandatory affairs. As the stages of preparation of RPJMD, the formulation of policy directions food security begins with the depiction of past performance indicators are close to food security. In accordance with the provisions of Regulation of the Minister of Agriculture abbreviated as *Permentan* 65/Permentan/140/12/2010 Minimum Standards of food security areas of the province and district/city, availability of food reserves in 2015 should be of 60% and availability of energy and protein of 90% in 2015. The condition of availability of food is especially food reserves in preparation of RPJMD depicted in series a few years ago. Based on past performance data related to the availability of food or rice then formulated the strategic issues. Based on the strategic issues formulated goals and objectives and policy directions and programs and activities.

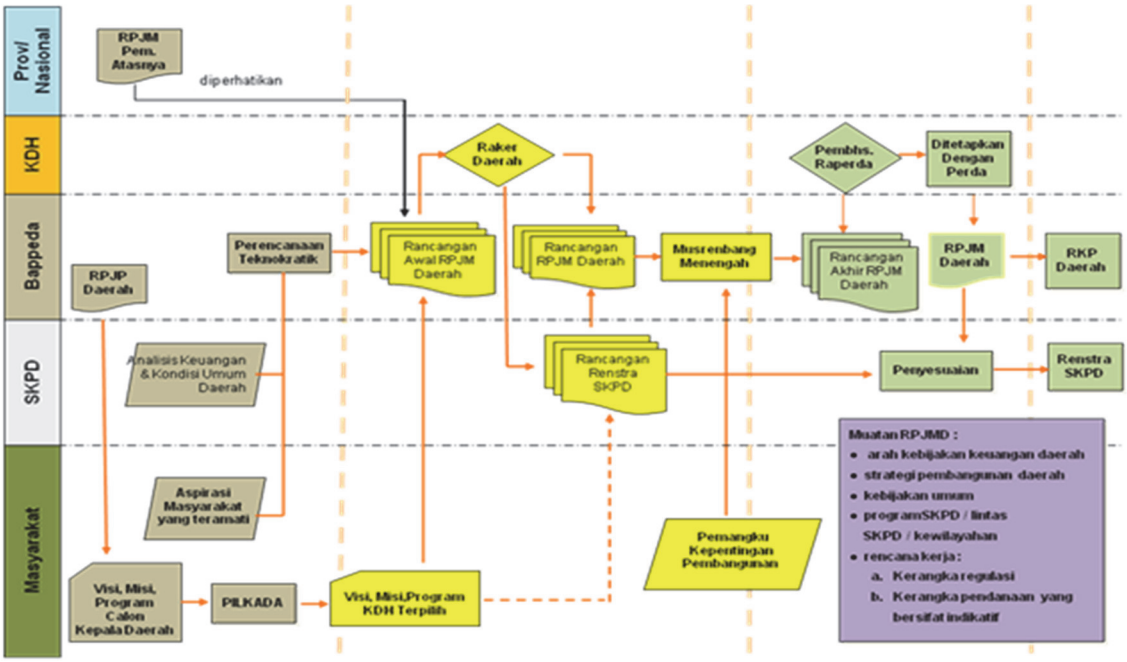

Figure 1. The Arrangement Process of RPJMD

Source: Regulation of the Minister of the Interior 54 in 2010

The diagram above illustrates the preparation process of RPJMD that contain of policy on food security. Thus analogous to the preparation of RPJMD, the food security policy formulation is through participatory processes, technocratic and political. Food security policy formulation in Rembang District is gone through long stages of discussion many times.

Increased availability of rice policy formulation as defined in Government Regulation No.68 in 2002 in Rembang District is done through the process of planning the construction for five-yearly and annual development planning. Food security policy formulation process is done through the process of the preparation of RPJMD and RKPD. In the preparing process of RJMD Rembang during 2010 – 2015 outlined the problems and issues of their respective strategic Affairs, subsequently formulated objectives, strategy, direction and activities policies and programs each affair. Materials used for preparation of RPJMD input comes from Strategic Plan (Renstra) Work Unit (SKPD) Area of the device, which is planning the construction of a five-yearly at the level of the SEGWAY.

Based on the description it can be concluded that the County Government has the perfect follow through Government Regulation No.68 in 2002 about food security. It looks in the preparation of RPJMD containing the Affairs of food security as one of 26 mandatory affairs. Food security policy formulation is loaded together with other affairs policy in document RPJMD strategic issues formulated in the next. Based on the strategic issues formulated goals and objectives and policy directions and programs and activities.

b. Policy Formulation, Program and Activity of Rice Availability

In a development planning process of the formulation of policies, programs and activities are always based on strategic issues or problems. Policies, programs and activities should ideally be used to solve the problems or issues that arise. Likewise than contain in the setting of the program and food security activities in Rembang District.

Formulation of policy directions, programs and activities in the framework of food security especially the rice availability is done together in a coordination meeting called Forum with SEGWAY in order the preparation of RPJMD Rembang District during 2010 – 2015. In the forum formulated the direction of policies, programs and activities to especially food security the availability of rice poured in document RPJMD Rembang. The formulation of policies, programs and activities is the implementation of Government Regulation 68 in 2002 about food security. The direction of policies, programs and activities is a description of what will be achieved and done by Rembang for five years into the future in order to carry out the Affairs of food security especially in maintaining the food availability especially for rice.

This policy direction is in fact the implementation efforts of the Organization of the food security as mandated in Government Regulation No 68 in 2002. Policy implementation of the food security as stated in Government Regulation No 68 in 2002 is implemented in the direction of policies, programs and activities at the local level are listed in the RPJMD and Renstra P4K and Food Security Agency. The area is responsible for the implementation of the food security so that the region must create local policies to implement food security.

Based on the description can be concluded that between a policy that is stated on the RPJMD of Renstra Agency and on food security and food availability policy P4K particularly availability of rice already in line, as a form of implementation of Government Regulation No 68 in 2002, with the aim of seeking the availability of rice through the establishment of policy on food availability and food reserves that meet the quality, quantity for the community as well as the diversification of food products, up to the 2015.

c. The Condition of Rica Availability This Time

The condition of the rice availability reflects the readiness of the region to serve the community in meeting the rice necessity. The condition of availability is the comparison between the production and consumption of rice or the form of the difference between production and consumption in the span of one harvest season or a year. The difference between consumption and production of rice this is the rice availability accounted for the ability of the region to meet the rice necessity for community. The rice availability there is two possibilities that surplus and deficit while conditions of production equals consumption included in the deficit. Conditions of production is equal to deficit areas zoned consumption do not have enough food reserves to meet the needs of its residents or citizens of the society.

Food reserves is very important for a country's food security, including the State of Indonesia is an agrarian. Since 2005, the Government has had the Government's Rice Reserve (CBP) managed by BULOG, blends with the stock of BULOG and accessible in each warehouse BULOG across Indonesia by the Government.

CBP is a number of specific government-owned rice which is the source of the funding comes from the State

Budget and managed by the BULOG which used to cater to the needs of society and rice in order to anticipate the problem of food shortages, pricing turmoil, State of emergency resulting from disasters and food insecurity. The benefits of the existence of the CBP have been tested in the handling of a variety of natural disasters in the country. Rice that has been available in the warehouses BULOG which is fairly spread throughout the homeland can be immediately utilized by provincial governments and district/city Governments for use in meeting food needs for displaced disaster victims.

According to Constitutional Laws No. 7/1996 of the food mentioned that food is a basic human needs be any rights the people of Indonesia. Food is determining the level of the community welfare sector in rural and poor communities/consumers in urban areas. According to Government Regulation No. 68 in 2002, about food security, explained that food security is a condition to satisfy food for households that are reflected from the availability of foods sufficient, good number of nor quality, secure, equitable, and affordable. There are three pillars of food security that must be realized at any time and in any place namely the availability (availability), affordability physically (accessibility), and economic stability & (stability).

Rice is a staple food that is produced by many farmers and consumed by the majority of society Indonesia. Rice is the policy efforts of increasing food security. In the history of rice in Indonesia had never been separated from the role of Government to participate in organizing the national rice economy. This is because the release at all government intervention in national the risks are enormous. The Government has never changed fundamentally national of rice policy objectives being done during these still revolve around maintaining the viability of domestic rice production, protect the rice farmers as well as ensure the sufficiency of rice for the community so they get easy access to physical as well as economically sustainable.

Government intervention in the economy, among other rice done through food served in Governments implement policies that concern both the rice aspects of pre production, production process, as well as post production. The organization food that is given the task of the Government to address the issue of post production, particularly in the areas of pricing, marketing and distribution is the State Logistics Agency (BULOG). Institutions such as BULOG has been around since the days of colonialism, when the Netherlands prior to the occupation of the Netherlands known as VMF, colonial rule Japan known as Sangyobu Nanyo Kohatsu Kaisha, or also at the time of independence that many experience changes since from PMR, BAMA, YUBM, BPUP, Kolognas and BULOG. The duties and functions of the food agencies are generally revolves around the issue of control pricing, distribution and marketing. Only the main focus can differ between time and between these institutions.

BULOG is a government agency established in 1967 which was commissioned by the Government to control price stability and the provision of staple, especially at the level of the consumer. BULOG's role was developed again with producer price plus control through the instrument base price to protect farmers ' rice. In a further development, the role of BULOG is not only limited to rice alone but also on controlling prices and the provision of other commodities such as sugar, wheat flour, soybean and livestock feed, cooking oil, eggs and meats as well as herbs- flavor, which carried out incidental situations especially when the price increases.

Before in 1998, the task given to the BULOG intended to control prices and maintain the stability of the producer price of rice consumers, as well as providing rice stocks between time and an area for the purpose of connecting Government and backup routine for the purposes of emergency or other purposes. Weight control the producer price and consumer price balanced. Starting in 1998, BULOG back only handle rice. The task given to the BULOG also experienced changes due to changing rice policy of the Government does. Protection to farmers through a price floor remains a top priority. As for the stabilization of consumer prices diminished in line with the continued controlling of the domestic rice price. Instead the role of BULOG to help the poor that food insecurity is increasingly prominent.

d. The Policy Analysis Of Rice Availability

The implementation process of existing rice availability policy based on the survey results is beginning from the determination of the rice availability policy. The process of drafting is illustrated the policy assignment issue or agenda setting. The problems that arise with regard to the availability of rice is increasing the rice availability in Rembang until 2015. Surplus rice in Rembang until 2012 is about 57,541 tons. The policy is taken to solve these problems is "provided the food availability and access of society to food quality, nutritious, safe and affordable".

Should the formulation of policy at district level Rembang also must wait for the Council's role as a Regional food security forum of policy makers about food security. In normative Council of greater food security are already formed is supposed to formulate a regional food security policy however until the end of the year 2012 has since formed the Council of food security chaired by Rembang District (former official) yet undertake

activities of any kind. Regent less focus towards greater food security, according to this result is not visible as a monument for governmental, so do not prioritize the Regent food security as one of the program's successful.

The food security policy of Rembang District decided not through the Council for food security, but through the mechanism of the preparation of RPJMD and Renstra SEGWAY leverages the momentum of preparation of RPJMD in early Government Regent. From the analysis above, the proposed process of policy formulation should be. Food security policy formulation included the availability of rice should be based on the results of the Coordination Meeting with the agreement of the Council of food security in the year in question. Furthermore, in the formulation of policies should also be based on the needs of the community are chosen through the Regional Development Planning discussion forum annually.

5. Conclusion and Suggestion

A. Conclusion

Based on the research results obtained findings many obstacles faced in the policy implementation of the food security in particular the of rice availability in Rembang. The process of drafting the policy assignment contain on issue or agenda setting. The problems that arise with regard to the rice availability are increasing the rice availability in Rembang until 2015. Surplus rice in Rembang until 2012 is about 57,541 tons. The policy is taken to solve these problems is "provided the food availability and access of society to food quality, nutritious, safe and affordable". Rice availability policy assignment is done via the process of formulation of RPJMD as contained in Government Regulation 8 in 2008 about guidelines, treatment and evaluation of local development Plans. Determination in PARLIAMENT did not explicitly put forward the Agenda Setting, about food security to resolve problems related to food security but rather caused by the demands of regulations (normative). Rice Availability policy formulated Government Rembang was the implementation of Government Regulation No 68 in 2002 and Government Regulation 83 in 2006. Policy formulation in Rembang District level also must wait for the Council's role as a Regional food security forum of policy makers about food security. In normative Council of greater food security are already formed is supposed to formulate a regional food security policy however until the end of the year 2012 has since formed the Council of food security chaired by Regent Rembang (ex-official) yet undertake activities of any kind. The food security policy of Rembang decided not through the Council for food security, but through the mechanism of the preparation of RPJMD and Renstra SEGWAY leverages the momentum of preparation of RPJMD in early Government Regent.

Based on the results of the research with the informant can be concluded that the rice availability in Rembang in 2012 is relatively sufficient to meet the needs of Community rice in the upcoming 2013 until the next harvest season. Some areas of paddy rice production drape rainwater need to gain attention because during the dry season they threatened shortages of rice. At the time the research was conducted in rice availability conditions experienced surplus 57,541 tons. Analysis of the management to keep the availability of rice in Rembang includes an overview and study how the Government plan, implement and evaluate policies toward maintaining and improving the availability of rice on the Regency Rembang. Description and study of management of rice availability is beginning with planning, organizing, implementing and monitoring and evaluation.

Policy implementation on the availability of rice also performed with collaborating with a group of farmers. The role of the Group of farmers or farmers themselves more on efforts to increase the production of rice.BKP and P4K as the institutions also have a duty to perform agricultural extension to farmers play a role by giving farmers cultivate guidance to farmers on a regular basis and are routine. The role of farmers and farmer groups in maintaining food security especially the availability of rice is seeking so that farmers have food reserves sufficient to meet family needs. Item trader has an important role in maintaining the availability of rice in one region. This is what traders do rice distribution to the community. Traders with his trademark instincts do the selling and distributing rice to the community. Traders also set the selling price of rice in accordance with economic principles by taking a certain profit margin for them. Determination of rice prices is very depending on the market mechanism. This means that the selling price of rice is very depending on the supply and demand of rice in the community. In addition, according to traders in rice prices largely determined by the price at the level of trader which usually have business rice mill. When rice was scarce at the time or not yet harvest season is usually the price at the rate of trader is already high.

Mechanisms of monitoring and evaluation of the rice availability is done periodically or as needed. The period of monitoring and evaluation of the availability of rice on a regular basis is conducted each month by the clerk BKP. Monitoring also performed at a time when the price of rice rose by drastic. Mechanisms of monitoring and evaluation of the availability of rice on the diagram above is too simple regardless of the various perpetrators of other businesses or other stakeholders as well as less Standard Operating Procedures (SOPs).

Policy on the availability of enough rice, secure, good quality and affordable by the community, the benefits of this policy for the community not directly can be enjoyed by the target group. The public is less likely to understand the policy of the availability of the rice, but for farmers benefit directly from this policy had already been felt. Through the policy of increasing the availability of rice of course followed by the increase in rice production, and the Government is facilitating increased production with a variety of programs that touch directly PUAP, among others, farmers SLPTT, Sapta Effort Farmers, planting rows of patterns and so on. The program is directly beneficial to farmers to boost rice production which in turn will increase the income of farmers.

The degree of change expected from policies the availability of enough rice, secure, good quality and affordable by the community is a change in the way the rice farming of the conventional into the pattern Rows; changes to food diversification by not eating rice a day within a year. Changes for society to reduce the consumption of rice society still do not correspond to the expectations because the community particularly farmers don't want to not eat the rice in one day. They provide a reason that these changes be felt heavily. Farmers are not strong in a day do not eat rice.

In the implementation of the policy program improves the availability of enough rice, safe and affordable, one of the implementation done is Increased the food security Office in Rembang became the Agency's food security and Implementing Extension agriculture, plantations and forestry (BKP and P4K); Community involvement is quite good, particularly the Group of farmers as well as ctively involved in food security program; Yet the realization of integration and synergize between stakeholder related, still appeared ego sector and overlap in implementing their task; Yet the realization of integration program between stakeholders with one another; Regulatory support and advice infrastructure are still limited. The resources involved in the implementation of this policy are a resource in its own level of bureaucratic problems in the implementation of the policy of food security. Bureaucracy is the main implementers must be able to move communities to carry out what is expected of the Government through policies that are drafted.

B. Suggestion

Based on the presence of some of the obstacles in the policy implementation of the food security in particular the availability of rice, then researchers recommend a few things as follows:

1. In order for the policy "of non government organizations of sugar" from Central Java Province Government does not conflict with the policy of the availability of the rice, it needs to be disseminated to the Community/farmers so that the farmers in productive paddy fields is not switched on the plant cane.

2. The Council's coordination meeting Scheduled food security the area once each year involving all members/SEGWAY to formulate and plan the program of activities, strategies, and objectives are shared on the basis of the input of the entire Member/SKPD implemented integrated by involving the entire SEGWAY SOPs related to clear so synchronize and aligned in the implementation. This agenda can also be used looking for solutions to the problems of agriculture and infrastructure need to be developed or improved (e.g. means of irrigation agriculture which is the responsibility of the Department of PU Fields of water resources), so integrated can be discussed together to find a solution.

3. Evaluation of the implementation of activities meetings Scheduled every 6 months, and each Member of the Board of the regional food security reported the results of its activities so that it could soon do the anticipation, against obstacles or because of circumstances and conditions must changing the strategy and objectives. This activity also aims to intensify communication between members of the Council of regional food security.

4. With planning, formulation of policies, programs and activities as well as the involvement of a clear human resources, as well as for the improvement of infrastructure and facilities the budget proposals attempted in RAPBD

5. So happens the same understanding and intact socialization and the construction of the present intensively managing apparatus and stakeholders about the program activity policies availability of rice so that it formed a strong commitment to achieve the goal.

6. Required information and communication system development based on IT to improve communication and encourage accelerated expansion of information on the availability of rice policy.

7. Limitations of human resources at the BKP and P4K especially in the areas of availability of Rice as the most competent agencies need immediately plus so BKP and P4K is not overwhelmed in dealing with the large number of problems and implementation activities Rice availability policy.

References

Asmadi, H., & Md Nasrudin Md Akhir (2008). Japan and East Asian Regionalism, Kuala Lumpur: East Asian Studies Department.

Daramola, B. (2005). Government policies and competitiveness of Nigerian rice economy. Paper presented at the workshop on rice policy and food security in Sub- Saharan Africa organized by Africa Rice Centre (WARDA), Cotonou, Republic of Benin, November 7-9, 2005.

International Rice Research Institute (IRRI) (2005). Facts About Cooperation- Bangladesh, Cambodia, China, India, Indonesia, Japan, Korea, Laos, Myanmar, Philippines, Thailand and Vietnam. Retrieved from http://www.irri.org/media/facts/

Lassa, J. (2009), Politik Ketahanan Pangan Indonesia 1950 – 2005, World Food Summit, Journal Ketahanan Pangan.

Lincoln, Y. S., & Egon, G. G. (1985). Naturalistic Inquiry, SAGE Publication, California, New Delhi, London.

Mears, L. (1978). Problems of Supply and Marketing of Food in Indonesia in Repelita III. *BIES, XIV*(3), 52-62.

Miles, B., Mathew, A., & Michael, H. (1992). Analisa Data Kualitatif (terjemahan). Penerbit Universitas Indonesia (Ul-Press). Jakarta.

Mirsha, U. (2010). Current Food Security and Challenges, dalam Food Security in Bangladesh, Papers presented In the National Workshop. 2010.

Moleong, L. (2000). Metode Penelitian Kualitatif, Edisi keempat, Remaja Rosda Karya, Bandung.

Sitmatupang, P. (1999). Toward Sustainable Food Security: The Need for A New Paradigm in Simatupang, P. et a/- (edisi Indonesia's Economic Crisis: Effects on Agriculture and Policy Responses. 1999. Centre for International Economic Studies. University of Adelaide 5005 Australia.

The Dojima Rice Market and the Origins of Futures Trading. Retrieved from https://edisciplinas.usp.br/pluginfile.php/151297/mod_resource/content/2/Dojima_Rice_Market_Case.pdf

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The Extent of Practicing Social Interaction Skills by Jordanian Elementary School Students in accordance with Carl Orff's Approach to Music Education

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Abstract

The present study aimed at identifying the extent of practicing social interaction skills by Jordanian elementary school students in accordance with Carl Orff's approach to music education. The study's population consists from all the male and female music teachers who teach at primary levels in public and private Jordanian schools (i.e. 350 female and male teachers). In order to collect the required data, the researchers developed a questionnaire that consists from 50 statements.

It was concluded that the level of practicing the social interaction skills by Jordanian elementary school students is low from the perspective of the sampled teachers. That is because the total arithmetic mean is 1.80. As for the total standard deviation, it is 0.71. In addition, the means of all the questionnaire statements are within the moderate and low levels. In the light of the study's results, the researchers recommend the following:

1. Promoting the role of the music education at private and public schools. The researchers also recommend providing all the necessary means and instruments for facilitating and improving the educational process
2. Holding more training courses for teachers regularly by the ministry of education about the music education strategies and methods.

Keywords: social interaction skills, Jordanian elementary school students

1. Introduction

The educational process aims at achieving social integration through turning human beings from biological beings into social beings. They are turned so through promoting interaction between them and the elements of the environment surrounding them. Based on the aforementioned, social interaction has become one of the pillars of the development and formation of the social characteristics of one's personality. In addition, social interaction is also considered a fundamental mean for learning and coping. It is also a fundamental tool for organizing societies and communities and passing their cultures from one generation to another (Naser, 2004).

It should be noted that all school subjects participate in achieving these goals and functions. One of those subjects is the music subject which contributes as much as the other subjects in achieving these goals and functions. For instance, musical education participates in developing the learner's personality through unleashing his potentials and fulfilling his latent needs that are associated with the development stage he is going through. According to psychology, one's personality consists from permanent physical and psychological tendencies that distinguish one from others. One's personality also consists from several components that concern physical, mental, emotive and social aspects. These components are not separate from one another. In fact, they interact with one another and complement and affect each other. In other words, the structure of one's personality is considered complex and involve a variety of aspects and characteristics. Thus, music education should focus on all the personality's aspects without excluding any, rather than focusing on one aspect only.

It should be noted that using the appropriate music educational methods shall participate in developing one's

personality fully in all its aspects. That shall enable one to cope with his social and physical environments and achieve harmony between one's self and these environments (Sadeq, 2007).

Music education involves various activities that can participate in developing one physically. For instance, it participate in developing one's hearing sense. That is achieved through training one to distinguish between different auditory stimuli and describe them. Such stimuli may include the sounds of the surrounding nature. As for their description, it may involve their pitch, thickness, duration and aspects of similarities and differences with other sounds.

Music education improves motor coordination and muscle synergies leading to achieve physical coordination. Such education also makes the learners acquire several motor skills that have mental and social aspects. However, the physical and muscular aspects dominate these skills. One can acquire such skills when practicing music activities, such as: singing, doing rhythmic exercises, and playing musical instruments (Al-Wahsh, 2014).

From an emotive perspective, efficient music education participates in developing positive artistic inclinations that play a significant role in improving the learner's behavior. Such inclinations improve one's ability to control his various emotional responses and reduce stress and anxiety levels leading to achieve a balance. These inclinations also stimulate positive emotional responses, such as: joy, delight and sympathy. That shall lead in turn to increase the learner's motivation to express himself (Ezz, 2011).

From a social perspective, practicing group music education activities shall increase the learner's social maturity and awareness. It shall encourage the formation of social groups that share common goals and orientations. It shall also promote a sense of initiative and responsibility within the learner when performing his musical role. Practicing such activities shall make the learners acquire social behavior patterns related to the human relationships existing between the group members. Such patterns may include: respect, cooperation, understanding, commitment, and self-control. Acquiring these patterns shall increase the learner's social discipline. Furthermore, music education plays a significant social role represented in passing the cultural heritage and the aesthetic aspects of the society from one generation to another. That shall be positively reflected on the social interaction between the members of the music group (Sadeq, 2007).

One of the contemporary and modern approaches to music educationist Carl Orff's approach. Through the latter approach, Orff provides philosophical ideas that participated in setting the music education foundations. The latter composer believes that music is the closest kind of art to the child and the thing that the child loves the most. He also believes that music is the thing that influence the child the most. That is because it is the mean that the child uses to express himself freely without constrains (Al-Hares, 2010).

Orff's music education ideas emphasizes the principle of (learning through playing). Applying this principle shall turn children's non-structured playing and singing into structured ones that have specific goals. Such goals may include stimulating their imagination, improving their areas of creativity and making use of their latent movement energy in an early age. Orff's music education ideas focus much on popular folk songs, children's songs, tales, stories, and games involving rhythmic exercises. All of these are connected to the child's social environment and needs.

One of the pillars of Carl Orff's approach to music education is represented in engaging the child in music experiences on the sensual and practical levels in a non-structured manner before making these experiences governed by rules and theories. That is similar to the process of learning how to read and write. For instance, at the beginning, the child learns the alphabets, then he identifies the theory by himself through deductive reasoning under his teacher's directions. That is implemented to avoid making the educational process a boring and dull process. Adopting this method shall develop the child's self-expression skills, self-efficacy, and self-awareness leading to improve his social competence, including the social interaction skills (Al-Lou, 2008).

The concept (self-expression) refers to a group of procedures through which people can express their rights, desires, inclinations, and attitudes or their opinions and feelings without violating the rights of others. It is also defined as the process that one carries out to develop his self-trust and establish relationships with others and the ability to maintain these relationships and make new ones. As for self-efficacy, it is defined as being one's belief of being capable to perform a specific task. Social skills are developed through allowing new relationships to develop, provided that such relationships involve interaction with a group of people (Yun and Kim, 2013).

School is a significant educational institution that complements the family's role. The child spends most of his time at it and it affects the formation and development of all his personality's aspects. It also affects his habits, activities, behaviors on the physical, psychological, mental, social, affective and congenital levels. If the school's educational environment is appropriate, it shall positively affect the students. It should be noted that all school

subjects – including music - participate in developing all the aspects of the student's personality. Thus, the music subject must be provided with adequate attention to promote its role in way that shall be reflected positively on the students' personality and the whole society.

Eric (2002) aimed at reviewing the studies that concern the relationship between music and emotive intelligence (EI). The latter researcher adopted the descriptive approach. He concluded that music has a positive impact on the functions of the brain cells responsible for emotive intelligence and mood. He also concluded that music increases motivation, and enhances one's cultural and artistic awareness. It can also improve one's awareness about aesthetics related matters. It was concluded that music can develop one's self-awareness skills and enable one to achieve self-realization and understand other people's feelings. Thus, music can enhance one's ability to integrate socially within the group and the surrounding community. It was concluded that it shall positively affect the development of one's emotional and social intelligence

Long et al. (2013) aimed at testing Carl Orff's approach among the primary school students enrolled in the public and private schools at the state of Illinois at the United States of America (USA). Their sample consists from 46 female and male students who were chosen from Marshall Primary School from two different grades. To be specific, 21female and male third grade students were taught in groups through using Orff's approach and performing music activities. They were divided into 4 groups and asked to perform each activity in turn. In addition, the latter researchers selected 25 female and male sixth grade students and the second lesson was illustrated to them. That was done through adopting the same procedures that were adopted when teaching the third grade students. The teacher illustrated to the students the practices they should perform while singing with music. Such practices include using body language. The latter researchers observed the way students learn when engaging them in music activities that are based on Orff's approach. The study was conducted with the cooperation of female and male teachers working at the school. In addition, lessons were recorded through using a camera video in order to record the observed data on papers and analyze them later. A questionnaire was also developed. The questionnaire forms were distributed to students after the experiment was finished. It was concluded that students responded positively to the music activities that are designed through Orff's approach.

Yun and Kim et al. (2013) aimed at identifying the effectiveness of Orff's approach in improving the self-expression, and social skills, and self-efficacy of the children who belong to families of low income in South Korea. That was done through adopting the experimental approach. The population of the latter study consists from all the children who belong to families of low income in South Korea. The latter researchers selected a random sample that consists from 43 children. These children belong to families whose monthly income is below average in South Korea according to their social security law. The experimental group was taught through using the Orff's approach, whereas the control group was taught through using the traditional method. It was concluded that the self-expression, and social skills, and self-efficacy levels were significantly improved among the members of the experimental group in comparison to the control group. It was concluded that it is necessary to apply Orff's approach to develop the emotional, and physiological aspect of the personality among the children who suffer from poverty. It was also concluded that it is necessary to useOrff's approach instead of the traditional methods. That is because Orff's approach is appropriate and takes into consideration the developmental needs of children on the biological, psychological, and physiological levels.

Jasem (2013) aimed at identifying the impact of a music-based training program on the development off avorable social behaviors among the nursery children. The purposive sample of the latter study consists from 200 female and male nursery children. They were selected from various nurseries that are affiliated with Baghdad directorates of education at Iraq.The sample was divided into two groups; a female group and a male group. The female group consists from 100 children and the male group consists from 100 children. She conducted the study through adopting the experimental approach. She used a social behavior scale. 24 female and male children received low scores. After that, they were divided into control and experimental groups. Each group includes 12 children. A test was conducted to identify how equivalent their levels are. Then, a training program was developed. This program includes a variety of music activities. This program was applied to the members of the experimental group. The pre-test and post-test forms were distributed to the sample. It was concluded that there are statistically significant differences between the post-test scores of the experimental and control groups for the favor of the experimental group and attributed to the music-based training program.

Webster (2015) aimed at identifying the impact of teaching music on the academic, social and emotional outcome of students from the perspective of secondary school students and their parents. The sample was selected from the schools and institutes that are affiliated with the directorates of education at Texas State. The sample was selected in way that represents the study's population. The study was conducted in cooperation with the Texas Music Educators Association (TMEA). The sample consists from 15 male and female individuals who

are students and parents. To be more specific, the sample consists from 4 male students, and 4 female students who are secondary school students. The sample also includes 7 mothers and 2 fathers. The respondents were examined through the magnetic resonance imaging (MRI) method to measure the activity of their brain cells. That was conducted to identify all the variable that might affect blood flow speed. In order to check the reliability of the overall student's academic score, IQ scores were measured.

Non-verbal Raven's progressive matrices (RPM) test was conducted to measure the advanced progressive matrices among the learners. This test is widely used because it suits children of all ages. In addition, the Torrance test of creative thinking (TTCT) and face to face interviews were conducted. Through these interviews, the researcher asked the sample close ended questions that involve academic, social and emotional areas. In addition, the interviews were recorded through audio records. These records include the respondents' answers to the questions that involve the academic, social and emotional areas. The collected data was recorded on papers and analyzed. It was concluded that participants confirmed that engaging in a variety of music education activities and experiences has a significant positive impact on academic outcomes, or results. Such academic outcomes involve: (neuro plasticity, behavioral changes, thinking patterns, remembering, problem solving, decision making, and decoding). It was also concluded that engaging in such activities and experiences has a significant positive impact on social outcomes. Such social outcomes involve: self-expression, self-confidence, communication, leadership skills, and accepting and recognizing others. Such social outcomes also involve participation, interaction and mutual trust among the group member. It was also concluded that engaging in such activities and experiences has a significant positive impact on emotional and affective outcomes, such as: mental health stability, empathy, fulfillment of one's needs and unleashing one's potentials. The latter outcomes also involve caring about others' feelings and appreciating one's feelings by one's self.

Based on the aforementioned studies, it can be concluded that researchers are concerned with investigating the actual music education practices carried by teachers and students. That is done to achieve a deeper understanding that shall enable these researchers to suggest appropriate solutions for the problems faced in the music education process. That is done in the aim of promoting the role of music education. The aforementioned studies provide a review for the relevant theoretical studies that cover various areas and aspects. The results of these studies vary due to the variation between them in terms of variables, samples, programs, objectives, circumstances, spatial dimensions and environments. The researchers of the present study provide a review for the aforementioned studies to develop and support the theoretical framework of the present study.

2. Statement of the Problem

After reviewing the relevant literature, the researchers noticed some shortcomings in the content of the music curriculum. They also noticed shortcomings in the instruments, resources, means and methods used in the music education process. These elements are used in the music educational process and environment. They aim at enhancing the learner's social interaction skills leading to establish effective social relationships that enable one to cope with the surrounding environment and get along with others. The researchers were able to identify these shortcoming due to the academic experience they possess. In addition, such shortcomings were identified because one of the researchers is specialized in playing Orff's music instruments.

The problem of the present study is represented in the following question:

(What is the extent of practicing the social interaction skills by Jordanian elementary school students in accordance with Carl Orff's approach to music education?)

2.1 The Study's Objectives

The present study aimed at identifying the extent of practicing the social interaction skills by Jordanian elementary school students in accordance with Carl Orff's approach to music education

2.2 The Study's Significance

The study's significance is represented in seeking to identify the role of music education in developing the social interaction skills of elementary school students in accordance with Carl Orff's approach to music education. The researchers chose this approach because it is considered as a comprehensive educational philosophy that might affect the social, physical, affective, and mental aspects of the learner's personality

3. Definition of Terms

3.1 Social Interaction Processes

They refer to the processes through which people communicate with each other mentally, emotionally, socially, culturally, physically, and spiritually leading to make each party satisfied about the other's behavior under

general behavioral framework accepted by the group(Naser, 2004).

The procedural definition: They refer to the skills developed through allowing new relationships to develop with a group of members through specific music activities performed in music classes. Carrying out these processes requires having an understanding for several social value and standards. It also requires having awareness about the significance of participating in social activities to maintain these relationships stable and balanced

3.2 Carl Orff's Approach

It is an approach used for teaching children music. It depends much on singing, playing music, improvising, and moving (Yun and Kim, 2013).

4. The Study's Limitations

1- Thematic limits: The present study is limited to identifying the extent of practicing social interaction skills by Jordanian elementary school students in accordance with Carl Orff's approach to music education

2- Human limits: The present study is limited to all the male and female music teachers who teach at primary levels in public and private Jordanian schools

3- Spatial limit: The present study is limited to public and private Jordanian schools that are affiliated with directorates of education located at the northern, central, and southern regions of Jordan, provided that these schools include music teachers who teach at primary levels

4- Temporal dimension: The present study was conducted during the first semester of the academic year 2017 / 2018

4.1 The Study Methodology

In order to fulfill the study's objectives, the researchers adopted the descriptive approach.

4.2 The Study Population

The study's population consists from all the male and female music teachers who were teaching at primary levels in public and private Jordanian schools during the year 2017 / 2018. According to the statistics of the Jordanian ministry of education, the study's population consists from 350 female and male teachers.

4.3 The Study tool

The researchers developed the study's questionnaire after reviewing the relevant previous studies. Such studies include: the studies conducted by Abu Ayash (2014), Yun and Kim (2013) and Jasem (2013). The study's questionnaire consists from one part that adopts the five point Likert scale. It aimed at exploring the actual practices of the social interaction skills by Jordanian elementary school students from the perspective of male and female music teachers who work at public and private Jordanian schools

4.4 The Tool Validity

In order to measure the content validity of the study's instrument, the researchers passed the instrument in its initial form to 15 experts to provide their comments. These experts are component university professors working at Jordanian universities and possess adequate experience. All of their comments were taken into consideration

4.5 The Tool Reliability

In order to measure the instrument's reliability, the researchers measured the internal consistency of each item of the questionnaire's items which are50 items. That was done through calculating the values of Cronbach's alpha coefficient for each item. The total value of Cronbach's alpha coefficient is 0.95.

5. Results and Discussion

The study question is the following: What is the extent of practicing social interaction skills by Jordanian elementary school students from the perspective of female and male music teachers?

In order to provide an answer to this question, the researchers calculated the arithmetic means and standard deviations for the respondents' attitudes towards the extent of practicing the social interaction skills by Jordanian elementary school students. Table (1) below presents these arithmetic means and standard deviations.

Table 1. The arithmetic means and standard deviations for the respondents' attitudes towards the extent of practicing the social interaction skills by Jordanian elementary school students in the descending order

Rank	No.	Statement	Arithmetic means	Standard deviations	Level
1	33	There is mutual respect among students while they are performing their tasks that are part of the music activity	2.69	0.782	Moderate
2	49	Students perform activities that involve popular folk music	2.68	0.677	Moderate
3	11	Students perform physical movements in a way that is in agreement with the music	2.65	0.774	Moderate
4	20	Students perform simple music patterns that are based on repetition	2.61	0.901	Moderate
5	28	Students recognize their roles easily when performing different group music activities	2.52	0.738	Moderate
6	12	The organized physical movements help students to (think and act) in the same intended manner. That shall increase the effectiveness of the social relationships between them	2.50	0.789	Moderate
7	34	Mutual influence between students shall ensure the continuation of forming music groups	2.46	0.773	Moderate
8	50	Folk music activities promote interaction between the students and their culture because such activities represent one of the cultural elements	2.44	0.751	Moderate
9	21	The repetition method in the music education process promotes the application of the participatory approach among the member group	2.43	0.892	Moderate
10	30	Recognizing and predicting one's role by one's self shall make the group balanced	2.36	0.761	Moderate
11	29	Students predict their roles easily while performing different group music activities	2.22	0.822	Low
12	3	Students practice music activities that unleash their own potentials	2.14	0.885	Low
13	5	Students practice music activities that simulate their social environment which increase their social interaction	2.12	0.845	Low
14	9	Students use their bodies as a percussion instrument while performing different kinds of music activities	2.09	0.731	Low
15	10	Physical movement encourages one to express his ideas and feelings which promote his social interaction with each other	1.99	0.795	Low
16	45	Students sing songs that have a rhythm and deliver social ideas and values	1.96	0.782	Low
16	43	Through the music education process, students act in a cooperative context	1.96	0.937	Low
18	4	Providing students' potentials with attention shall participate in unleashing these potentials	1.93	0.966	Low
19	35	Students sing songs of simple words that simulate their environments which makes it easy for them to memorize	1.92	0.834	Low
20	6	Through social interaction, the students learn the social standards that should govern his behavioral patterns and comply with them	1.85	0.930	Low
21	16	Students practice music activities that are in agreement with their developmental characteristics	1.79	0.917	Low
22	1	Students express their music-related orientations freely	1.74	0.948	Low
23	46	The songs that have a rhythm and carry social aspects participate in increasing students' social discipline. That is because such songs are considered one of the socialization methods	1.73	0.877	Low
24	13	Students perform expressive physical gestures, while listening to systematic audio configuration	1.69	0.805	Low
24	44	The integration of the music activities shall promote the application of a participatory approach among the group members in relation to the division and distribution of roles	1.69	0.975	Low

Rank	No.	Statement	Arithmetic means	Standard deviations	Level
26	36	Performing songs of simple words participates in promoting the development of all the personality's aspects. That is because such songs are considered learning models	1.66	0.884	Low
26	2	Providing students' music-related orientations with attention shall participate in unleashing the potentials of those students	1.66	0.928	Low
28	15	The systematic sound effects facilitate the performance of the music role and engaging in it	1.64	0.901	Low
29	17	Providing the students 'developmental characteristics with attention shall promote the effective application of the participatory approach among them	1.62	0.917	Low
30	14	The systematic sound effects participate in fulfilling the students' (psychological and social) needs	1.61	0.853	Low
31	7	Students practice group music activities that are based on the principle of organized play	1.51	0.809	Low
32	39	Students apply the flexibility principle while learning music through responding effectively	1.49	0.873	Low
33	8	Organized playing participates in promoting a social responsibility sense among students	1.47	0.864	Low
34	25	Practicing creative dramatics activities that represent the plot of a story lying within the rhythm-based song – shall promote interaction between the students and their culture. That is because practicing such activities shall make students simulate group of social values that are dominant within the society	1.45	0.863	Low
34	40	The flexibility-based music education participates in developing the self-expression skills	1.45	0.845	Low
36	27	Using simple percussion instruments shall participate in promoting interaction between the students from one hand and the audio configuration and its hidden messages from another hand	1.42	1.129	Low
36	23	The music activities that involve rhythm-based song carrying a story within participate in increasing students' motivation to learn	1.42	0.847	Low
38	22	Students practice music activities that are based on story telling	1.41	0.794	Low
39	41	Students learn music through perception-based experiences which increases their interaction	1.40	0.872	Low
40	24	Students practice creative dramatics activities representing the plot of the story lying within the rhythm-based song	1.39	0.801	Low
40	32	Creativity-based education participates in increasing one's self-esteem	1.39	0.861	Low
42	42	Learning through perception-based experiences shall develop students' capabilities to produce sounds, and configure them in a systematic manner	1.38	0.856	Low
42	18	Students practice music education activities that are based on the simulation principle	1.38	0.800	Low
44	31	Students use their creative imagination in music activities which promotes their interaction	1.36	0.782	Low
44	26	Students use simple tuned and unturned percussion instruments to simulate the plot of the story lying within the rhythm-based song	1.36	0.848	Low
46	19	The application of the simulation principle promotes the interaction between the students and their teacher which in turn promotes the implementation of the dialogue style	1.33	0.820	Low
47	37	Students apply the creative play principle while performing music activities which promotes their movement-based interaction	1.32	0.758	Low
48	47	Students are engaged in discovery-based learning activities which increases their interaction	1.31	0.847	Low
49	48	The discovery-based learning participates in enhancing the	1.28	0.818	Low

Rank	No.	Statement	Arithmetic means	Standard deviations	Level
		educational process			
50	38	The movement-based interaction participates in stimulating creativity leading students to improvise and discover things	1.27	0.735	Low
		Total	1. 8025	0.71065	Low

Based on table (1), it can be concluded that the overall level of practicing the social interaction skills by Jordanian elementary school students is low because the total mean is 1.80. As for the total standard deviation, it is 0.71. The means of all the questionnaire statements are within the moderate and low levels. That can be attributed to the fact that music teachers face challenges and difficulties in the music education process. Such challenges and difficulties hinder those teachers from applying the educational strategies that fulfill the students' psychological, motor, mental, and social needs. Thus, that shall prevent the teachers from dealing with the social changes and fulfilling the modern-day requirements

The researchers present below a discussion for the statements that show the highest five means and the lowest five means:

Statement (33) shows a moderate mean of 2.69 which is ranked first. As for its standard deviation, it is 0.78. The latter statement states the following: (There is mutual respect among students while they are performing their tasks that are part of the music activity). Such results is attributed to the fact that the nature of the performed music activities. This nature does not allow students to choose their music roles by themselves as they desire. For instance, students usually perform a specific task jointly under their teacher's directions. Thus, hat shall hinder the effective application of a participatory approach among the group members. In such a case, a mutual respect among students would appear to exist, but it is false. Such false respect is derived from adhering to their teacher's directions in the aim of achieving the best possible performance.

Statement (49) shows a moderate mean of 2.68 which is ranked second. As for its standard deviation, it is 0.68. The latter statement states the following: (Students perform activities that involve popular folk music). Such results is attributed to the fact that students participate only in the music activities that are organized by the school in coordination with the ministry of education only. These activities are limited to competitions, and celebration of official events which require performing popular music activities. However, the latter music activities are not practiced as being educational models that are based on specific pedagogical foundations.

Statement (11) shows a moderate mean of 2.65 which is ranked third. As for its standard deviation, it is 0.77. The latter statement states the following: (Students perform physical movements in a way that is in agreement with the music). This results is attributed to the students' low competency in understanding the rhythm. That can be attributed to the fact that students are not provided with opportunities to use their bodies as a percussion instrument through performing some physical movements while learning music. However, performing such movements shall promote their sense of rhythm. Them movements they often perform are limited to clapping at the beginning of some musical phrases of some specific music activities for enriching these music activities, rather than representing a rhythm.

Statement (20) shows a moderate mean of 2.61 which is ranked fourth. As for its standard deviation, it is 0.901. The latter statement states the following: (Students perform simple music patterns that are based on repetition). This results is attributed to the fact that music teachers do not use the appropriate music educational methods that are based on repetition due to the non-availability of the required resources. Thus, that force these teachers to simplify, and divide the music information and patterns they want to teach and present them gradually through using various techniques.

Statement (28) shows a moderate mean of 2.52 which is ranked fourth. As for its standard deviation, it is 0.738. The latter statement states the following: (Students recognize their roles easily when performing different group music activities). This results is attributed to the lack of diversity in the music activities that students perform. Such lack of diversity shall prevent the division and distribution of roles among students in accordance with their potential and inclinations. For instance, when music activities are limited to group singing, there won't be motivated to learn and respond effectively while performing music activities

Statement (26) shows a low mean of 1.36 which rank is 45. As for its standard deviation, it is 0.848. The latter statement states the following: (Students use simple tuned and unturned percussion instruments to simulate the plot of the story lying within the rhythm-based song).This results is attributed to the lack or scarcity of the

simple percussion instruments. This result can be also attributed to the lack of experience among the music teachers in using the appropriate methods for directing students in using these instruments, in case they are available. This result can be also attributed to the absence of an appropriate educational environment for practicing such kind of activities within the classroom.

Statement (19) shows a low mean of 1.33 which rank is 16. As for its standard deviation, it is 0.820. The latter statement states the following: (The application of the simulation principle promotes the interaction between the students and their teacher which in turn promotes the implementation of the dialogue style). This results is attributed to the fact that students face difficulties in simulating their teacher's music performance when illustrating music idea to them. That is because these ideas are difficult to be understood and inconsistent with their environment, potentials and perception level. This results can be attributed to the non-availability of the required simple music instruments that allow students to perform simulation activities easily. That shall hinder the interaction between the students and their teacher which shall prevent any creative-based conversation that involves pleasure and thrill.

Statement (37) shows a low mean of 1.32 which rank is 47. As for its standard deviation, it is 0.758. The latter statement states the following: (Students apply the creative play principle while performing music activities which promotes their movement-based interaction). That is because students' roles are limited to performing formal music activities that don't require flexibility and often require one individual. Such role are performed though using musical instruments made for formal music. This result can be also attributed to the fact that students are not provided with opportunities to practice music activities that are based on the creative play principle. That is attributed to then on-availability of the musical instruments that suit the activities based on the creative play principle. Such music activities may include songs of simple words that deal with a subject related to their surrounding environment to make it easy to memorize. Such music activities may also include dancing melodies that encourage students to move. These activities may also include easy rhythm. This result can be also attributed to the non-availability of the appropriate musical instruments, and necessary means, instruments and resources within the school. It can be also attributed to the inappropriateness of the environment and using inappropriate educational methods and approaches by the music teachers

Statement (47) shows a low mean of 1.31 which rank is 48. As for its standard deviation, it is 0.847. The latter statement states the following: (Students are engaged in discovery-based learning activities which increases their interaction). That is because students learn music rules and the way of playing musical instruments through the traditional method which depends on their own personal efforts outside the school. In addition, music teachers usually train students how to perform specific music activities for fun rather than tutoring them. That shall eliminate the interaction between the students and their teacher which stems out from the discovery-based activities

Statement (48) shows a low mean of 1.28 which rank is 49. As for its standard deviation, it is 0.818. The latter statement states the following: (The discovery-based learning participates in enhancing the educational process). This result is attributed to the nature of the performed music activities. This nature does not provide students with opportunities to discover. To illustrate more, the music activities they perform often carry a formal nature which makes it difficult for students to improvise through composing their own simple music. However, it should be noted that such improvisation shall make students acquire social and personal skills

Statement (38) shows a low mean of 1.27 which rank is 50. As for its standard deviation, it is 0.735. The latter statement states the following: (The movement-based interaction participates in stimulating creativity leading students to improvise and discover things). That is attributed to the limited number of movements performed by students while performing music activities. Such limited number is attributed to the absence of motivation which should drive students to respond and interact with each other through moving and playing. The absence of this motivation shall deprive students from the opportunities to use their creative imagination in the learning process within an education environment governed by the principles of improvisation and flexibility

6. Recommendations

In the light of the aforementioned result, the researchers of the present study recommend the following

1) Promoting the role of the music education at private and public schools. The researchers also recommend providing all the necessary means and instruments for facilitating and improving the educational process
2) Holding more training courses for teachers regularly by the ministry of education about the music education strategies and methods

3) Conducting more studies in the future about the implementation of global approaches to music education- such as: Kodaly approach - in the aim of developing students' social interaction skills.

References

Al-Hares, M. (2010). The effectiveness of a children singing program based on Carl Orff's approach on the development of emotional intelligence among a Jordanian sample, Unpublished PhD dissertation, The University of Jordan, Amman, Jordan.

Al-Lou, N. (2008). The most significant approaches to music education in the world (Episode 3). *The Journal of Music Life, Damascus, 48*, 209-228.

Al-Wahsh, M. (2014). The impact of music, drama, and structured playing in education, Amman, Dejla publishing and distribution house.

Eric, J. (2002). *What research tells us about the brain Music Connection?* Retrieved March 4, 2017, from http://www.edinak12m.hus/Lightants/Classes arise/Music20%research.htm

Ezz, M. (2011). Art, music, and drama in children education, Amman, Al-Nahda publishing house.

Jasem, W. (2013). The impact of a music training program on the development of favorable social behaviors among the nursery children. *The Educational Sciences Journal, Iraq*(97), 300- 397.

Long, A. (2013). Involve Me: Using the Orff Approach within the Elementary Classroom. Eastern Illinois University, the Keep.

Naser, I. (2004). Socialization, Amma, Amman publishing and distribution house.

Sadeq, A. (2007). Studies and research about music psychologyand education, Cairo, Al-Anglo library. The references written in English language.

Webster, J. D. (2015). The Effects of Music Education on Academic, Social and Emotional Outcomes: An Investigation into the Perceptions of High School Students and their Parents. Unpublished Dissertation: Texas Weslyan University.

Yun, Y. B., & Kim, J. E. (2013). The Effects of the Orff Approach on Self-Expression, Self -Efficacy. *Social Skills of Children in Low-Income Families in South Korea, 92*(4), 123-158.

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The Influence of Perceived Organizational Support and Work Adjustment on the Employee Performance of Expatriate Teachers in Thailand

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Abstract

This study investigated the influence of perceived organizational support (POS) and work adjustment (WA) on the employee performance (EP) of expatriate English teachers in Thailand. A quantitative method was used; self-evaluation data were collected from 210 expatriate English teachers working in Thailand. The results of the study confirm the hypothesized positive correlational effect of POS and WA on EP. The empirical results confirm the model of investigation consisting of POS, WA and EP developed for testing in the context of Thailand. It also challenges the established connection of POS and WA of EP in a well-understood context of antecedence and is relevant for policymakers, workers, and managers, with implications for future research.

Keywords: perceived organizational support, work adjustment, employee performance, expatriate adjustment, Thailand

1. Introduction

1.1 Introduce the Problem

Research on employee performance (EP) has brought academic attention to a key theme in human resource management, human resource development, organizational development, and organizational behavior. Taiwan et al. (2017) described EP in organizations as a vital construct in research that researchers and practitioners should note, paying attention to its antecedents. Prominent models EP models; for example, Na-Nan & Pukkeeree (2013) found that organizational factors are independent and influence EP directly and indirectly through job satisfaction. Many researchers have sought ways to promote effective EP by considering employee engagement (Anitha, 2014, Nazir et al., 2017) and perceived organizational support (POS) (Byrne & Hochwarter, 2008, Karatepe, 2012, Karatepe & Aga, 2016), as can be seen in psychological and organizational factors. Other studies investigated adjustment as an independent variable for EP as a dependent variable (Awais Bhatti et al., 2013b, Awais Bhatti et al., 2013a). Work adjustment (WA) can be considered to be a process of system performance. Its role in a model of a psychological process, such as adjusting to work, adjusting to the rules environment, and adjusting to co-workers, seems to be as a mediator of effective performance, especially for new workers or expatriates who come to join organizations. However, the studies from which the factors mentioned above appear to ignore of these factors.

1.2 Explore Importance of the Problem

Although EP has been well researched and can be found in a growing number of research studies, however, there remain gaps in the literature, and models that have been investigated need to be studied (Jyoti & Kour, 2017). Among a number of under-researched aspects, Selmer et al. (2011) concluded that the influence of environmental factors was crucial. One such factor is the location to which the new worker or expatriate is assigned. Most studies of workers abroad focus on expatriate managers in Asia and Europe, but there have been no studies focusing on expatriate teachers who come to teach in Southeast Asia, though they play an important role in developing students' knowledge, skills, and attitude to be make them effective. This is a gap that this study attempted to fill.

This article is structured as follows: first, existing literature on POS, WA, and EP is reviewed; second, hypotheses on the influence of the POS and WA on EP are proposed, derived from existing research; third, the results of our analyses on the effect of POS and WA on EP are provided, and we discuss these results; fourth, theoretical and practical implications of this study are examined; and finally, we note the limitations of the study.

1.3 Describe Relevant Scholarship

Employee Performance

The concept of EP refers to the function of direct knowledge, abilities, skills, and motivation in role-prescribed behavior, for instance in formal job responsibilities (Campbell, 1999). In addition, only actions and behavior related to the goals of the organization are seen as factors in individual job performance (Campbell et al., 1993). Job performance theory indicates a multidimensional construct of job performance that consists of the task dimension (normally deadline-driven production sometimes called the "in-role") and the contextual dimension (sometimes considered discretionary and normally termed the "extra role") (Borman & Motowidlo, 1993). It has been argued in the expatriate management literature that it is expected for expatriates to work not only on their tasks in the contextual performance dimensions but also on other assignments (e.g., transferring technologies and knowledge). In response to this need, a third EP dimension was proposed by Caligiuri (1997) and Caligiuri & Day (2000), the specific assignment performance dimension for expatriates. This was well received in the literature. Na-Nan & Chalermthanakij (2012) and Na-Nan (2016) found that job performance could be defined as the behaviors that employees display at work that amount to the delivery of the outcomes desired by the organization in terms of job quality, quantity, and time.

Job quality is vital to the products and services of an organization and involves meeting set criteria and standards with regard to the procurement, production, quality inspection, and delivery of goods and services. Job quality can also be used as a process control and as a quality determinant within the context of quality control and inspection. Measuring organizational performance requires the measurement of employees' job quality as it reflects their individual attentiveness to work-related activities. Specifically, the job-quality dimension of EP emphasizes instilling an awareness of the significance of product and service quality among the employees.

Job quantity refers to the units of output as a result of employees' behaviors, such as product quantity, waste quantity, and sales figures; measurement of job quantity is essential to the work-related behaviors of an employee, because job quantity (i.e., units of output) reflects the deployment of the employee's physical and mental ability to fulfill responsibilities. Furthermore, job quantity is a straightforward measure of employee job performance: an employee either meets or does not meet the set quantity. Job quantity is impartial, since the measurement is based on tangible and objective results accomplished by each employee.

Job time concerns the amount of time required to complete work-related activities in relation to task difficulty. Employees satisfy job-time goals as long as tasks are carried out accurately and within a reasonable amount of time and the delivery of products or services is on schedule. According to Na-Nan & Chalermthanakij (2012), job time should be taken into consideration in the measurement of employee job performance. If the time dimension is disregarded, employees may exploit this shortcoming at the expense of the organization's overall performance. In addition, according to Newman (2013), job-time performance drives and directs employees to perform tasks and outcomes in a timely manner.

Perceived Organizational Support

According to theories of perceived organizational support, POS development is encouraged by the tendency of employees to assign humanlike characteristics to their organization (Eisenberger et al., 2001). As noted in Levinson (1965), agents take actions in the organization that are usually seen as indicators of organizational intent rather than those solely attributed to the personal motives of the agents. This organizational personification that Levinson suggested is abetted by the moral and financial responsibility and legal actions of agents of the organization through organizational norms, policies, and culture that prescribe and provide ongoing behaviors and by organizational agents exerting power over each employee. Using organizational personification, the view of employees in the organization can be traced to their liking or disliking their treatment, as the organization gives indication that it favors or disfavors indication.

The concept of POS stems from the theory of organizational support (Eisenberger et al., 2001), where it indicates an employee's evaluation of the extent that his or her employer values and cares for his or her contributions and well-being (Rhoades et al., 2001). Employees benefit from this evaluation not only in determining what would meet their socio-emotional needs at work but also to evaluate the dispensation of the organization to reward additional efforts. Crucially, human-like tendencies are ascribed by employees to organizations, and via this

personification treatment as received is interpreted by them at the hands of the organization as an indicator of the organization's orientation to the employee.

Organizational support theorists argue (Eisenberger et al., 2001) that strengthening POS occurs when an employee has a favorable work environment experiences and believes that these favorable experiences were directly enhanced by their decision to work purposefully and voluntarily for the organization (i.e., not from the legal point of view or regulatory forced compliance). The relationship between POS and favorable work experiences is strongest when experiences are attributed toward discretionary acts in the organizational part (Rhoades et al., 2001). An interesting underpinning of organizational support is in social exchange theory, stating that employees tend to dedicate their efforts to the workplace for tangible incentives such as pay and for socio-emotional benefits such as caring, esteem and approval (Mael & Ashforth, 1992). It has been suggested, due to the reciprocity norm, that high POS levels will engender the employee concern for organizational welfare and its achieving its goals (Rhoades et al., 2001). This relies on the fact that higher levels of POS among employees would also lead to feelings of engagement and therefore an exertion of the required effort in helping the organization work toward the achievement of its objectives.

Work Adjustment

There are not clear theoretical links between WA and POS. Some studies have investigated the relative POS as a predictor of WA, or PE but they do not test WA as mediator for predicting in the model. Dahling & Librizzi (2015) commented that WA is a correspondence between the person and environment, focusing on how employees fit into their responsibilities and how the abilities of an employee fit with their job or organizational environment. In addition, Na-Nan & Pukkeeree (2013) found that work adjustment is the psychological state of a person, the feeling of comfort or relaxation, with the varieties of environment that are experienced. WA is a complex process involved with acculturative stress reduction (Berry, 1992), a gradual amelioration of social skills deficits (Lauring & Selmer, 2015), a recognition of expectations fitting with the new reality (Ghosh, 2013), or sometimes the culmination of a personal odyssey with a change in a philosophical worldview (Yoshikawa, 1987). A three-dimensional view of WA was proposed by Na-Nan & Pukkeeree (2013) as follows: (1) adjustment to work: a level of ability or potential according to which people are able to perform their responsibilities perfectly based on their knowledge, skills, and personality to meet the needs and expectations of the organization (Dawis & Lofquist, 1984); (2) adjustment to rules: the personal ability to accept or adapt to the organization's rules, structure, communication system, commands, and decentralization, which the employee must face in their work; and (3) adjustment to co-workers or networking (Andrews & Kacmar, 2001, Ashford & Black, 1996, Raghuram et al., 2001): the personal ability to work with or maintain independence from others in a workplace, a basic need of people who maintain social stability.

Therefore, this research is likely to contribute in the field of human resource management and development in Thailand's circumstance and talking about the discussed variables the gap becomes more prominent.

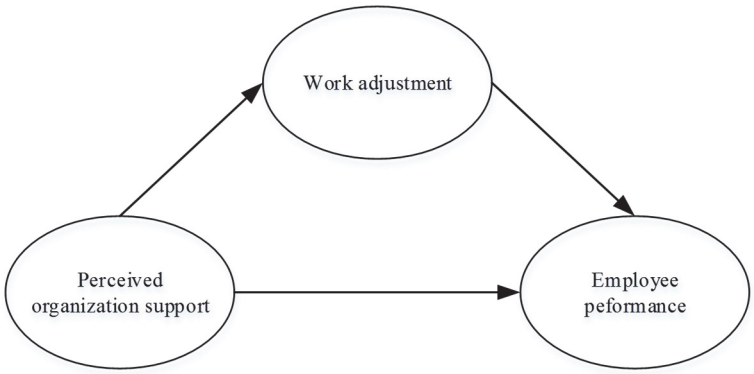

Figure 1. The proposed structural equation model of the influence of perceived organizational support and work adjustment on the employee performance of expatriate teachers in Thailand

1.4 State Hypotheses and Their Correspondence to Research Design

The social support literature has found a positive relation between expatriate adjustment and organizational performance (e.g., Kraimer et al., 2001; Qin & Baruch, 2010). Similarly, social support was proposed by Lee (2010), as it (i.e., POS and supervisor support) may lead to the higher levels of expatriate adjustment and career

success (i.e., job satisfaction and performance). Moreover, in the literature on expatriates, it has been found that performance is essential in expatriate effectiveness and organizational success (Kim et al., 2008). Performance here means the degree to which an employee can achieve requirements and expectation in his or her employee role (Pulakos et al., 2000). Thus, the following hypothesis is proposed.

H1. There is a positive correlational effect of POS on EP.

Research has consistently found that for higher levels of social support, workers can overcome psychological distress related to living and working within a host country, which it is otherwise difficult to adjust to (Farh et al., 2010, Iida et al., 2008). Social support is an essential factor in the context of a foreign country assignment (Stroppa & Spieß, 2011). Previous studies have categorized social support sub-dimensions based on the purposes of the study; for instance, there are two sub-dimensions in social support (i.e., POS and supervisor support) (Kraimer & Wayne, 2004, Kraimer et al., 2001). Stroppa & Spieß (2011) have also separated social support into two components (i.e., co-worker and supervisor support). Recently, research has examined social support for individual behavior at work (e.g., Baranik et al., 2010; Kraimer et al., 2001; Lee, 2010). These variables (i.e., POS and supervisor support) are examined as well.

The literature on social support suggests that support comes from multiple sources (i.e., organizations, supervisors, and colleagues) and these can enhance the WA of expatriate personnel by lessening their psychological distress in a multi-cultural setting (Caligiuri & Lazarova, 2001, Kraimer et al., 2001, Kupka & Cathro, 2007). An individual's ability to become more capable in providing social support for adjustment positively influences their increased adjustment within cross-cultural environments (Wu & Ang, 2011). If sufficient support is not given to expatriates by the organization and supervisors, the failure of adjustment is easily noticed from the results of reassignment (Andreason, 2003). On the other hand, expatriates with strong levels of social support perception may have a better ability to become successful in a cross-cultural environment adjustment (e.g., Farh et al., 2010; Shaffer et al., 2006; Wang & Takeuchi, 2007). Thus, a hypothesis is proposed below.

H2. There is a positive correlational effect of POS on WA.

In a cross-cultural environment, there is a positive relationship of WA to the ability of employees to effectively complete assignments (Ang et al., 2006, Templer et al., 2006) The present study holds that expatriate adjustment to a new cultural setting means the degree of adjustment when individual needs are met in the work setting and in turn performance and job satisfaction are enhanced (Stahl & Caligiuri, 2005). It has been empirically proven that there is a positive impact of expatriate adjustment on job performance (e.g., Kraimer et al., 2001; Mol et al., 2005). Indeed, it has been indicated by (Wu & Ang, 2011) that there is a partial effect of cultural adjustment and expatriate performance, but the findings seem inconsistent regarding the assumption of Lee & Sukoco (2010). In the expatriate adjustment literature, when there is poor adjustment of a worker to a host country, it has been found there is a low ability to adapt to a new cross-cultural environment (Kim et al., 2008) and that poorer performance accompanies greater psychological stress (Lee & Sukoco, 2010). Thus, it is assumed in this study that when expatriates adjust to a host nation's general environment their performance will not be different than what it is at home. Following the research discussion above, a hypothesis is proposed as follows:

H3. There is a positive correlation effect of WA on EP.

2. Method

The following section concerns the analytical strategy and instruments used to collect the responses.

2.1 Sample and Data Collection

Expatiate teachers at international schools in Thailand were surveyed. They come from countries all over the world, and they have responsibility for creating lesson plans and implementing their plans for the entire class, to individual students, or in small groups, tracking student progress and presenting this information to parents, creating tests, creating and enforcing classroom rules, working with the school administration to prepare students for standardized tests, and managing students outside the classroom. Thus, we believe that expatiate teachers are suitable participants for testing the current research model.

The decision was made to obtain the sample from the 113 member schools of the International Schools Association of Thailand, at which 1,130 expatriate teachers teach, as the target population. The researchers contacted the principals of the international schools to obtain permission to collect the data. Questionnaires were given to these principals, who then distributed them to the teachers who were the research samples.

2.2 Participant (Subject) Characteristics

A total of 300 expatiate teachers were invited to participate in the study, and 245 questionnaires were retuned, with

a total of 210 usable questionnaires obtained for a 70% response rate. The number of responses was enough to analyze using the proposed structural equation model (SEM). Hair et al. (2010) stated that the sample size should be 15 times the number of the SEM parameters (i.e., 14 parameters require 210 samples). Of these 210 individuals, a preliminary analysis revealed that 80% of subjects were female, with an average age of 34.10 (SD = 9.01) years old and an age range from 20 to 57 years old. A majority of the participants (nearly 57%) had at least a high school education, and just over 43% percent had a college education. The respondents, on average, had almost 8.19 (SD = 5.74) years of work experience.

2.3 Measurement Scales

Existing scales were used in the questionnaire. The researchers have also adjusted and developed scales. To measure the POS, we adopted Kurtessis et al. (2017) of questionnaire, with 17 items. Some POS questions were "Your boss is fair in recognizing and aware on individual accomplishments," "Disputes or conflicts are fairly resolved," and "Your boss is fair in recognizing team accomplishments." To measure WA, we used Na-Nan and Pukkeeree (2013) of questionnaire, which includes 12 items. Some WA items were "I understand the methods and ways to work," "I follow the organization rules or disciplines," and "I feel not pressure to work with others." To measure expatriate performance (EP), we used Na-Nan and Chalermthanakij's (2017) questionnaire, composed of 13 items. Some EP questions were "Tasks are performed attentively and correctly," "Quality inspection is conducted prior to the delivery of goods or services," and "Tasks are normally completed on schedule."

The measurements were carried out using a 6-point Likert scale, where 1 denotes strongly disagree and 6 strongly agree. Prior to the collection of data, the questionnaire was tested with a sample of 30 expatriate teachers to determine its reliability and internal consistency, with the content validity of 0.60–1.00 and Cronbach's α coefficients in the range of 0.862–0.930.

This study examined the Pearson correlation coefficients between the questionnaire questions for quantitative analysis. The confirmatory factor analysis of the SEM variables was then carried out and the path analysis of the SEM performed. The goodness of fit of the proposed SEM was finally determined.

3. Results

To examine research results, the study used a two-stage approach, applying SEM. The key reason for select a two-stage approach is its ability to reduce the interactional effects of structural models and measurements (Byrne, 2013). First, data were checked for missing values, outliers, and correlations to fulfill the basic assumptions of SEM (Byrne, 2013, Hair et al., 2010). The main reason for applying correlation was to check whether any variables had a significant influence on the others and check the multicollinearity of the variables. Fortunately, all variables were found to have a significant relationship with the others and there was no multicollinearity found (Table I). The Pearson correlation coefficients of the 12 observable variables were in the range of 0.001 to 0.541.

Table 1. Correlation analysis

Variables	POS1	POS2	POS3	WA1	WA2	WA3	EP1	EP2
POS1								
POS2	0.460**							
POS3	0.181**	0.250**						
WA1	0.541**	0.460**	0.345**					
WA2	0.360**	0.323**	0.249**	0.370**				
WA3	0.323**	0.357**	0.193**	0.245**	0.656**			
EP1	0.201**	0.339**	0.001	0.205**	0.224**	0.258**		
EP2	0.237**	0.255**	0.115	0.220**	0.326**	0.399**	0.504**	
EP3	0.188**	0.221**	0.220**	0.198**	0.279**	0.366**	0.289**	0.562**

Notes: POS1 = fairness; POS2 = supervisor support; POS3 = organizational rewards and job condition; WA1 = adjust to work; WA2 = adjust to rules; WA3 = adjust to co-workers or networking; EP1 = job quality; EP2 = job quantity; EP3 = job time; ** $p < 0.01$

In checking the multicollinearity of the variables, Hair et al. (2010) stated that correlations among independent variables and correlations that exceed 0.800 can indicate problems. No variable correlation was found over standard (Table I), indicating no multicollinearity.

First Phase – Assessment of Uni-dimensionality

In the first phase, we used confirmatory factor analysis (CFA) to check the uni-dimensionality of factors, because the instruments used in the present study were developed on the basis of concepts and theory. To check whether the values of the model fit, standard values of Hair et al. (2010) were applied, that is, the value of χ^2/df should not be over 3; the higher the value of the comparative fit index (CFI), the higher the model fit; the goodness of fit index (GFI), the adjusted goodness of fit index (AGFI), and the normed fit index (NFI) should be greater than 0.090. The value of the root mean square error of approximation (RMSEA) should not be over 0.800.

Table 2. Confirmatory factor analysis

Item	Factor loading	Cronbach's α	CR	AVE
Perceived organization support				
POS1	0.655	0.862	0.756	0.510
POS2	0.638			
POS3	0.752			
Work adjustment				
WA1	0.529	0.891		
WA2	0.737			
WA3	0.865		0.760	0.523
Employee performance				
PE1	0.564	0.930.	0.746	0.504
PE2	0.883			
PE3	0.644			
Goodness of fit: χ^2 = 26.847, χ2/df = 1.790, CFI = 0.979, GFI = 0.974, AGFA = 0.923, NFI = 0.954 and RMSEA = 0.600.				

Notes: POS1 = fairness; POS2 = supervisor support; POS3 = organizational rewards and job condition; WA1 = adjustment to work; WA2 = adjustment to rules; WA3 = adjustment to co-workers or networking; EP1 = job quality; EP2 = job quantity; EP3 = job time

Additionally, the value of the modification indices and normalized residual were also estimated for model fitness (Byrne, 2013). The modification indices depict the results of the calculation of those relations that are not estimated in the model, while normalized residuals identify the difference between the observed and estimated correlations. All possible modifications were made following the instruction of Hair et al. (2010), because the first analysis did not fit with the model fit index and was consistent with empirical data. After making all the adjustments, the values of test adaptability were found to be χ^2 = 26.847, χ2/df = 1.790, CFI = 0.979, GFI = 0.974, AGFA = 0.923, NFI = 0.954, and RMSEA = 0.600. All model fit indices are well above the standard values found in Hair et al. (2010).

Table II tabulates the factor loading (λ), composite reliability, and average variance extracted (AVE) of each construct. Checking the reliability of the scale, Cronbach's α values were examined, with the standard cut-off limit of 0.700. Discriminant validity was examined using Kline's (2015) cutoff value of 0.85 as a correlation between variables and composite reliability (CR), while convergent validity was analyzed through AVE. The results in Table II identify that the instrument has convergent and discriminant validity, as the values of CR and AVE are well above 0.60 and 0.50, respectively (Hair et al., 2010).

Second Phase - Hypothesis Testing

To investigate both the direct and indirect paths and how the latent variables are related, a structural equation model was used (Byrne, 2013). The hypotheses were examined by investigating path coefficients. All the research hypotheses were supported, showing statistically significant path coefficients ($t < 1.980$, $p < 0.010$).

First, the hypothesized structural equation model was tested (Figure 1). The hypothesized model did not reveal a good fit model index with the cut-off values given by Hair et al. (2010), apart from the value of the root mean square error of approximation (RMSEA = 0.128) and the goodness of fit index (GFI = 0.905). The values of the model fitness were χ^2 = 109.747, χ^2/df = 4.573, CFI = 0.844, AGFA = 0.822, NFI = 0.813.

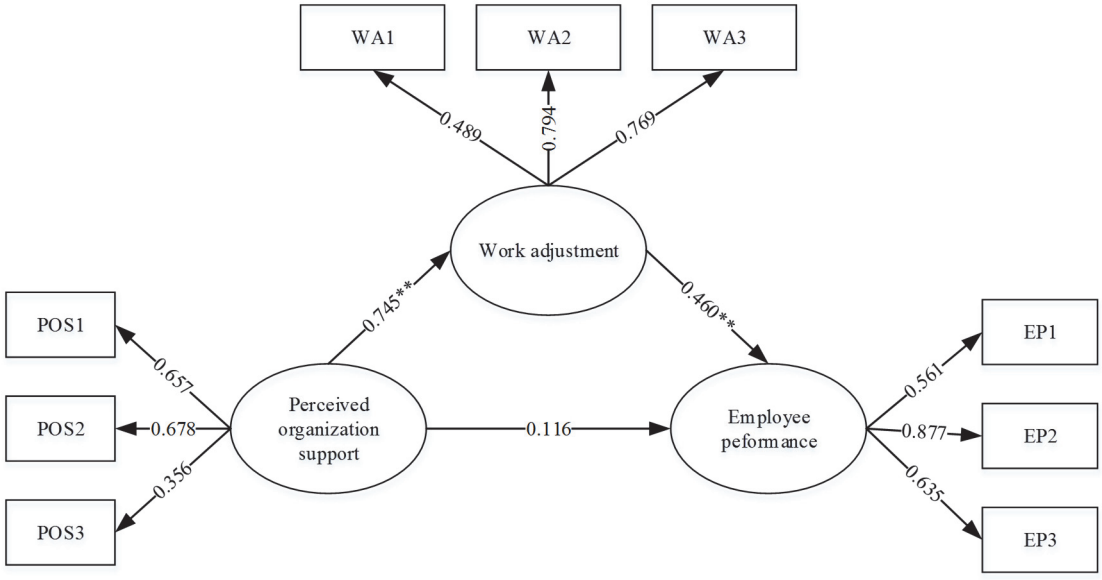

Figure 2. Hypothesized model

Second, an alternate model was also tested, as shown in Figure 2 and was found to be the best fit for all indices, that is, $\chi 2 = 1.358$, $\chi 2/df = 0.339$, CFI = 0.999, GFI = 0.999, AGFA = 0.985, NFI = 0.998, and RMSEA = 0.000. The fitness values of the alternate model were found to be greater than those of the hypothesis model (i.e., $\Delta \chi 2/\Delta$ df was observed as 4.230). Therefore, the alternate model was accepted and the hypothesized model was rejected.

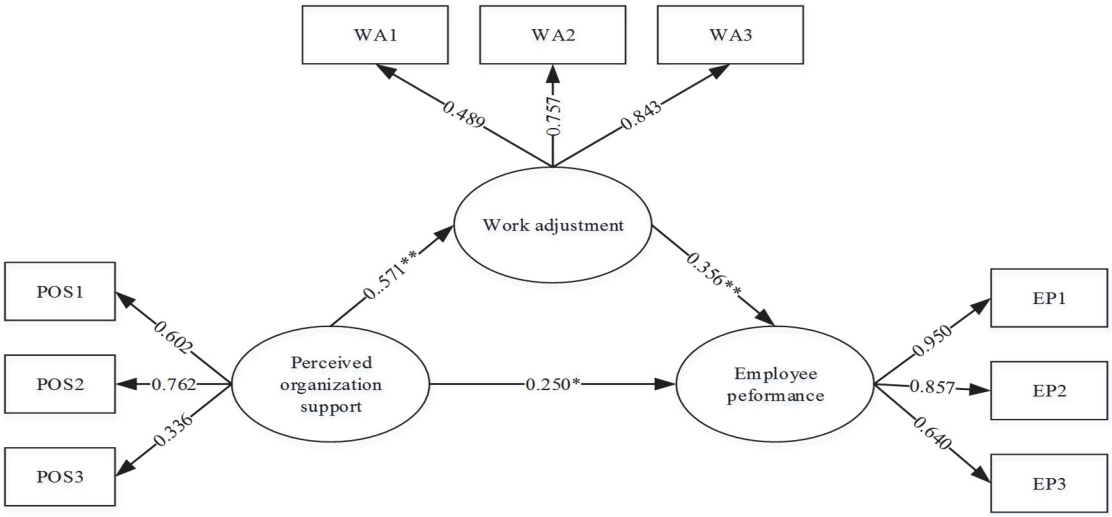

Figure 3. Alternate model

The results revealed that POS had a direct positive influence on EP ($\beta = 0.250$) and on WA ($\beta = 0.571$), which confirmed *H1* and *H2*, respectively. Similarly, the path coefficient of WA on EP was also found to be significant ($\beta = 0.356$), which supports *H3*.

4. Discussion

This study develops and investigates a model of the joint correlation between POS and WA on EP. The results of the study show that the POS factor has a positive and significant direct correlation effect of POS on EP among expatriate teachers in Thailand. Similarity, the WA factor was found to have a positive direct correlation effect on EP factor. Meanwhile, it was found that POS has an indirect influence on EP through WA as well. It might be assumed that when employees are supported and encouraged by their organization or provided with resources that

they need on a continual basis, they will show more WA toward their responsibilities and will deliver services or products to individuals and the organization. The present study suggests that employee POS shows a more comfortable adjustment to work and delivers effective performance to their organizations. The social exchange theory of Blau (1964) also supports the notion that when employees perceive something positive about their organization, they will experience satisfaction or deliver results back to the organization. Consistent with the concept of Eisenberger et al. (2001) and Ahmed et al. (2015) commented that employees who feel genuinely cared for in their socio-emotional needs and well-being by their organization will feel a reciprocating obligation with regard to the fulfilling the organization's objectives.

Arshadi & Hayavi (2013) found that when organizational staff perceive a high level of encouragement or support from the organization, the employees work more effectively or take more responsibility for their jobs and create high performance for the organization. Kraimer & Wayne (2004) write on organizational support in the form of POS that the global belief in the value of the contributions by the employee can be given by the firm through care for the employees' well-being. This study showed a positive relationship between the parental company commitment, POS, attempts to complete assignments, and task performance. Similarly, work of Lee (2010) found that POS and supervisor support may lead to higher levels of expatriate adjustment and career success (i.e., job satisfaction and performance).

In addition, this study found that POS has a direct correlational effect on WA. This is consistent with the study of Kawai & Strange (2014), who commented that employees supported by the organization will let them adjust to work, the atmosphere, and the regulations of organization. Bhatti et al. (2012) wrote that the POS of employees (financial assistance, family support, co-worker support, career path) at high levels helps them adjust to working with their co-worker, organizational rules, or work procedures. This study can supports POS theory as a beneficial provision aiding for two people but with a psychologically buffering intention on the distress for enhancement of emotional well-being. A study on social support showed that with better social support, expatriates avoided psychological distress related to work, living, and interactive aspects in the host country where it was not easy to adjust (Farh et al., 2010, Iida et al., 2008).

Finally, WA directly influences EP. It is assumed that expatriate employees with a high level of WA can deliver the high results or performance to organizations. In the study of Lee et al. (2013) on the effects of social support and transformational leadership on expatriate adjustment and performance, the results show a significantly positive relationship between expatriate adjustment and performance. That study was in line with Wu & Ang (2011), where a constructive relation between employee's WA and task performance was found, as well as a positive relation between employees' interaction adjustment and contextual performance.

5. Theoretical Implications

The concept of POS, based on the theory of Eisenberger et al. (2001), stems from the theory of organizational support, which explained employees' evaluations to the extent that they and their contributions were valued by the employer as well as their well-being (Rhoades et al., 2001). This evaluation is beneficial for employees not only in their determination of things to fulfill their socio-emotional needs at work, but also to assess the dispensation of the organization to reward additional efforts. It is crucial that human-like tendencies be ascribed by employees to the organizations and received treatment is interpreted by them through personification as an employee orientation indicator (Na- Nan, Panich, Thipnete & Kulsingh, 2016).

This study's results indicate that POS has a statistically significant impact on the WA. Structural equation modeling showed the consistency of findings with previous research and theory; the study gained extremely in POS. Human behavioral phenomena were described to boost awareness of organization directors of the interest of WA and EP. WA is valuable, and organizations should explain regulations, how to work with peers, and the work procedures of the organization for workers interacting with foreign nationals. This can assist the firm in these factors and policy management with the aim to facilitate expatriate adjustment to a new environment.

6. Practical Implications

Researchers have previously conducted separate study of different theories and presented their effects on EP. As can be seen from this study, the organization was found to need to successfully implement expatriate performance. One contribution of this study was to seek a positive relationship between adjustment and performance. It is often found that poor adjustment can cause toward the failure of an expatriate. A crucial contribution of the concept of WA was the search for a positive relationship between adjustment and performance where it is normally found that poor adjustment generally leads to worker failure. The results provide initial evidence that expatriates with good work adjustment who can comfortably interact with host-country residents and have better task performance and expatriate contextual performance. Longitudinal study should be conducted to give better evidence related to job

performance as preceded by adjustment in which recommendations are taken from stress management theories. Relevant performance dimensions were found between expatriate contextual performances and task performance in managerial and technical expatriates.

The focus of organizations should be on the employees; they could benefit from this evaluation to meet socio-emotion needs at work and create an organizational dispensation in offering a reward for additional effort (Na-Nan, Thanitbenjasith, Sanamthong, & Pukkeeree, 2016; Na-Nan, Chaiprasit & Pukkeeree, 2017).

7. Limitation of the Study

This study had several limitations. Its focus was on the effects of POS and WA on EP. It must be recognized that the researchers attempted to conduct the study to produce accurate results. Limitations that should be noted are as follows. First, the population of expatriate teachers as the target group working in the 113 member schools of the International Schools Association of Thailand may be a unique population. Second, the relation between expatriate adjustment and expatriate performance were examined, but no comparison of the performance levels and different levels of adjustment in different organizations was made. Future research is required on this point. Last, in this study expatriate adjustment was not separated by nationality. Other firms and users should be aware of these points when applying the results of this study.

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References

Ahmed, I., Nawaz, Muhammad, M., Ali, G., & Islam, T. (2015). Perceived organizational support and its outcomes: A meta-analysis of latest available literature. *Management Research Review, 38*(6), 627-639.

Andreason, Aaron W. (2003). Expatriate adjustment to foreign assignments. *International Journal of Commerce and Management, 13*(1), 42-60.

Andrews, M. C., & Kacmar, K. M. (2001). Discriminating among organizational politics, justice, and support. *Journal of Organizational Behavior, 22*(4), 347-366.

Ang, S., Van Dyne, L., & Koh, C. (2006). Personality correlates of the four-factor model of cultural intelligence. *Group & Organization Management, 31*(1), 100-123.

Anitha, J. (2014). Determinants of employee engagement and their impact on employee performance. *International Journal of Productivity and Performance Management, 63*(3), 308-323.

Arshadi, N., & Hayavi, G. (2013). The effect of perceived organizational support on affective commitment and job performance: mediating role of OBSE. *Procedia-Social and Behavioral Sciences, 84*, 739-743.

Ashford, S. J., & Black, J. S. (1996). Proactivity during organizational entry: The role of desire for control. *Journal of Applied Psychology, 81*(2), 199-214.

Awais, B., Muhammad, K. S., & Mohamed, B. M. (2013a). Effects of individual characteristics on expatriates' adjustment and job performance. *European Journal of Training and Development, 37*(6), 544-563.

Awais, B., Muhammad, M. B., & Rageh, I. A. (2013b). Expatriates adjustment and job performance: an examination of individual and organizational factors. *International Journal of Productivity and Performance Management, 62*(7), 694-717.

Baranik, L. E., Roling, E. A., & Eby, L. T. (2010). Why does mentoring work? The role of perceived organizational support. *Journal of vocational behavior, 76*(3), 366-373.

Berry, J. W. (1992). Acculturation and adaptation in a new society. *International migration, 30*(s1), 69-85.

Bhatti, M. A., Sundram, V. P. K., & Hoe, C. H. (2012). Expatriate job performance and adjustment: Role of individual and organizational factors. *Journal of Business & Management, 1*(1), 29-39.

Blau, P. M. (1964). *Exchange and power in social life*: Transaction Publishers.

Borman, W. C., & Motowidlo, S. J. (1993). Expanding the criteria domain to include elements of contextual performance. In N Schmitt & W. C Borman (Eds.), *Personnel selection in organizations* (pp. 71-98). San Francisco: Jossey-Bass.

Byrne, B. M. (2013). *Structural equation modeling with Mplus: Basic concepts, applications, and programming*:

Routledge.

Byrne, Z. S., & Hochwarter, W. A. (2008). Perceived organizational support and performance: Relationships across levels of organizational cynicism. *Journal of Managerial Psychology, 23*(1), 54-72.

Caligiuri, P. M. (1997). Assessin expatriate success: Beyong just "being there" In Saunders D. M. & Z. Aycan (Eds.), *New approaches to employee management* (Vol. 4, pp. 117-140). Greenwich, CT: JAI Press.

Caligiuri, P. M., & Day, D. V. (2000). Effects of Self-Monitoring on Technical, Contextual, and Assignment-Specific Performance A Study of Cross-National Work Performance Ratings. *Group & Organization Management, 25*(2), 154-174.

Caligiuri, P. M., & Lazarova, M. (2001). Strategic repatriation policies to enhance global leadership development. *Developing global business leaders*, pp. 243-256.

Campbell, J. P. (1999). The definition and measurement of performance in the new age. In D. R. Ilgen & E. D. Pulakos (Eds.), *The changing nature of performance: Implications for staffing, motivation. and development* (pp. 339-429). San Francisco: Calif: Jossey-Bass.

Campbell, J. P., McCloy, R. A., Oppler, S. H, & Sager, C. E. (1993). A theory of performance. In N Schmitt & W. C. Borman (Eds.), *Personnel selection in organizations* (pp. 35-70). San Francisco: Jossey-Bass.

Dahling, J. J., & Librizzi, U. A. (2015). Integrating the theory of work adjustment and attachment theory to predict job turnover intentions. *Journal of Career Development, 42*(3), 215-228.

Dawis, R. W., & Lofquist, L. H. (1984). *A Psychological Theory of Work Adjustment*. Minneapoles, MN Universityof Minnesota Press.

Eisenberger, R., Armeli, S., Rexwinkel, B., Lynch, P. D., & Rhoades, L. (2001). Reciprocation of perceived organizational support. *Journal of applied psychology, 86*(1), 42-51.

Farh, C. I. C., Bartol, K. M., Shapiro, D. L., & Shin, J. (2010). Networking abroad: A process model of how expatriates form support ties to facilitate adjustment. *Academy of Management Review, 35*(3), 434-454.

Ghosh, A. (2013). Interpersonal cross-cultural contact: Exploring the role of cultural encounters as antecedent to cultural competence at workplace. *Management and Labour Studies, 38*(1-2), 81-101.

Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. (2010). *Multivariate data analysis* (7 ed): Prentice hall Upper Saddle River, NJ.

Iida, M., Seidman, Gwendolyn, Shrout, P. E., Fujita, K., & Bolger, N. (2008). Modeling support provision in intimate relationships. *Journal of Personality and Social Psychology, 94*(3), 460-478.

Jyoti, J., & Kour, S. (2017). Factors affecting cultural intelligence and its impact on job performance: role of cross-cultural adjustment, experience and perceived social support. *Personnel Review, 46*(4), 767-791.

Karatepe, O. M. (2012). Perceived organizational support, career satisfaction, and performance outcomes: a study of hotel employees in Cameroon. *International Journal of Contemporary Hospitality Management, 24*(5), 735-752.

Karatepe, O. M., & Aga, M. (2016). The effects of organization mission fulfillment and perceived organizational support on job performance: The mediating role of work engagement. *International Journal of Bank Marketing, 34*(3), 368-387.

Kawai, N., & Strange, R. (2014). Perceived organizational support and expatriate performance: Understanding a mediated model. *The International Journal of Human Resource Management, 25*(17), 2438-2462.

Kim, Kwanghyun, Kirkman, B. L., & Chen, G. (2008). Cultural intelligence and international assignment effectiveness. *Handbook of cultural intelligence: Theory, measurement, and applications*, pp. 71-90.

Kline, R. B. (2015). *Principles and practice of structural equation modeling*: Guilford publications.

Kraimer, M. L., & Wayne, S. J. (2004). An examination of perceived organizational support as a multidimensional construct in the context of an expatriate assignment. *Journal of Management, 30*(2), 209-237.

Kraimer, M. L., Wayne, S. J., & Jaworski, R. A. (2001). Sources of support and expatriate performance: The mediating role of expatriate adjustment. *Personnel Psychology, 54*(1), 71-99.

Kupka, B., & Cathro, V. (2007). Desperate housewives–social and professional isolation of German expatriated spouses. *The International Journal of Human Resource Management, 18*(6), 951-968.

Kurtessis, J. N., Eisenberger, R., Ford, M. T., Buffardi, L. C., Stewart, K. A., & Adis, C. S. (2017). Perceived

organizational support: A meta-analytic evaluation of organizational support theory. *Journal of Management, 43*(6), 1854-1884.

Lauring, J., & Selmer, J. (2015). Job engagement and work outcomes in a cognitively demanding context: The case of expatriate academics. *Personnel Review, 44*(4), 629-647.

Lee, L. Y. (2010). Multiple intelligences and the success of expatriation: The roles of contingency variables. *African Journal of Business Management, 4*(17), 3793-3804.

Lee, L. Y., & Sukoco, B. M. (2010). The effects of cultural intelligence on expatriate performance: The moderating effects of international experience. *The International Journal of Human Resource Management, 21*(7), 963-981.

Lee, L. Y., Veasna, S., & Wu, W. Y. (2013). The effects of social support and transformational leadership on expatriate adjustment and performance: The moderating roles of socialization experience and cultural intelligence. *Career Development International, 18*(4), 377-415.

Levinson, H. (1965). Reciprocation: The relationship between man and organization. *Administrative Science Quarterly*, 370-390.

Mael, F., & Ashforth, B. E. (1992). Alumni and their alma mater: A partial test of the reformulated model of organizational identification. *Journal of organizational Behavior, 13*(2), 103-123.

Mol, S. T., Born, M. P., Willemsen, M. E., & Van, D. M., Henk, T. (2005). Predicting expatriate job performance for selection purposes A quantitative review. *Journal of Cross-Cultural Psychology, 36*(5), 590-620.

Na-Nan, K. (2016). Performance management system of SMEs in Thailand. *International journal of Economics Research, 13*(4), 1641-1658.

Na-Nan, K., & Chalermthanakij, K. (2012). A causal model of affecting factor on organizational commitment and employee performance factors. *Rmutt Global Busines and Economics Review, 7*(1), 145-168.

Na-Nan, K., & Pukkeeree, P. (2013). Influence of job characteristics and job satisfaction effect work adjustment for entering labor market of new graduates in Thailand. *International Journal of Business and Social Science, 4*(2). 95-103.

Na-Nan, K., Chaiprasit, K., & Pukkeeree, P. (2017). Influences of workplace environment factors on employees' training transfer. *Industrial and Commercial Training, 49*(6), 303-314.

Na-Nan, K., Panich, T., Thipnete, A., & Kulsingh, R. (2016). Influence of job characteristics, organizational climate, job satisfaction and employee engagement that affect the organizational citizenship behavior of teachers in Thailand. *The Social Sciences, 11*(18), 4523-4533.

Na-Nan, K., Thanitbenjasith, P., Sanamthong, E., & Pukkeeree, P. (2016). The Relationship between organizational cultures and courageous followership behaviors: That's the relationship and why does it matter. *International Business Management, 10*(8), 4384-4390.

Nazir, O., & Islam, Jamid Ul. (2017). Enhancing organizational commitment and employee performance through employee engagement: An empirical check. *South Asian Journal of Business Studies, 6*(1), 98-114.

Newman, D. (2013). Time to evaluate great expectations. *Employers' Law, 1*(1), 20-21.

Pulakos, E. D., Arad, S., Donovan, M. A., & Plamondon, K. E. (2000). Adaptability in the workplace: development of a taxonomy of adaptive performance. *Journal of applied psychology, 85*(4), 612-624.

Qin, Chenyi, & Baruch, Y. (2010). The impact of cross-cultural training for expatriates in a Chinese firm. *Career Development International, 15*(3), 296-318.

Raghuram, Su., Garud, R., Wiesenfeld, B., & Gupta, V. (2001). Factors contributing to virtual work adjustment. *Journal of Management, 27*(3), 383-405.

Rhoades, L., Eisenberger, R., & Armeli, S. (2001). Affective commitment to the organization: the contribution of perceived organizational support. *Journal of Applied Psychology, 86*(5), 825-836.

Selmer, J., Suutari, V., Kittler, M. G., Rygl, D., Mackinnon, A., & Wiedemann, K. (2011). Work role and work adjustment in emerging markets: A study of German expatriates in CEE countries and Russia. *Cross Cultural Management: An International Journal, 18*(2), 165-184.

Shaffer, M. A., Harrison, D. A., Gregersen, H., Black, J. S., & Ferzandi, L. A. (2006). You can take it with you: individual differences and expatriate effectiveness. *Journal of Applied Psychology, 91*(1), 109-125.

Stahl, G. K., & Caligiuri, P. (2005). The effectiveness of expatriate coping strategies: the moderating role of cultural distance, position level, and time on the international assignment. *Journal of Applied Psychology, 90*(4), 603-615.

Stroppa, C., & Spieß, E. (2011). International assignments: The role of social support and personal initiative. *International Journal of Intercultural Relations, 35*(2), 234-245.

Taiwan, A., Na-Nan, Khahan, & Ngudgratoke, S. (2017). The effects of personality and transformational leadership on expatriate adjustment and expatriate performance. *International Journal of Applied Business and Economic Research, 15*(22), 223-234.

Templer, K. J., Tay, C., & Chandrasekar, N. (2006). Motivational cultural intelligence, realistic job preview, realistic living conditions preview, and cross-cultural adjustment. *Group & Organization Management, 31*(1), 154-173.

Thongpull, K., Rugchoochip, K., & Na-Nan, Khahan. (2016). A causal model of job characteristics, transformational leadership, and perceived organizational support effects on organizational commitment and organizational citizenship behavior. *Suthiparithat, 30*(93), 131-145.

Wang, M., & Takeuchi, R. (2007). The role of goal orientation during expatriation: a cross-sectional and longitudinal investigation. *Journal of Applied Psychology, 92*(5), 1437-1445.

Wu, P. C., & Ang, S. H. (2011). The impact of expatriate supporting practices and cultural intelligence on cross-cultural adjustment and performance of expatriates in Singapore. *The International Journal of Human Resource Management, 22*(13), 2683-2702.

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Sandwich Panel Behavior for Core Loading Beyond the Yield Limit

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Abstract

The effect of loading core material beyond its yield limit on sandwich panel behavior is investigated. Different core materials of different stiffness are studied. The panel modeled using a finite element analysis package. Simply supported boundary conditions are applied on all sides of the panel. The effect of core stiffness is investigated parametrically by utilizing univariate search optimization technique. The load has been increased in quasi–static steps till face sheets reach the yield point. The model has been validated analytically and experimentally for selected cases. The finite element model results show very good agreement with the analytical and the experimental results investigation. It is proved in this study that the load carrying capacity of the panel increases as the core material goes beyond the yield point. Load transmitted to the face sheets increases as the core stiffness gets softer. As core material is getting stiffer face sheets of sandwich panel yield before the core.

Keywords: sandwich panel, foam core, beyond yield stress, finite element analysis

1. Introduction

New materials typically bring new challenges to designer who utilizes these new materials. In the past decades various sandwich panels have been implemented in aerospace, marine, architectural and transportation industry. Light-weight, excellent corrosion characteristics and rapid installation capabilities created tremendous opportunities for these sandwich panels in industry. Sandwich panel normally consists of a low-density core material sandwiched between two high modulus face skins to produce a lightweight panel with exceptional stiffness as shown in Figure 1. The face skins act like the flanges of an I-beam whereas the core works like web by spacing the facing skins and transfers shear between them to make the composite panel work as a homogeneous structure. The faces are typically bonded to the core to achieve the composite action and to transfer the forces between the components.

According to the literature the first book about sandwich structures was written by (Plantema, 1966), followed by a book written by (Allen, 1969), and more recently by (Zenkert, 1995). A method to design for minimum weight and reported the failure mode map of sandwich construction was developed by (Triantafillou & Gibson, 1987); however the method did not consider the post yield state of the sandwich structure. (L.L. Mercado, Sikarskie, & Miskioglu, 2000) reported that the load carrying capacity by sandwich structures continue to increase after core yielding. Knowing that the core could not carry additional load after yield, this increasing load carrying capacity of post yield sandwich structure initiates the postulation that the additional shear load was transferred to the face sheets. To account for the above-mentioned phenomenon, (L. L. Mercado & Sikarskie, 1999) developed a higher order theory by including a bilinear core material module. This theory yields a fairly accurate prediction on the deflection of a foam cored sandwich structure in four point bending. In addition, this theory does not take into account the core compression under localized load, or any geometric non-linearity. The classical sandwich beam theory also assumes that in-plane displacements of the core through its depth are linear. In other words, it was assumed that the core thickness remains constant and cross-sections perpendicular to the neutral axis remain plane after deformation. This assumption is generally true for traditional core material such as metallic honeycomb. However, this assumption is not suitable for soft, foam-based cores, especially when the sandwich structure is subjected to a concentrated load. With a much lower rigidity compared to metallic honeycomb, foam-based cored sandwich structures are susceptible to localized failure. Insufficient support to the

face sheets due to core compression near the application points of concentrated loads can lead to failures such as face sheet / core delamination, face sheet buckling, and face sheet yielding. This localized non-linearity is reported by many researchers (Caprino & Langella, 2000; Gdoutos, Daniel, Wang, & Abot, 2001; Thomsen, 1993, 1995). The shear distribution at localized failure points has not been well defined.

To design an efficient sandwich structure, it is vital to understand the behavior of each layer in the structure. Classical sandwich theory, higher order theory by (L.L. Mercado et al., 2000) and high order theory developed by (Frostig, Baruch, Vilnay, & Sheinman, 1992) could predict the sandwich panel behavior fairly accurate in the linear range. However, these theories could not give an accurate prediction of the sandwich structure behavior after core yielding. Large deflection of sandwich structures due to core yielding could vary the direction of the applied load on the structure. Recently (Akour & Maaitah, 2012) studied the effect of the loading area on the behavior and they reported that loads distributed over small areas lead to local dentation in the face sheet and local yielding for the sandwich panel core. Also (Akour, Maaitah, & Nayfeh, 2012) studied the effect of sandwich panel core thickness and they found that increasing the core thickness results higher load carrying capacity of the sandwich panel and the panel behavior gets closer to the I-Beam behavior.

Finite element (FE) analysis is utilized to investigate the response of sandwich panel under distributed load. Geometric nonlinearity and material nonlinearity are considered in this investigation to unveil the behavior of sandwich panel beyond core yielding. The effect of core stiffness is investigated. Four core materials are utilized to cover the stiffness range from 37.5 MPa to 402.6 MPa. Univariate search optimization technique is adopted in studying these parameters (Chapra & Canale, 2006).

2. Method

The methodology includes the physical model, the finite element model, the experimental setup and procedure for utilized in the experimental verification, and theoretical varication of the finite element model.

2.1 Physical Model

The sandwich panel consists of two face sheets made of metal. The thickness of each face sheet is **t**. Soft core of **c** thickness is sandwiched between those face sheets. The core material is made of foam which is soft compared to the face sheets. The panel is square in shape. The side length is designated by **a** whereas the overall thickness is designated by **h**. Figure 1 illustrates the sandwich panel geometry. The values of **a**, **t** and **c** are 608mm, 1.0mm and 50mm respectively.

This research takes into account the geometric non-linearity as well as the material nonlinearity. The following assumptions are made to simplify the model without losing the physics of the problem

1. Face sheets and core are perfectly bonded: no de-lamination occur between layers. Future study is to extend the delamination effect.
2. Face sheets remain elastic all the time: Due to the significantly higher yield strength and modulus of elasticity of the face sheets compared to the core, face sheets are assumed to remain elastic throughout the loading. The analysis stops when the face sheets start to yield.
3. Geometric non-linearity has a significant effect: Geometric non-linearity is considered to have significant effect on the load distribution on each layer of the sandwich structure.
4. The panel is simply supported from all sides.
5. Out of plane load is applied and varied in quasi-static manner.

Due to the symmetry only quarter of the sandwich panel is modeled. The loading area is square in shape; its side length is 100mm for full panel dimension. However for quarter model of the panel, the side length is 50mm. The load is applied to the sandwich top face sheet as a distributed load which is increased gradually (step by step) till face sheet stress reaches the yield limit of the face sheet material. A distributed load is applied on the top surface of the sandwich panel. The area on which the distributed load is applied is located at the middle of the top face sheet plate. The loading area at the middle top face of sandwich panel is square in shape.

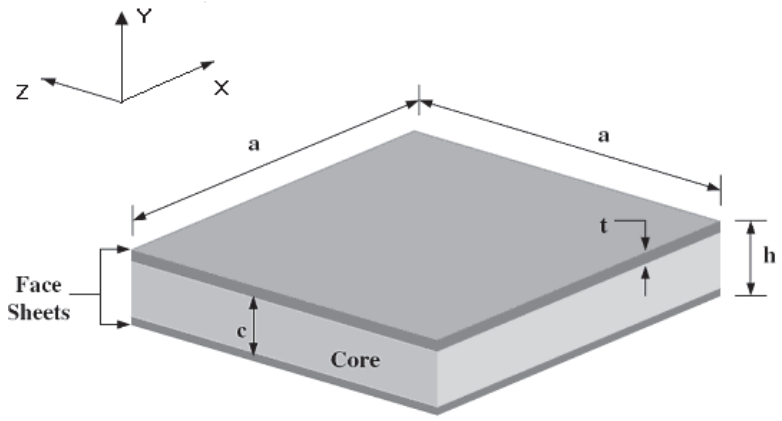


Figure 1. Illustration sandwich plate geometry

Four different materials are investigated. The influence of core material stiffness on the performance of the sandwich plate is studied. Their modulus of elasticity is varying from 37.5 MPa through 138.6 MPa, 180 MPa, and 402.6 MPa. Table 1 presents the materials used in the current investigation. The first row presents the mechanical properties of the face sheet material while the rest are the core materials. For FEM analysis the aluminum metal face sheet is utilized whereas for experimental verification commercial steel metal face sheet is utilized. The corresponding stress strain curves of the core materials A through D shown in Table 1 can be found in reference (Akour & Maaitah, 2010). These materials are selected because of their wide usage in the industry.

Table 1. Compression of sandwich panel material properties

Material	Property source	Young's modulus (MPa)	Poisson's ratio	Shear modulus (Mpa)	Shear strength (Mpa)	0.2% offset yield strength (Mpa)	Strain at yield popup (mm/mm)
Face sheet: Aluminum 3003-H14	(Boyer & Gall, 1991)	69,000	0.33	25,000	120	145	Not available
Core A : AirexR63.50	(Rao, 2002)	37.5	0.335	14.05	0.45	0.637	0.019
Core B: H100	(Kuang-An, 2001)	138.6	0.35	47.574	1.2	1.5	0.0108225
Core C: Herex C70.200	(Rao, 2002)	180	0.37	65.69	1.6	2.554	0.0162
Core D: H250	(Kuang-An, 2001)	402.6	0.35	117.2	4.5	5	0.014

2.2 Finite Element Model

The FE package used in the development of the FE models is I-DEAS (Master Series 10, 1999). The relatively robust and user-friendly solid modeling, and FE meshing interface are the main advantages of this solid modeling/ finite element software.

The non-linear analysis capabilities of I-DEAS are utilized in carrying the FE analyses of the model which includes geometric non-linearity and material nonlinearity. Load is applied to the model in quasi-static manner by utilizing the load increment module of I-DEAS. Load increments are applied slowly during the analysis (i.e. simulates exactly the real life). The type of analysis done for this research effort is "static, non-linear analysis".

The symmetric nature of the problem allows only quarter of the whole panel to be modeled and meshed. The boundary conditions applied are shown on Figure 2.

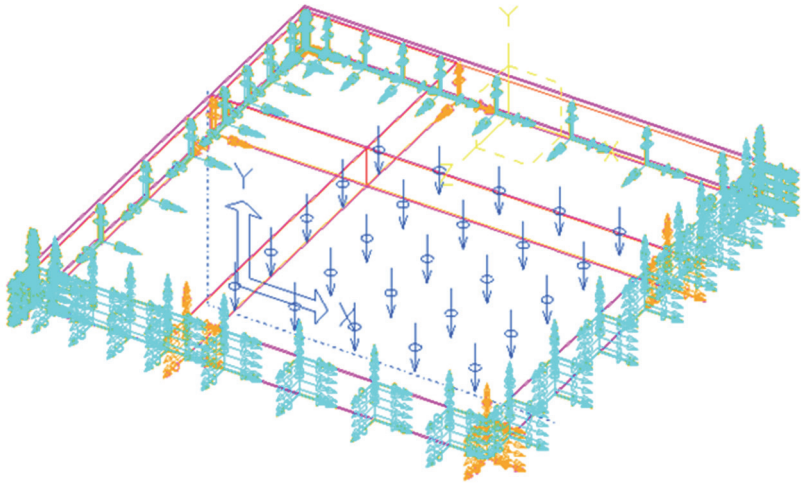


Figure 2. Sandwich panel boundary condition (cyan arrows) and loading (blue arrows)

The two planes of symmetry of the panel have symmetry boundary conditions. A simply supported boundary condition is applied to the other two sides of the quarter panel. A distributed load is applied on the top surface of the sandwich panel. The area on which the distributed load is applied is shown in Figure 2.

The FE software is set in such a way to solve the model at each load step. This allows each case to be done in a single run of the finite element model. As a result of this, the model would take less memory space because one single solid model and FE model can be used for all load steps of each case.

The numerical model utilizes the map meshing facility in I-DEAS. By controlling the number of nodes along each edge of the solid model, this function provides full control of the mesh size. The mesh is refined till the changes in the result are less than 0.5%. Constant mesh density is applied using the mapped meshing function. This is important because constant mesh density ensures that data collected from any region of the plate are of the same degree of resolution. Three-dimensional (solid) brick elements are used in this analysis. Second order (parabolic) brick elements are chosen over the first order (linear) brick elements in order to better interpolate the data between nodes.

Since the analysis involves material non-linearity, a yield function or yield criteria needs to be defined for the model. Von Mises yield criteria and its associated flow rule is used in this analysis. Isotropic hardening is also used to describe the changes of the yield criterion as a result of plastic straining. Only the core elements are assigned a yield function due to the assumption that only core yielding occurs throughout the loading process. The face sheets are assumed to remain elastic at all the time; hence no yield function is assigned to the face sheet elements. However the yield point of the face sheet material is fed to the software to be used as indicator for stopping the analysis.

2.3 Model Verification

To assure accuracy and validity of the results the model is verified experimentally and analytically. For experimental verification, selected cases are examined and compared with the FEM. Analytical model is produced based on the classical sandwich panel theory. The analytical solution covers only the elastic range whereas the experimental covers both the elastic and plastic ranges.

2.3.1 Experimental Verification

The following subsections explain the test setup utilized in the verification, the mechanical properties and the analysis of experimental results. The analysis show how close the experimental results to the FEM.

Test Setup

Here is a description of the experimental setup used in the study. It consists of the following:

1. The Specimens have been manufactured. Core of the sandwich panel is made of polyurethane foam. Top and bottom sheets of the sandwich panel are made of steel. The side length **a** of panel used for verification is 250mm. the Mechanical properties of the sheet metal and the core are obtained experimentally based on the corresponding ASTM Standard tests (ASTM-C273–94, 1994; ASTM-C297/C297M, 2004; ASTM-C365/C365M-11a, 2011; ASTM-D6416/D6416-99, 1999; ASTM-E8/E8M-13a, 2013). Steel sheet metal faces are used in the experimental verification instead of the Aluminum sheets due to the unavailability of the Aluminum sheets at the time of the experiment conduction. However the FEM was modified for steel and the comparison analysis were carried out.
2. Fixture for applying simply supported boundary condition is produced. Figures 3 show different views of the fixture.
3. The test is performed on a uniaxial testing machine that is shown in Figure 4. The system is a vertical column-tester, hydraulically driven, and with direct display of the force. The maximum testing force is 50 kN. In the working space, tensile force as well as compressive force can be applied. Distributed load is applied to the specimen by adaptors manufactured for this purpose. Figure 5 illustrates the adapters used in experimental setup that is square in shape and has side length of *d*. Different sizes of these adapters are produced to perform the experiments that are correspondent test specimens.

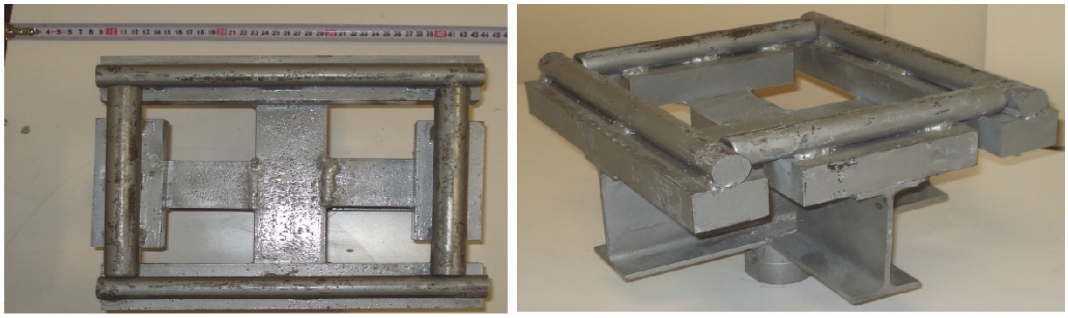
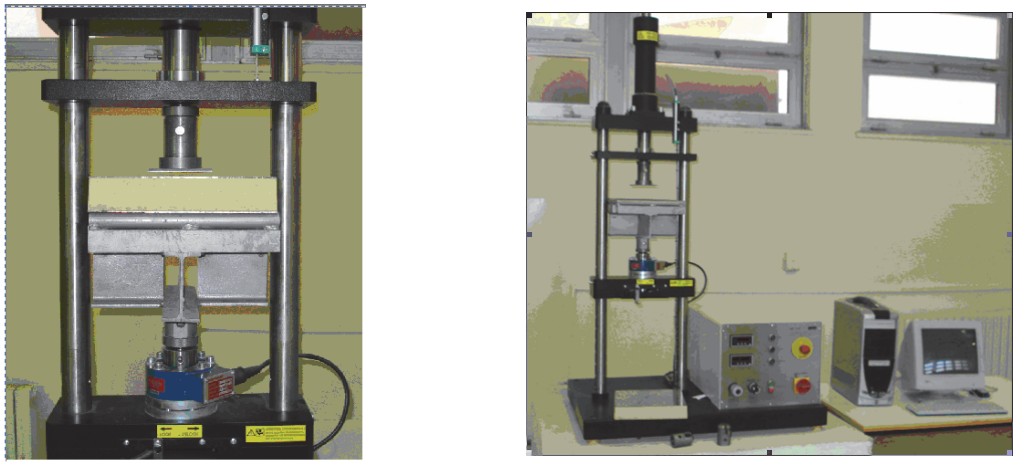


Figure 3. Presentation of the fixture that is produced for applying simply supported boundary condition (different views)



(a) (b)

Figure 4. Uniaxial testing machine a) with specimen and b) without specimen.

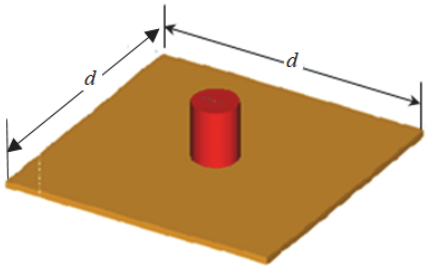


Figure 5. Illustration of the adapters used in the experiments for applying distributed load on specimen, where *d* is the side length

Mechanical Properties of the Specimen

The sandwich panel is made of polyurethane foam and steel sheets. The mechanical properties are obtained experimentally for both the core and the sheets by utilizing the following standards: (ASTM-C273–94, 1994) Standard test method for shear properties of sandwich core materials, (ASTM-C297/C297M, 2004) Standard Test Method for Flatwise Tensile Strength of Sandwich Constructions, (ASTM-C365/C365M-11a, 2011) Standard Test Method for Flatwise Compressive Properties of Sandwich Cores, (ASTM-E8/E8M-13a, 2013) Standard Test Methods for Tension Testing of Metallic Materials tests.

Analysis

(ASTM-D6416/D6416-99, 1999) Standard Test Method for Two-Dimensional Flexural Properties of Simply Supported Sandwich Composite Plates Subjected to a Distributed Load is utilized in conduction the testing for the sandwich panel. The experiments are carried out and the relation between the applied load and the deflection of the specimen center point is recorded. Figure 6 and Figure 7 presents the experiment and FEM results for core thickness 49mm and 71mm respectively. It may be seen that the results are in very good agreement.

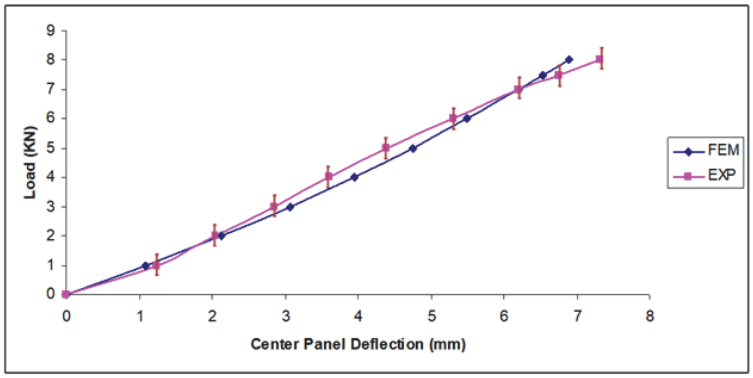


Figure 6. Comparison of load versus center deflection for core thickness = 49 mm, Sheet Thickness = 0.5 mm, applied load area = 200 mm*200 mm

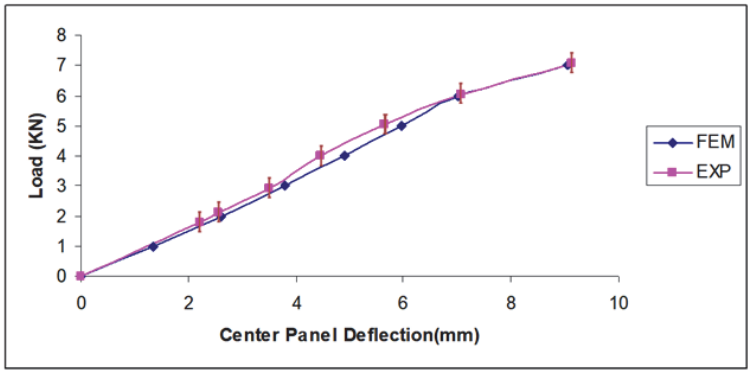


Figure 7. Comparison of load versus center deflection for core thickness=71 mm, sheet Thickness = 0.5 mm, applied load area = 150 mm*150 mm

To assure accuracy of the experimental results, the experiment is performed many times and the average of the readings is plotted. The variation in the experimental results dose not exceeds 7% of the average value. The error bars in Figures 6 and 7 show the range of variation of the experimental values over the mean value.

2.4 Analytical Verification

Classical sandwich theory has been utilized to obtain close form solution (Zenkert, 1995). The equations that are derived are programmed using **Matlab** Software. Appendix A presents the analytical model utilized in the verification. The comparison between the numerical and theoretical models in the linear range are presented in Figures 8 (a), (b) and (c). These Figures demonstrates very good agreement between theoretical and numerical solution.

The classical sandwich plate theory is used to compare and validate the numerically predicted shear distribution of the plate in the linear range. Comparison between the numerically determined shear distribution and the classical sandwich plate theory distribution is made for all load steps. It is assumed that the core carries the entire shear load in the linear range. Figures 8(a), (b) and (c) show the total shear resultant obtained by the finite element model against the theoretical model in the linear range. The data is collected at three load steps 17.2 KPa, 34.5 KPa and 51.7 KPa. The relative difference between the theoretical and the finite element results does not exceed 1%.

3. Results and Discussion

The core material (different materials with different modulus of elasticity) is varied for studying its influence on the sandwich panel behavior. The main advantage of this investigation over the sandwich panel theory is that both geometric and material nonlinearities are considered without approximation. Usually these approximations eliminate part of the problem physics. By utilizing "I-DEAS' pre and post processing module, stress and it is all components, strain and it is all components including the plastic strain, and deformations are obtained.

It is clear from Figure 9 (a) that the plastic deformation occurs close to the panel support (close to the area where boundary conditions are applied). The stress distribution is similar for all panels. The criterion that is adopted by this investigation, at what load step the FE model should stop is, either when anyone of the face sheets starts to yield or when the core material reaches the fracture limit. This criterion fulfills the designer need; in general, design engineers try to avoid panel permanent distortion or failure. As soon as the face sheet metal starts to yield, this means that permanent deformation is taking place. So all produced results do not exceed the loading that could cause face - sheet yielding. Von mises stress contour and deformation contour are presented in Figures 9 (b) and 9 (c) respectively. Figure 9 (b) shows that the stress is high near the edges and at the center of the core where the load is applied. Figure 9 (c) illustrates maximum deformation at the center of the panel.

Figure 10 (a), (b) and (c) demonstrate the effect of material stiffness. Since the modulus of elasticity is $E_A < E_B < E_C < E_D$, it can be seen that the softer the material is, the more load is transferred from core material to the sheet metal as the core starts to yield. The horizontal lines presented in Figure 10 (a) represent the shear strength of materials A, B and C. Each line has the same mark of its corresponding material. It is obvious that the load carrying capacity of the panel increases as its core material stiffness increases. It may be seen that in Figure 10 (a) the core material is still within the elastic range for C and D; however in Figure 10 (b) in the bottom face sheet starts to yield (entering the plastic range). As the core starts to yield, its maximum-stress increment-rate starts to decrease (see Figure 10 (b) and (c)) whereas the maximum-stress incremental-rate of the bottom - face – sheet starts to increase, this means that the load is being transferred to the face sheet-metal. This is the main advantage of increasing the load beyond the yield limit of the core material.

It is demonstrated in Figures 10 (a), (b) and (c) that as the stiffness of core material increases the load carrying capacity of panel increases. The increment of shear stress with respect to strain decreases as the load increases. In yield range, the post yield deformation rate of the core material is higher than that of the elastic range for the same load increment as presented in Figure 10 (a). This deformation works as a mechanism of transferring the excess load to the face sheets. For example panel A in Figures 10 (a), (b) and (c) the core reaches yield point at 1580 kPa load and it is stress stays constant while the bottom and top sheets stress keeps increasing.

As illustrated in Figure 9 (a) and (b), the metal material starts to yield (entering the plastic range) close to the support (where the boundary conditions are applied). This is physically true, the distributed load over the loading area becomes reaction force concentrated on the strip area on which the boundary conditions (simply supported boundary condition) are applied, i.e., distributed load is converted to concentrated load. So the area where the boundary conditions are applied reaches the yield stress range before any other part of the panel. The graphs

show that sheet material D has reached the yield point before the core material. This can be referred to the high stiffness of its core material, i.e., the panel gets closer in its behavior to isotropic plate.

It can be seen from Figure 10 (b) and (c) that the load carrying capacity has increased for materials C and D on the expense of low loading for the core material. The worst situation is for material D where the stress is almost half way to the yield limit (see Figure 10 (a) and Table 1). The material C is not much better than D because both the sheet metal and the core reach the yield limit almost at the same load. Materials A and B have gone beyond the yield limit and provide increase in the load carrying capacity. It is obvious in Figure 10 (b) that material A reached yield at load 1580 KN which is presented by the vertical line (that has the same mark as material A) and the yield of the bottom face sheet is reached at load 2632 KN (horizontal line in the graph). The difference between these two loads is the amount of increase in the load carrying capacity of material A, i.e. 67% increase in the load carrying capacity. For material C the yield load (vertical line) of the core material is almost the same load of bottom face sheet i.e., the vertical line on Figure 10 (b) that is correspondent to material C intersects with the curve of material C at the same point. The increase in the load carrying capacity of material C does not exceed 4 %. The percent increase in the load carrying capacity against the core to face sheet modulus of elasticity ratio that is obtained from FEM results analysis is plotted in Figure 11. Increasing the stiffness ratio beyond 0.0026 is of no benefit in gaining higher load carrying capacity as a result of increasing the load beyond the core yield limit. It may be seen that the relative increase of load carrying capacity is about 67 % to 59% for the range 0.0005 to 0.002 respectively. However it starts to decrease after stiffness ratio 0.002 till it reaches 4% at 0.0026.

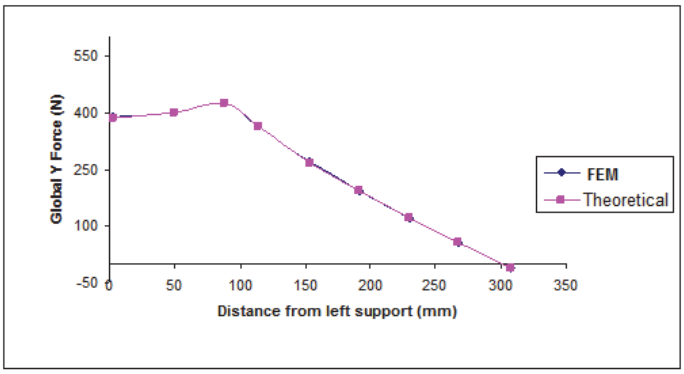
The results of this work are generated according to the univariate search optimization technique (Chapra & Canale, 2006). Based on this numerical optimization technique, the data has been produced by utilizing the parametric optimization module of 'I-DEAS' software.

4. Conclusions

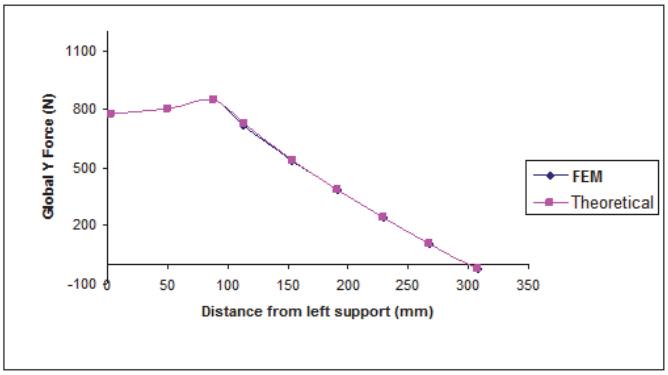
Investigation of sandwich panel behavior beyond core material yield is carried out. The investigation is accomplished in sight of the core material nonlinearity and the geometric nonlinearity of the whole panel. This model is validated against selected analytical and experimental cases. The model shows very good agreement with both the analytical and the experimental results and the max difference with FE model is 1% and 7% respectively.

The effects of core material stiffness necessary in designing sandwich panels are unveiled. It is also proved that the load carrying capacity of sandwich panel can be improved by loading the panel beyond the core yield limit. This load is going to be transmitted to the face sheet as long as the core material is relatively soft. The maximum increase in load carrying capacity achieved is 67% at stiffness ratio of 0.0005.

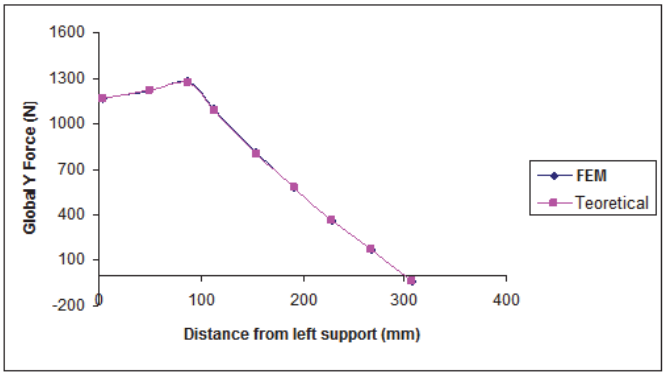
Increasing the stiffness of the core material to a certain extent leads to face sheet yielding before the core material. It is proved that increasing core stiffness increases the load carrying capacity of the sandwich panel. Increasing the stiffness ratio beyond 0.0026, this will lead to toward a behavior close to the isotropic plat.



(a)

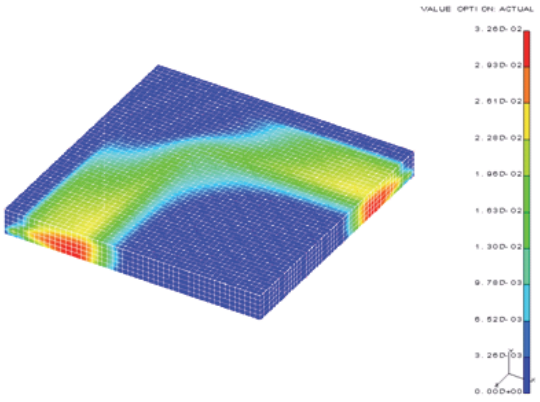


(b)

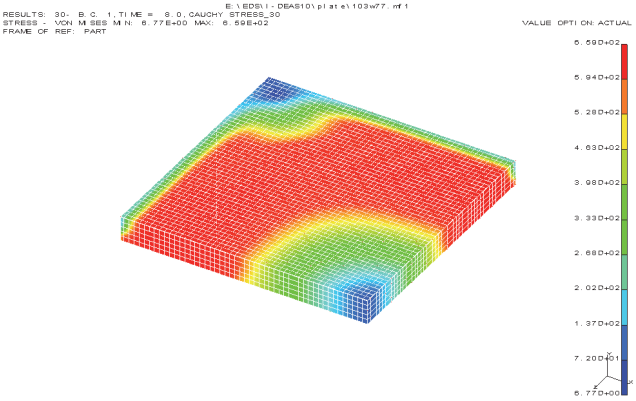


(c)

Figure 8. Total plate shear distribution comparison along X-axis at load a) 17.2 kPa, b) 34.5 kPa and c) 51.7 kPa



(a)



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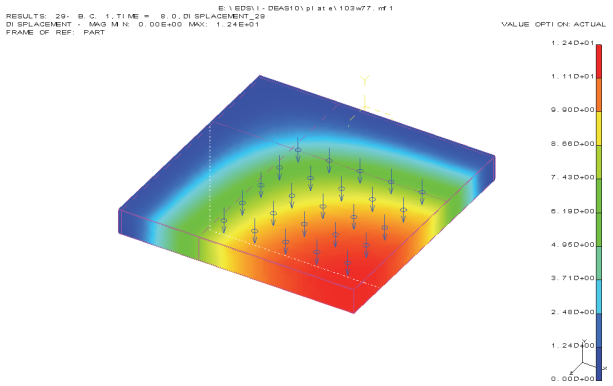
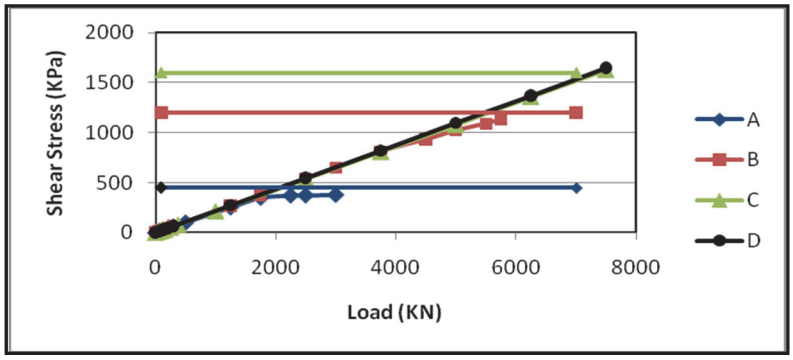
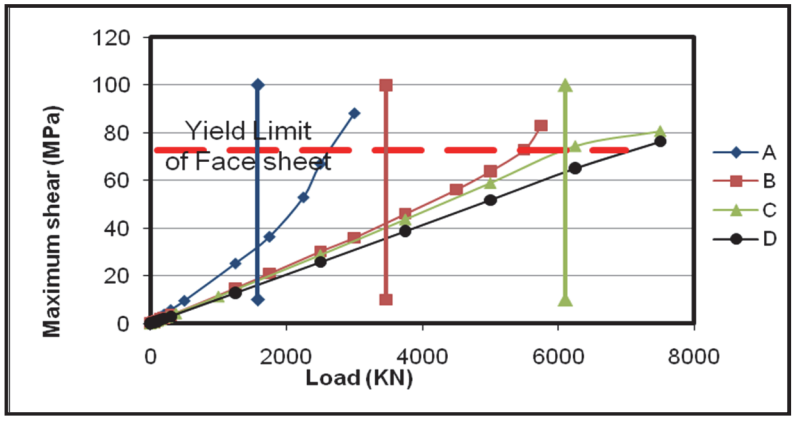


(c)

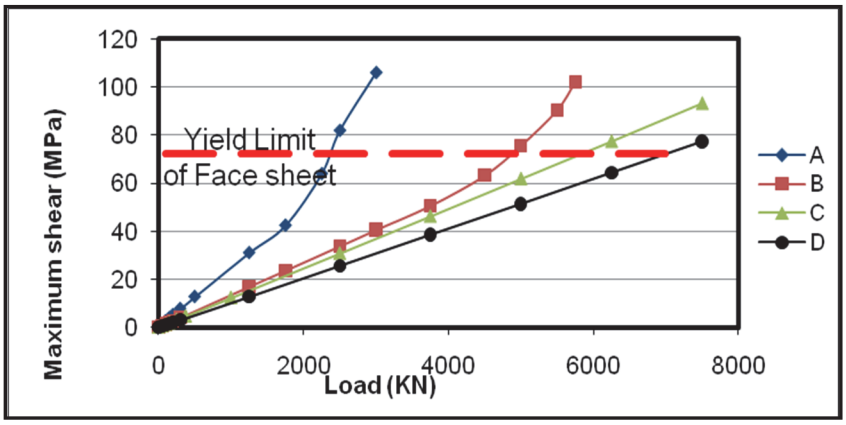
Figure 9. Illustration of A core material for loading area (200mmX 200mm) and core thickness of 30mm at load step 145 kPa, a) the core plastic deformations contour, b) Von Mises stress contour (in MPa) and c) the panel deformations contour



(a)



(b)



(c)

Figure 10. Illustration of maximum shear stress to shear yield stress versus load for a) core material, (b) lower Sheet and (c) upper Sheet

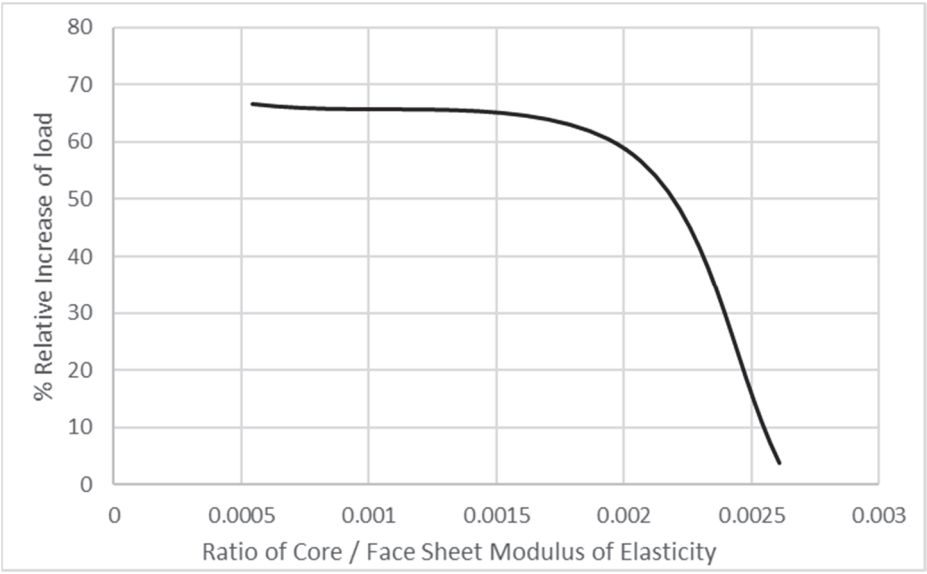


Figure 11. Illustration of the percent increase of load carrying capacity against the ratio of core to face sheet modulus of elasticity

References

Akour, S., & Maaitah, H. (2010). *Effect of Core Material Stiffness on Sandwich Panel Behavior Beyond the Yield Limit.* Paper presented at the World Congress on Engineering, London, U.K.

Akour, S., & Maaitah, H. (2012). Finite Element Analysis of Loading Area Effect on Sandwich Panel Behaviour Beyond the Yield Limit. In F. Ebrahimi (Ed.), *Finite Element Analysis - New Trends and Developments* (pp. 353-376). London-UNITED KINGDOM: Intech.

Akour, S., Maaitah, H., & Nayfeh, J. (2012). Effect of Core Thickness on Load Carrying Capacity of Sandwich Panel Behavior Beyond Yield Limit. In A.-T. Evon, S. Asim El, & J. Mostafa (Eds.), *Technology Engineering and Management in Aviation: Advancements and Discoveries* (pp. 171-181). Hershey, PA, USA: IGI Global.

Allen, H. G. (1969). *Analysis and Design of Structural Sandwich Panels - 1st Edition*: Pergamon Press, Oxford.

ASTM-C273–94. (1994). *Standard test method for shear properties of sandwich core materials* (Vol. 15).

ASTM-C297/C297M. (2004). *Standard Test Method for Flatwise Tensile Strength of Sandwich Constructions* (Vol. 03).

ASTM-C365/C365M-11a. (2011). *Standard Test Method for Flatwise Compressive Properties of Sandwich Cores* (Vol. 15).

ASTM-D6416/D6416-99. (1999). *Standard Test Method for Two-Dimensional Flexural Properties of Simply Supported Composite Sandwich Plates Subjected to a Distributed Load* (Vol. 15).

ASTM-E8/E8M-13a. (2013). *Standard Test Methods for Tension Testing of Metallic Materials* (Vol. 15).

Boyer, H. E., & Gall, T. L. (1991). *Metals Handbook*. USA: American Society for Metals.

Caprino, G., & Langella, A. (2000). Study of a three-point bending specimen for shear characterisation of sandwich cores. *Journal of Composite Materials, 34*(9), 791-814.

Chapra, S., & Canale, R. (2006). *Numerical Methods for Engineers* (5th ed.). McGraw-Hill.

Frostig, Y., Baruch, M., Vilnay, O., & Sheinman, I. (1992). High-Order Theory for Sandwich-Beam Behavior with Transversely Flexible Core. *Journal of Engineering Mechanics-Asce, 118*(5), 1026-1043. https://doi.org/10.1061/(asce)0733-9399(1992)118:5(1026)

Gdoutos, E. E., Daniel, I. M., Wang, K. A., & Abot, J. L. (2001). Nonlinear behavior of composite sandwich beams in three-point bending. *Experimental Mechanics, 41*(2), 182-189. https://doi.org/10.1007/bf02323195

Kuang-An, W. (2001). *Failure Analysis of Sandwich Beams.* Northwestern University, Evanston, Illinois.

Mercado, L. L., & Sikarskie, D. L. (1999). On the response of a sandwich panel with a bilinear core. *Mechanics of Composite Materials and Structures, 6*(1), 57-67. https://doi.org/10.1080/107594199305656

Mercado, L. L., Sikarskie, D. L., & Miskioglu, I. (2000). *Higher order theory for sandwich beams with yielded core*. Paper presented at the 5th international conference on sandwich structures, Zurich.

Plantema, F. J. (1966). *Sandwich construction : the bending and buckling of sandwich beams, plates, and shells*. New York, USA: Wiley.

Rao, T. (2002). *Study of Core Compression Using Digital Image Correlation (DIC).* (Master of Science), Michigan Technological University, Houghton, Michigan.

Thomsen, O. T. (1993). Analysis of Local Bending Effects in Sandwich Plates with Orthotropic Face Layers Subjected to Localized Loads. *Composite Structures, 25*(1-4), 511-520. https://doi.org/10.1016/0263-8223(93)90199-z

Thomsen, O. T. (1995). Theoretical and Experimental Investigation of Local Bending Effects in Sandwich Plates. *Composite Structures, 30*(1), 85-101. https://doi.org/10.1016/0263-8223(94)00029-8

Triantafillou, T. C., & Gibson, L. J. (1987). Minimum weight design of foam core sandwich panels for a given strength. *Materials Science and Engineering, 95*(Novmber), 55-62. https://doi.org/10.1016/0025-5416(87)90497-6

Zenkert, D. (1995). *An Introduction to Sandwich Construction*: Engineering Materials Advisory Services.

Appendix A

Analytical Model

The following is derivation of the analytical model used in the analytical verification of the FEM. Classical Sandwich panel theory is used in developing this model.

Consider a sandwich plate with dimension *a. b* as shown in Figure A.1. The positive senses for shear forces (Q_x, Q_y) acting on the panel are shown in Figure A.2. The shear forces have units of force per unit length.

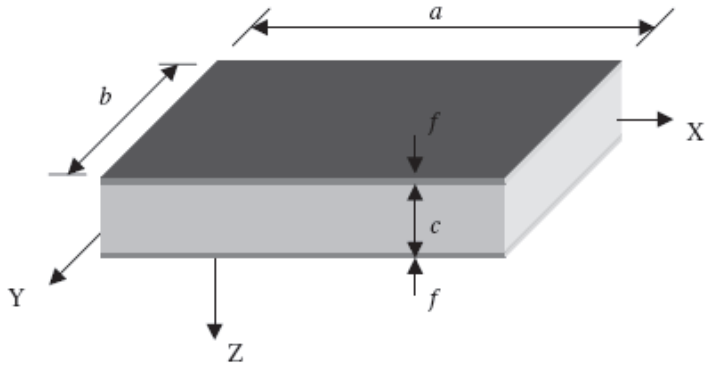


Figure A.1. Sandwich panel geometry

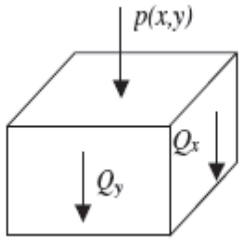


Figure A.2. Positive senses of forces

For sandwich plates that have a high overall length to thickness ratio, a small face sheet to overall thickness ratio, and a high face sheet to core mechanical properties ratio, the following assumptions are classically made:

1. Plane sections before deformation remain plane after deformation.
2. Transverse normal stiffness of core is infinite (i.e. no change in plate thickness).
3. Overall deflection is small compared to the thickness of the plate (i.e. no geometric non-linearity.
4. Slopes of the plate are small enough such that $tan(\frac{dw}{dx}) \cong \frac{dw}{dx}$
5. The core carries the entire shear load and the face sheets carry all bending load.
6. The total displacement of the sandwich plate is the result of bending and shear deformation.
7. The strains are small enough that the linear strain displacement relationship is valid, i.e.

$$\varepsilon_x = \frac{\partial u}{\partial x}$$

8. The core and face sheets are perfectly bonded.

One of the assumptions in the classical sandwich plate theory is that the core carries the entire shear load. Therefore the shear load can also be expressed in terms of core shear rigidity and shear deflection:

$$Q_x = \tau_{xzc} c = G_{c0} c \gamma_{xzc} = S \frac{\partial w_s}{\partial x} \tag{A.1}$$

$$Q_y = \tau_{yzc} c = G_{c0} c \gamma_{yzc} = S \frac{\partial w_s}{\partial y} \tag{A.2}$$

The boundary conditions for a simply supported sandwich panel are shown in Figure A.3. The total deflection and the second derivative of the bending deflection should vanish along the edges of the simply supported plate as shown in the figure.

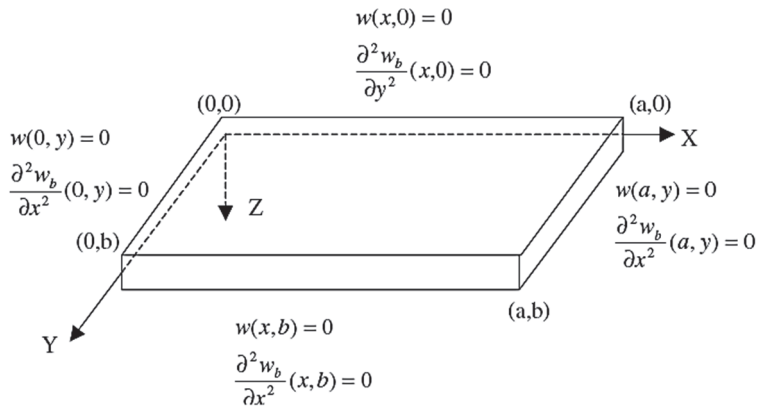


Figure A.3. Simply supported boundary condition for a sandwich panel

In order to find an expression that satisfies the simply supported boundary condition, a Fourier sine series solution, also called Navier's solution, is used. This solution automatically satisfies the expression of the bending deflection, shear deflection and the applied load terms within the simply supported panel under distributed load.

$$w_s(x,y) = \sum_{m}^{\infty} \sum_{n}^{\infty} r_{mn} \sin(\alpha x) \sin(\beta y) \qquad m,n = 1,2,3..... \tag{A.3}$$

$$p(x,y) = \sum_{m}^{\infty} \sum_{n}^{\infty} p_{mn} \sin(\alpha x) \sin(\beta y) \qquad m,n = 1,2,3..... \tag{A.4}$$

Where $\alpha = \frac{m\pi}{a}$ and $\beta = \frac{n\pi}{b}, r_{mn},$ and P_{mn} are unknown coefficients and a, b are the length and the width of the panel between the support.

The step pressure model assumes a uniform distributed load applied on the surface of the sandwich panel over a corresponding square effective area. Figure C.4 shows the schematic of the step pressure model.

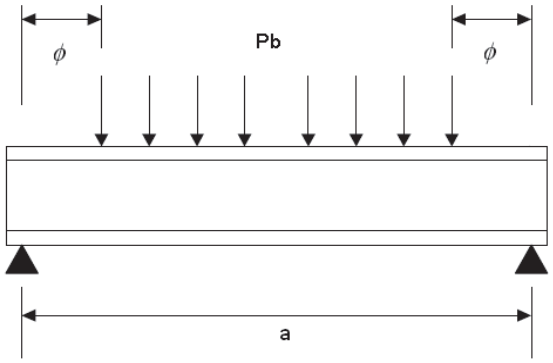


Figure A.4. Step pressure model on simply supported sandwich plate

This loading model can be represented mathematically as:

$$P(x,y) = \begin{cases} P_b & \emptyset \le x,y \le (a-\emptyset) \\ 0 & elsewhere \end{cases} \tag{A.5}$$

The effective contact area, A_{eff} and the width of the unloaded region ϕ are given by the expressions:

$$\phi = \frac{1}{2}(a - \sqrt{A_{eff}}) \tag{A.6}$$

With the step pressure model defined, r_{mn}, and p_{mn} can be determined by using equations A.3 and A.4

$$p_{mn} = \frac{16 p_b \cos(\frac{m\phi\pi}{a})\cos(\frac{m\phi\pi}{b})}{\pi^2 mn} \qquad m,n = 1,3,5.... \tag{A.7}$$

$$r_{mn} = \frac{p_{mn}}{S(\alpha^2 + \beta^2)} \qquad m,n = 1,3,5.... \tag{A.8}$$

From equations A.1, A.2 and A.3, the shear stress components of the can be represented as:

$$\tau_{xzc} = G_{c0}\frac{\partial w_s}{\partial x} = \sum_m^\infty \sum_n^\infty r_{mn}\cos(\alpha x)\sin(\beta y)(G_{c0}\alpha) \tag{A.9}$$

$$\tau_{yzc} = G_{c0}\frac{\partial w_s}{\partial y} = \sum_m^\infty \sum_n^\infty r_{mn}\sin(\alpha x)\cos(\beta y)(G_{c0}\beta) \tag{A.10}$$

In order to find the resultant shear load carried by the structure along any span pf the plate in the *X* and *Y*-axes, equations A.9 and A.10 are integrated with respect to their respective cross section areas. The results are:

$$Q_{xzc} = \int_0^c \int_0^b \tau_{xzc} dydz = \sum_m^\infty \sum_n^\infty r_{mn}\cos(\alpha x)(1-\cos(\beta y))(\frac{cG_{c0}\alpha}{\beta}) \tag{A.11}$$

$$Q_{yzc} = \int_0^c \int_0^b \tau_{yzc} dydz = \sum_m^\infty \sum_n^\infty r_{mn}\cos(\beta y)(1-\cos(\alpha a))(\frac{cG_{c0}\beta}{\alpha}) \tag{A.12}$$

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Electronic Structure and Dipole Moment Calculations of the Electronic States of the Molecule ZnS

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Abstract

In this study, the low lying electronic states and spectroscopy of diatomic molecule ZnS in addition to its dipole moments have been investigated by performing highly correlated ab initio calculations, the Complete Active Space Self Consistent Field (CASSCF) method with Multi Reference Configuration Interaction (MRCI+Q) for an accurate picture for these states. The proposed study includes information about the potential energy curves of the lowest 12 singlet and 9 triplet electronic states of the molecule ZnS, in the representation $^{2s+1}\Lambda^{(+/-)}$. Nine of these states have been studied here for the first time. The harmonic frequency w_e, the internuclear distance r_e, the electronic energy with respect to the ground state T_e, the rotational constant B_e, and the permanent dipole moment μ have been calculated, compared and compiled with the available existing data to illustrate the electronic characteristics. The comparison of these values reveals a very good agreement.

Keywords: *ab initio* calculation, electronic structure, spectroscopic constants, potential energy curves, dipole moments

1. Introduction

The zinc Chalcogenides (ZnS, ZnSe, and ZnTe) are diatomic molecules yield from the combination between a metal of group IIb (Zn, Cd, Hg) with a valence electronic configuration ns^2 and a chalcogen (O, S, Se, Te) with a valence electronic configuration $n's^2n'p^4$ (Chamboud 2008). These compounds have the wide band gap, the high iconicity (0.77, 0.63, and 0.49 respectively) of chemical bond, the smaller energy of formation of vacancies, and they are very sensitive to any strain (Peterson, Spheler, Singleton, 2007).

These compounds are the promising materials for their use in many optoelectronic applications. The zinc sulphide ZnS exists both in natural and synthetic crystalline form possessing cubic or hexagonal structures. The poly-nuclear diatomic molecule ZnS is used in luminescent materials such as X-ray screens to glow in the dark products. With copper this molecule is used in electroluminescent panels and also exhibit phosphorescence. ZnS is used also for infrared optical materials such as optical window or shaped into lenses, pigment which with barium sulfate forms lithopone used for interior paints and a pigment used to change color of reflected or transmitted ray. Also it is commonly used as a source of evaporation and as a semiconductor for electronic and solar applications. Away from lab, ZnS is usually produced from waste materials such as cosmetic, pharmaceutical, and rubber industries. Thus, they perform a toxicity and harmful impact on aquatic life as disturbing the dissolved oxygen content of the water (Wikipedia).

The aim of this study is to calculate the near-equilibrium potential energy of the lowest electronic states of diatomic molecule zinc sulfide ZnS. $^1S^+$ and ^3P are the ground and the first exited states respectively. The $^1S^+$ ($1s^2,1d^4,1p^4,2s^2,3s^2,2p^4,4s^0$) is known always as shorter equilibrium band energy dissociation and larger dipole moment compared to those of ^3P ($1s^2,1d^4,1p4,2s^2,3s^2,2p^3,4s^1$) where state $^1S^+$ is stabilized relative to ^3P. Because of these properties, any small change in the bond length leads to a great change in the electronic structure without involving a large quantity of energy (Chamboud 2008).

2. Method

The given study is based on configuration interaction (CI) and on Multi-Reference configuration interaction methods (MRCI) where the CI calculation includes instantaneous electron correlation. It is also called as configuration mixing method (CM) where it involves first-higher order corrections to the Hartree-Fock wave

function. It is useful for calculating excited states of molecules, where the Hartree-Fock fails (Atkins & Friedman).

In the present work, the low-lying singlet, and triplet electronic states of the molecule ZnS are calculated using Complete Active Space Self Consistent Field (CASSCF) procedure followed by a multireference configuration interaction (MRCI+Q with Davidson correction) treatment for the electron correlation. The entire CASSCF configuration space was done by the means of the computational chemistry program MOLPRO (MOLPRO) taking advantage of the graphical user interface GABEDIT (Allouche 2011).

The 30 electrons of zinc atom and the 16 electrons of sulfur atom are taken as a system relative to ECP10MDF as basis set for *s*, *p*, and *d* orbitals, and ECP10MWB basis z-set for *s* and *p* orbitals with *d* orbital which is treated by aug-cc-PVDZ basis set respectively. Therefore, the diatomic molecule is studied as 26 free electrons among 12 electrons were frozen and 14 as valance electrons corresponding to active orbitals were explicitly treated with 10 valance orbitals.

3. Results

3.1 Potential Energy Curves and Spectroscopic Constants

The potential energy curves (PECs) for the 21 singlet, and triplet electronic states, in the representation $^{2s+1}\Lambda^{(+/-)}$, of the molecule ZnS were performed using the MRCI+Q for internuclear distances calculations in the range 1.4Å≤ R_e ≤4.4Å (figs. (1-2)) and in the range 1.5Å≤ R_e ≤9.6Å (figs.(3-4))

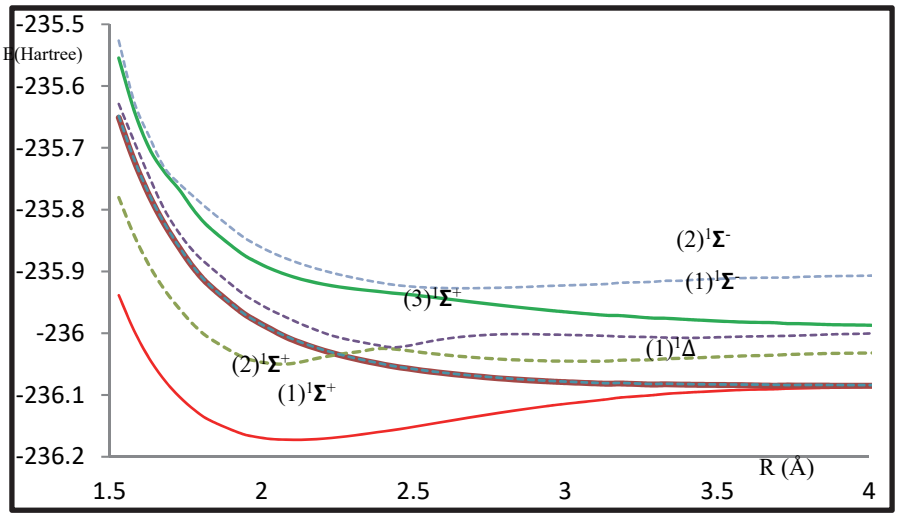

Figure 1. Potential Energy Curves of the $^1\Sigma^{\pm}$ and $^1\Delta$ States of the Molecule ZnS

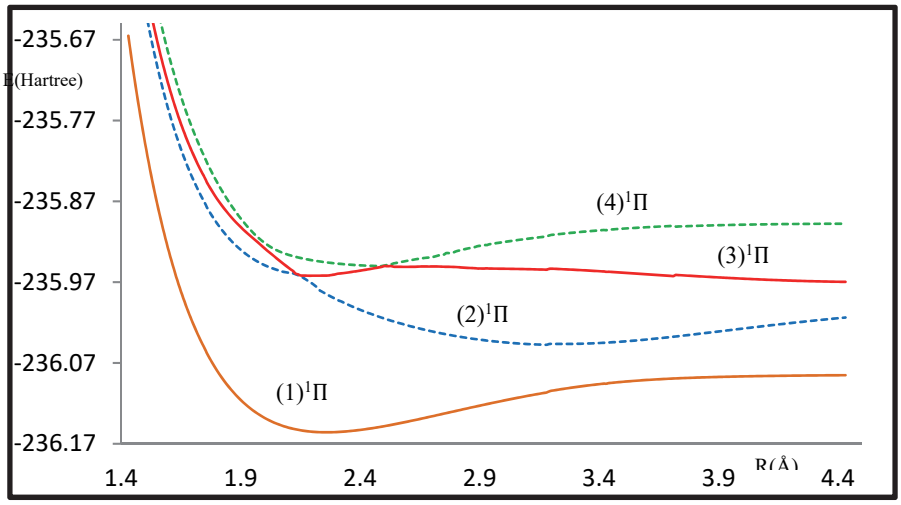

Figure 2. Potential Energy Curves of the $^1\Pi$ States of the Molecule ZnS

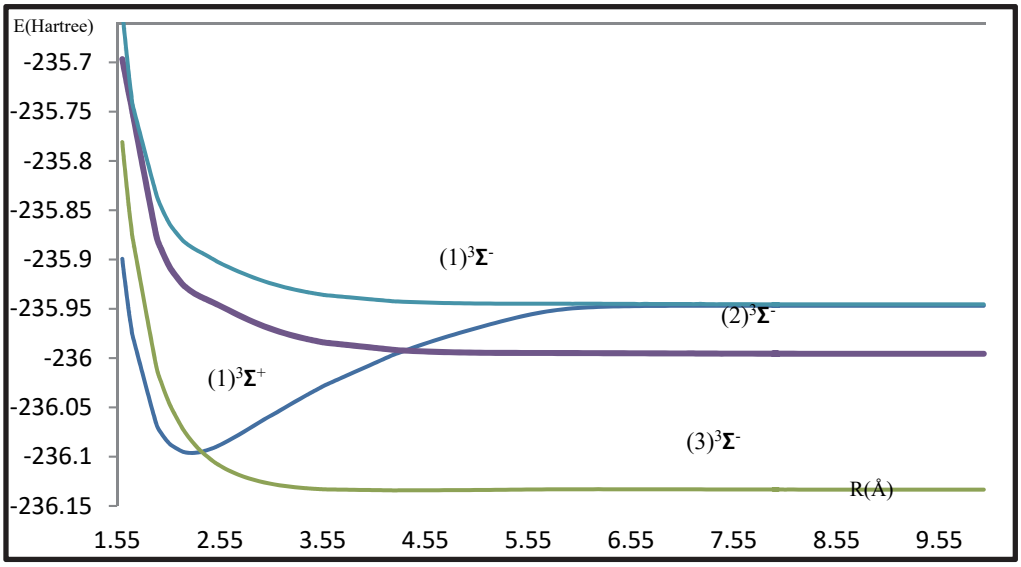

Figure 3. Potential Energy Curves of the $^3\Sigma^{\pm}$ States of the Molecule ZnS

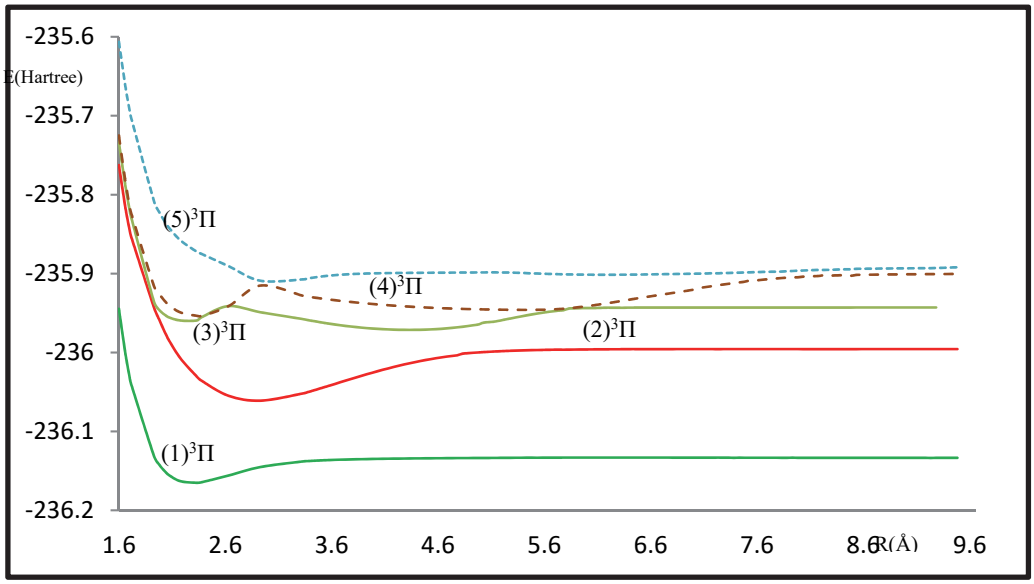

Figure 4. Potential Energy Curves of the $^3\Pi$ States of the Molecule ZnS

The spectroscopic constants ω_e, T_e, and B_e have been obtained by calculating points around the internuclear distance at equilibrium R_e. Table 1 illustrates the spectroscopic constants for some lowest singlet and triplet electronic states of ZnS diatomic molecule. The obtained results are compared with other available studies (Peterson, Spheler, & Singleton 2007), (Peterson, Spheler, & Singleton 2007 -CCSD(T)), (Chamboud 2008), (Raptis, Papadopoulos, Sadlej, 1999), (Jensen, Roos, & Ryde 2007), (Boldyrev, & Simsons 1997), (Bauschlicher, & Partridge .H 2001), (Dolg, Wedig, Stoll, & Preuss, 1987), and (Kullie, Zhang, Kolb, & Kolb, 2006).This comparison of the values is also shown in the given table.

Table 1. The Spectroscopic Constant of Diatomic Molecule ZnS

State	T_e cm^{-1}	$\Delta T_e/T_e$ %	R_e Å	$\Delta R_e/R_e$ %	B_e cm^{-1}	$\Delta B_e/B_e$ %	ω_e cm^{-1}	$\Delta\omega_e/\omega_e$ %
$X^1\Sigma^+$	0.0[a]		2.106		0.1766		421.1	
	0.0[b]		2.046	2.93			459.4	8.33
	0.0[c]		3.886	45.80			472.7	10.91
	0.0[d]		3.87	45.58			447.0	5.79
	0.0[e]		3.92	46.27				
	0.0[f]		2.12	0.66				
	0.0[g]		3.91	46.1				
	0.0[i]		2.083	1.10			434.0	2.97
	0.0[j]		2.048	2.83			478.0	11.90
	0.0[k]		2.074	1.54			447.0	5.79
$(1)^3\Pi$	1646.45[a]		2.29		0.1491		305.69	
	3840.00[b]		2.22	3.05			343.8	11.08
	3980.00[c]		2.23	2.69			347.00	11.90
	2258.00[g]		2.25	1.77			329.00	7.08
	1797.70[i]		2.30	0.43			287.00	6.51
	2334.80[j]		2.22	3.05			349.00	12.40
	1141.80[k]		2.25	1.77			329.00	7.08
	2257.68[l]							
$(2)^1\Sigma^-$	3243.03[a]		2.17		0.1656		388.11	
$(1)^1\Pi$	4464.00[a]		4.27		0.1656		351.82	
	6888.00[c]		4.21	1.42			363.80	3.29
$(1)^3\Sigma^+$	9375.03[a]		4.70		0.3701		271.57	
	9696.36[i]		6.04	22.18			7.00	100
	9864.47[j]		4.52	3.98			20.00	100
	7462.84[k]		4.62	1.73			18.00	100
	8798.25[l]							
$(2)^3\Sigma^+$	16778.1[a]		2.27		0.1517		324.68	
	18539.4[i]		2.25	0.88			309.00	5.07
	18340.7[j]		2.21	2.71			336.00	3.36
	16937.4[k]		2.22	2.25			335.00	3.08
	17899.3[l]							
$(2)^3\Pi$	24479.86[a]		2.89		0.9350		226.53	
$(3)^3\Pi$	46551.32[a]		3.33		0.7028		705.09	
$(3)^3\Sigma^-$	52520.27[a]		2.63		0.1129		221.19	
$(4)^3\Sigma^-$	54313.69[a]		2.63		0.1130		207.91	
$(4)^1\Pi$	54509.71[a]		2.49		0.1257			
$(2)^1\Delta$	64438.19[a]		2.55		0.1199		217.88	

[a]Present Work, [b] (Peterson, Spheler, & Singleton, 2007), [c] (Peterson, Spheler, & Singleton, 2007 - CCSD(T)), [d](Chamboud 2008), [e] (Raptis, Papadopoulos, & Sadlej, 1999), [f] (Jensen, Roos, & Ryde, 2007), [g](Boldyrev, & Simsons, 1997), [i] (Bauschlicher,& Partridge, 2001), [j] (Dolg, Wedig, Stoll, & Preuss, 1987), [k](Kullie, Zhang, Kolb, & Kolb, 2006).

By examining the given data, you notice that $^1\Sigma^+$ is the lowest electronic state of the diatomic molecule ZnS followed by $^3\Pi$ and $^1\Pi$ respectively. These states are close to each other (Chamboud 2008). For ZnS molecule the three states, $^1S^+$, ^3P and $^3S^+$ have short bond lengths and high frequencies and therefore they are chemically bound, while the $^3S^-$ state is of long bond and very low vibrational frequency. The $^1\Sigma^+$ is known always as shorter equilibrium band energy dissociation and larger dipole moment compared to those of $^3\Pi$ where state $^1\Sigma^+$ is stabilized relative to $^3\Pi$ (Chamboud 2008). The $^1S^+$ state was concluded as ground electronic state with r_e (the internuclear distance) = 2.106 Å and w_e (the harmonic frequency) =421.15 cm^{-1} which are compatible with other studies performed before and acceptable with percentage 2.9%, 0.66%, 1.1%, 2.8%, and 1.5% relative to some studies with respect to r_e. Similarly for ω_e it is compatible with some studies with percentage 2.9%, 5.7%, 7.1%, and 8.3%. And those the first exited state ^3P are calculated to be r_e= 2.29 Å and w_e= 305.69 cm^{-1} which are also in agree with those obtained in previous studies with percentage 0.5%, 1.4%, 1.7%, and 2.6% relative to r_e and

6.5%, and 7% with respect to ω_e. The sulfur atoms correlate in their ^3P ground electronic state with the ground electronic state of Zn to form $^3S^-$ states, not the singlet $^1S^+$ ground state. By comparing r_e and ω_e values - 4.27Å and 351.82 cm^{-1} respectively - of $^1\Pi$ with values performed by other studies, the results are compatible by 1.4% and 3.2% respectively. In case of $(1)^3\Sigma^-$, r_e shows compatibility with other studied by 1.5% and 3.9% while ω_e shows a big difference with results of other studies, whereas the $(2)^3\Sigma^-$ shows a good compatible with other studies by 0.75%, 1.9%, and 2.4% for r_e and 3%, 3.3%, and 5% for ω_e. The other electronic states are not compared to the fact that they r studied for the first time. By proposing the comparison for T_e we will see some compatible results with good percentage such that: $^3\Pi$ agrees by 8.4%, $(1)^3\Sigma^-$ and $(2)^3\Sigma^+$ agree with other results by 3.3% and 0.94% respectively. Other electronic states like $^1\Pi$ show a big disagreement with the only result performed by 35% as well as $^3\Pi$ which shows also a big disagreement with a mentioned study by 58%. The rest of states are compared since as it was mentioned before are being studied for the first time. According to the rotational constant B_e, no comparison are done since it is not calculated by other studies. One can notice that our calculated values of the spectroscopic constants are in better agreement with experimental data then the theoretical values given in literature for these constants. With this agreement with literature values, we can predict the accuracy of the spectroscopic constants of the new electronic states investigated for the first time in the present work.

3.2 Static Dipole Moment

By taking the Zn atom at the origin and sulfur atom along the internuclear Z-axis, we present in Figs (5-6-7-8) the calculated values of the static dipole moment in term of the internuclear distance R.

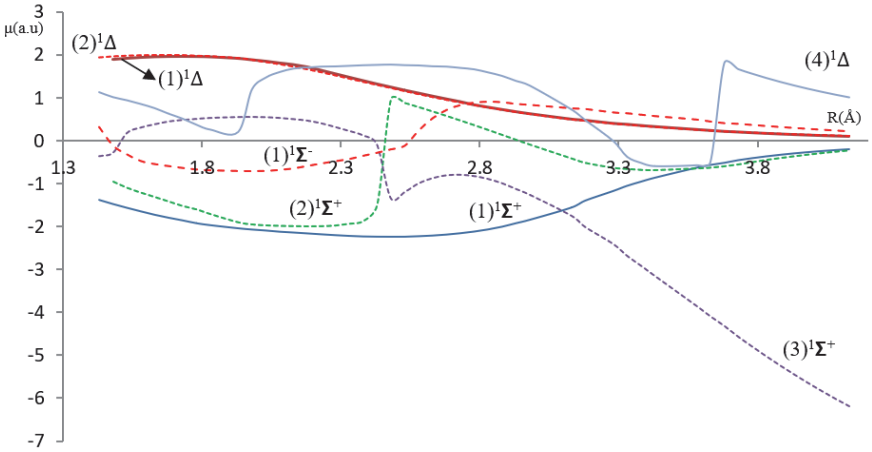

Figure 5. Static Dipole Curves of the Electronic States $^1\Sigma^{\pm}$, and $^1\Delta$ of the Molecule ZnS

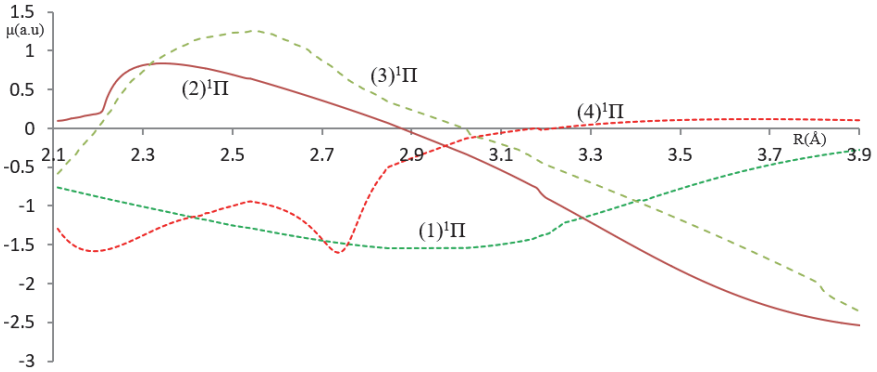

Figure 6. Static Dipole Curves of the Electronic States $^1\angle$ of the Molecule ZnS

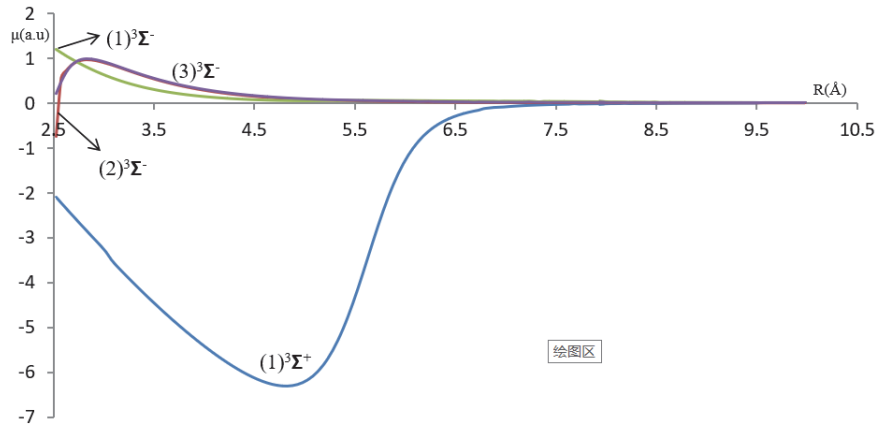

Figure 7. Static Dipole Curves of the Electronic States $^3\Sigma^{\pm}$ of the Molecule ZnS.

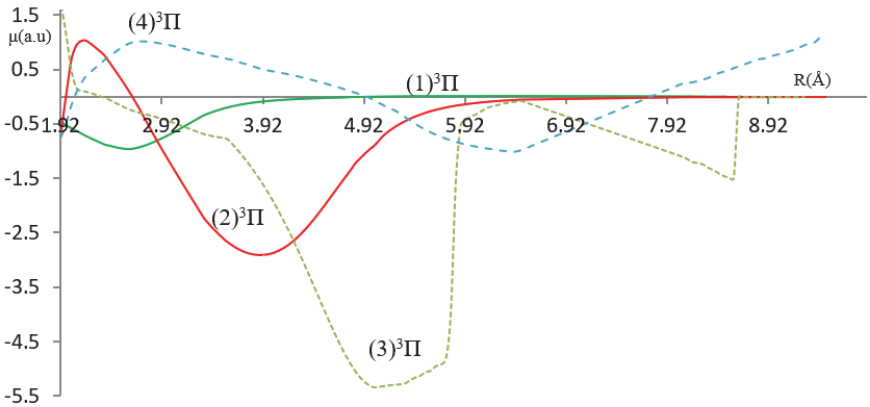

Figure 8. Static Dipole Curves of the Electronic States $^3\Pi$ of the Molecule ZnS.

The dipole value of the $^1S^+$ state is much higher than that of the two P states, which lie somehow above that of the $^3S^-$ state. Except for the dipole moment of the ^1P state, these values vary little with the inter-atomic distance (Chamboud 2008). The investigation of these curves is mainly used to discuss the bond nature, the polarity of the states and their interactions. As the internuclear distance increases one can notice three types of the DMC's for the singlet, triplet and quintet electronic states: curves in the positive region which are corresponding to an ionic structure of $Zn^{\delta-}S^{\delta+}$ type, curves in the negative region which are corresponding to an ionic structure of $Zn^{d+}S^{d-}$ type, and curves passing from one region to another by changing the ionic structure. It is noticed that at large internuclear distances, the dipole moment curves of all the investigated electronic states tend smoothly to zero which is theoretically the correct behavior for a molecule that dissociates into natural fragments. The sharp change in the directions of the DM curves indicate an avoided crossing of the potential energy curves at the same position of the internuclear distance where the polarity of the atoms is reversed (Atkins & Friedman). From this agreement, we can confirm the validity and the accuracy of the calculation of the studied excited electronic states.

It is known that the canonical functions approach can replace the radial Schrödinger equation (Kobeissi, Korek, & Dagher 1989), and (Korek 1999) where the eigenvalues E_v, and the rotational constants B_v have been calculated for the electronic states $(1)^3P$ and $(1)^3S^+$. These values are given in Table 2.

Table 2. The Eigenvalue E_v, and the Rotational Constant B_v of the Molecule ZnS.

State	V	$E_v(cm^{-1})$	$B_v \times 10^2$ (cm^{-1})
	0	164	16.77
	1	489	16.536

$(1)^3\Pi$	2	809	16.388
	3	1124	16.249
	4	1433	16.104
	5	1737	15.981
	6	2035	15.943
	7	2326	16.137
	8	2612	16.617
	9	2890	15.279
	10	3162	15.1
	11	3427	14.915
	12	3685	14.724
	13	3936	14.53
	14	4179	14.356
	15	4415	14.288
	16	4641	14.499
	17	4858	15.006
	18	5066	15.309
	19	5262	9.359
	20	5448	23.647
	21	5623	10.533
	22	5786	160.918
	23	5937	13.705
	24	6075	6.388
	25	6200	32.162
	26	6313	14.111
$(1)^3\mathbf{\Sigma}^+$	0	177	16.8872
	1	519	16.8051
	2	854	16.6824
	3	1190	16.6229
	4	1519	16.5143
	5	1848	16.4259
	6	2174	16.3458
	7	2499	16.2474
	8	2821	16.1613
	9	3140	16.0593
	10	3457	15.9611
	11	3771	15.8657
	12	4082	15.7654
	13	4391	15.6692
	14	4698	15.5691
	15	5003	15.4653
	16	5305	15.362
	17	5605	15.2522
	18	5903	15.1344
	19	6199	15.0078
	20	6492	14.8649
	21	6784	14.7024
	22	7073	14.5212
	23	7359	14.3194
	24	7643	14.0992
	25	7924	13.8691
	26	8202	13.6377
	27	8476	13.4175
	28	8746	13.2303

	29	9014	13.0954
	30	9281	13.0085
	31	9546	12.9417
	32	9811	12.8689
	33	10074	12.7819
	34	10335	12.6821
	35	10594	12.5678
	36	10851	12.4377
	37	11107	12.299
	38	11361	12.1639
	39	11613	12.0434
	40	11864	11.9426
	41	12112	11.8597
	42	12359	11.7867
	43	12604	11.7147
	44	12848	11.6352
	45	13089	11.543
	46	13329	11.438
	47	13568	11.326
	48	13804	11.215
	49	14039	11.1131
	50	14272	11.024
	51	14504	10.9482
	52	14733	10.8808
	53	14962	27.4959
	54	15188	10.7447
	55	15413	9.9711
	56	15636	74.6
	57	15858	26.3

To draw connections among the different investigated data, we will refer to the following spectroscopic formulas (Herzberg 1950)

$$E_v = \omega_e(v+1/2) - \omega_e x_e(v+1/2)2 + ..$$

$$B_v = B_e - \alpha(v+1/2) ..$$

For $v = 0$ of the electronic states $(1)^3\Pi$ and $(1)\ ^3\Sigma^+$, with approximation to the first term, implies that $\omega_e = 328$ cm^{-1} is a constant whose value is in good accordance to $\omega_e = 312$ cm^{-1}, and $\omega_e = 354$ cm^{-1} is close to $\omega_e = 340$ cm^{-1} respectively. Also, the value of $B_e = 0.1682$ cm^{-1} is close to the value of $B_e = 0.1491$ cm^{-1}, and $B_e = 0.1679$ cm^{-1} is close to $B_e = 0.1493$ cm^{-1} respectively. No comparison with other data since they given here for the first time.

4. Conclusion

The ab-*initio* MRCI+Q calculation of permanent dipole moment and the potential energy curves was investigated for 21 singlets, and triplet electronic states for diatomic molecule zinc sulfide ZnS. The study includes plots of these curves, and the spectroscopic constants R_e, ω_e, T_e, and B_e of the investigated electronic states which are compared with the results of other studies when available. The spectroscopic constants for 7 states are given here for the first time. The confirmation of these theoretical investigated data can be done by a future experiment for these electronic states of the molecule ZnS.

References

Allouche A. R. (2011). Gabedit: A graphical user interface for computational chemistry software. *J. Comp.Chem., 32*, 174-182. https://doi.org/10.1002/jcc.21600

Atkins, P., & Friedman, R. (2016). Molecular Quantum Mechanics, Fourth Edition, Oxford University PRESS. Retrieved from https://www.oxfordtextbooks.co.uk/orc/mqm5c/

Herzberg. G., Molecular, S., & Molecular, S. (1950). Spectra of Diatomic Molecules, D. Van Nostrand Company, Inc., New Jersey, New York, London, Toronto. https://doi.org/ISBN 0-12-245606-8.

Kobeissi, H., Korek, M., & Dagher, M. (1989). On the computation of diatomic centrifugal distortion constants: Exact solution for initial value problems. *J. Mol. Spectrosc., 138*, 1-4, 1989. https://doi.org/10.1016/0022-2852(89)90092-1U

Mahmoud K. (1999). Highly Accurate diatomic Centrifugal Distortion Constants. *Comput. Phys., 119*, 169. https://doi.org/10.1002/jcc.540130909

MOLPRO. (2015). Retrieved from https://www.molpro.net/info/2015.1/doc/update/node1.html

Peterson, K. A., Spheler, B. C., Singleton, J. M., & Mol, P. (2007) 1139 using MRCI+Q/CBS. https://doi.org/10.1080/00268970701241664

Pr. Chamboud Gilberte theoretical study of electronic structure and spectroscopy of molecules containing metallic atoms 2008, thèse dirigèe. Retrieved from https://tel.archives-ouvertes.fr/tel-00462184

Wu, H. Z., Qiu, D. J., Cai, Y. J., Xu, L. X., Chen, W. B., & Cryst, J. G. (2002), 245-50. https://doi.org/10.1021/ct700205n

Zinc Sulfide (N/A). Retrieved from https://en.m.wikipedia.org/wiki/Zinc_ Sulfide

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Urban form Analysis Based on Smart Growth Characteristics at Neighborhoods of 9th District in Mashhad Municipality

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Abstract

The purpose of this article is investigating the form of cities based on the new approach of urban smart growth and transect. Currently, the smart urban growth by using the transect method has been able to apply the environmental criteria and keep away from sprawl. The design is based on applying transect method in scale of neighborhoods within metropolis zone. In the zones of transect, different indexes of urban forms have defined clearly; furthermore are measurable and analyzable. The second purpose is determining degree of compatibility between urban characteristics within metropolis zone in one hand, and form-base codes of smart growth in the other hand. The case study of present research is selected due to having diversity of urban forms, different kinds of density, land-use and urban natural landscapes. For this diversity, 9th district in Mashhad metropolis was selected. The transect method has six separate zoning from T1 as the most natural and rural indexes, to T6 including most urban and dense indexes. The new method of Space Matrix for measuring the urban is used for transect zoning. By selecting a north- south crosscut in the considered district and exploiting the urban indexes, the Transect typology of each selected urban unit was determined by spacematrix method. Then, resulted indexes for each urban unit separately were assessed by multi-criteria decision-making matrixes(MCDM). Finaly by the hypothesis test part, with respect to compliance of more than 50% of 26 indexes of urban units of 9th district, it seems that direction of new urban regulation and models totally express avoiding sprawl and tending to ecologic approaches in the concepts of smart growth and urban form characteristics can analyzed.

Keywords: form base codes, smart growth, space matrix, transect, urban form

1. Introduction

1.1 Introduce the Problem

Since late nineteenth and early twentieth century, a set of views and approaches were suggested in the field of urban construction and development in Europe; that consequently the planning knowledge was arouse.

Patrick Geddes and Lewis Mumford by using the principles of biology and ecology suggested the organism theory in the urban development. Based on their viewpoint, the comprehensive plans pattern was introduced. It found legal and official aspect in England and America. Geddes' views jointed with modern urban planning functionalism and were used throughout the world as a comprehensive urban development plan. In fact, Geddes views and the principles of comprehensive plans were dominate on the scientific worldwide thinking for more than half a century; and remained in its origins until the 1960s. However, the effects of this planning method have remained in the Third World countries, including Iran (Mahdizadeh, 1382).

Since the 1960s, designers have found that the conventional zoning (Euclidean method) that dominated urban development over the twentieth century has had a negative impact on the Urban form and suburbs.

1.2 History of Smart Growth

In 1982, the design of the Florida Coastal Area made by Duani and Zybrek was one of the first attempts to propose a form-based approach to create liveliness settlements. In 1993, the New urbanism Congress supported

the form-based regulation.

Andrés Duany and Elizabeth Plater Zyberk, as designers of the movement of new urbanism criticize the comprehensive plans and zoning (Euclidean) land use-base, because those urban regulations had no any physical point of view. They have neither any imagination, diagram and model for recommending nor any imagination about their considered place or even the desired buildings (Geller, 2010).

1.3 State Hypotheses and Their Correspondence to Research Design

In this paper, a new approach (Transect method) is used to analyze the urban form. Andreas Duany in Transect Planning said that the transect is an urban planning approach based on ecological principles, but it is also an important analytical tool. He said Transect methodology involves taking a linear cut across a landscape, usually horizontal, along which a diversity of systems and habitats is sampled, measured and analyzed.

The segmentation of the transect continuum is accomplished by dividing it into six different ecozones. The term ecozone is used to promote the link to natural ecologies. Rural elements should be located in rural locations and urban element should be located in more urban locations. In this part of the research, by using the method of documentary and library studies, the urban smart growth and Transect zoning indexes are obtained.

The first purpose of the research is finding the adaptability of Transect method in urban neighborhoods of Mashhad, by using space matrix diagrams and locating ecozones. The final purpose of the research is to determine and measure the compatibility of smart growth indexes in detailed plans and recent urban development patterns in 9th district of Mashhad metropolise. Space matrix diagrams method is a spatial analysis tool for measuring density and other physical factors of urban forms. The space matrix defines density as a multi-variable concept to relate density and urban form. The most important function of the space matrix method, other than presenting a clear definition of density, is to show that the density can be connected with urban form and other urban functions (Berghauser pont & Haupt, 2009). In this part of the research, the characteristics of a number of blocks and urban areas in 9th district of Mashhad Municipality were collected. It was carried out by the latest development model and detailed plan of the southwestern part of Mashhad, including 9th and 11th districts.

This collection was marked in a north- southern crosscut that is started from the axis of Mashhad subway (Vakilabad Boulevard) and is ended at the natural landscapes of the southern highlands of Mashhad (Khorshid Park). It is expected that most of six ecozones be observed in the above cross-section. Then, the specifications of above blocks and areas are compared and tested by the graphs of math space matrix that are regulated and calibrated with the crosscut regions indexes. Since, in this paper we study first,the adaptability of Transect method in typology of urban neighborhoods in 9th district of Mashhad. Then we study the compatibility of smart growth indexes with urban form characteristics of 9th district of Mashhad.

2. Theoretical Foundations of Research

Urban form can be defined as the spatial pattern of human activity at a specific period. Urban form is a terms using to describe physical elements in a city (Poormohammadi, Sadr Mousavi, & Jamali, 1390). M.R.G. Canzan, is known as the head of urban morphology, considers four elements as components of urban shape: land usage, buildings structure, segmentation pattern and street pattern (Daneshpoor & Moradi, 1391).

Rahnama takes into account four different aspects to determine the shape of the city including the city size, density, Gini index and Moran & Geary index (Rahnama & Abbas Zadeh, 1387).Many of the current social, economic, environmental and physical problems are directly consequences of producing urban spaces since World War II.Regarding the crises of climate change, energy dependency, public health, collapsing infrastructure and financial instability, we must keep in mind that all five categories are as the result of urban sprawl (Duani, Speck, & Lydon, 2010).Late 20th century, inspired by the scientific foundations of sustainable development, a new approach called "New Urbanism" and "Smart Growth" apeared for stabilizing the space form of cities (Zarrabi, Saberi, & Mohammadi, 1390).

In recent years, many communities have decided to build a model for the development of their communities based on principles and strategies of urban smart growth. These principles Encourages a mix of land uses, often reducing the need to travel, and Promotes a mix of housing types (Rahnama & Abbas Zadeh, 1387). The crosscut defines a set of areas including the transmitting from scattered rural houses to urban dense core. Each region is divided into parts including the same transition from the edge to the neighborhood center.

Duany believes The Transect seeks to rectify the inappropriate intermixing of rural and urban elements known as sprawl. No desire for a particular type of development is categorically "wrong"; it is just in the wrong Transect location. The Transect eliminates the "urbanizing of the rural"-office towers in otherwise pristine

environments-or, equally damaging, the "ruralizing of the urban"-undefined, vacant open space in the urban core. The prescribed urban pattern is therefore based on, theoretically, finding the proper balance between natural and human-made environments along the rural to urban Transect (Duany & Talen, 2001).

Form-based regulation having six zones apart from the T1 as the most natural and rural index, up to T6 including the most urban and densest indexes of these regulation that describe the regulation, criteria and feature of each crosscut region entirety.

Figure 1. Transect ecozones in urban smart growth approach (Duany A., 2005)

This classification assures the designer that a proper form of construction has been established between buildings and streets. This approach also regulates the relationship between buildings, streets and pedestrians (Geller, 2010). In general, for Transect zoning approach up to now, two major methods are used:

The first method is the extension of the cross-sectional line in the city, which is usually used in urban regions with low complexity, and is like application of it in ecological sciences.

The second method is to use the principles and concepts of cross-sectional method for analyzing urban environments The cross-sectional method (crosscut) does not necessarily use a cross section, but based on the principles, concepts and methodology of crosscutting, the various dimensions of urban environments are zoned.

The above method is very efficient and effective for using in urban with diverse and complex conditions. In this type of application, various analytical methods, such as morphology, typology and typomorphology are used with shape and numerical approaches. Among the examples of these method is the zoning of Grass Valley City in California State (Mohammadi & Mahabadi, 1393).

The rules and standards of smart growth, reduce separation of usages, but do not eliminate them. For example, the first zone of T1 is the most natural ones, including the city's reserve lands, and any construction in them is

prohibited. The T1, T2 zones are biological reservoirs of urban spaces that necessarily located in vast lands around cities and natural landscapes in the cities; these are like heights, rivers, and ponds.

The T3 to T5 zones are residential zones that are extend from simple residential forms with a natural and rural form to urban densely populated environments with more general uses. For example, the T5 zone of the city center with a density of at least 15 and maximum 60 units per hectare (depending on the operation and urban preparing program) is determined; and the size of the urban blocks should be the pieces smaller than the previous zones (environment less than 610 square meters). The passages in these areas may include highways, main road, rural and standard roads. In addition, considering bicycle paths in these passages is necessary. The lot occupation consists maximum 80% of the land, which will be bigger than the previous zones and is smaller than the next zone. The number of floors should be between 3 to 5 floors, so that the urban landscapes look similar to the whole zone. (Duany A., 2005)

3. Research Methodology and Statistical Sample Society

The present research in terms of objective is applicable- development by using the quantitative-qualitative method. The nature and method of this research is analytical-descriptive; and is codified by the documentary studies of indexes and smart growth criteria. In this research, by analyzing theories and views, the urban form indexes with smart growth approach and form-based rules are analyzes and compared. The study area is southwest of Mashhad (zone No. 9 of the municipality).

According to the studies carried out with respect to natural landscapes, high-rise construction and physical diversity, geographic extent, population diversity and construction, and tendency towards development and renovation, southwest zone and 9th district of Mashhad municipality due to the adequacy of the indexes are selected for conducting field studies (Farnahad, 1384).

In the present research, as the criteria and characteristics of the urban form are valuable, the classification of transect district is important as well; because by determination of transect zones, the especial indexes of each zone can be obtained and compiled.

The first stage of the research is the determination of the transect zone of each area or urban block by using the space matrix and Space-Mate charts. For analyzing the indexes, the MCDM multi-criteria decision-making method was selected.

This method tracks a powerful and scientific process for categorizing, weighing, unscaling, and analyzing quantitative indexes (Mohammad Moradi & Akhtar kavan, 2009). Therefore, based on the obtained matrix, we can judge and analyze the urban form on the scale of neighborhood units or urban blocks. This matrix of various urban aspects includes population density, environment, Thoroughfares, transportation, land-use, physical form, aesthetics, and configuration. It seems that the above matrix has been able to cover various aspects of urban form analysis based on the urban smart growth approach.

The statistical data in this research is the neighborhood units or pedestrian sheds, that have been used in urban development and new detailed plans of the Mashhad metropolis have used such scales under the title of urban area. The considered indexes in this study are often defined in the urban areas; that are transmitted directly to the adjusted tables and matrixes. (Rezvani Kakhki & Rahnama, Comparison of Renovation of Damaged Fabrics with Smart Growth Approach (Case Study: Mashhad), 2016)

In the field of collecting data, firstly, appropriate information is gathered in relation to the variables of the research. Then the collected values are compared with the standards of the form-based codes. This comparison was performed using SPSS software and the hypothesis testing was done.

The present research area is 9th district of Mashhad Municipality. A part of that area is in form of crosscut in accordance with the transect method in smart growth from the beginning of Hashemieh Boulevard on the south side of Vakilabad Boulevard. It includes a direct route with about 5500 meters length and with 400-500 meters width toward the natural landscapes of Binalood Mountains called the Southern Heights. The mentioned line (trace) due to crossing has 160 meters height difference from beginning (Vaklabad Boulevard) to the end (southern heights and the eastern side of the Khorshid Park at the end of Hashemieh).

In the collection of information from urban maps, the 1/2000 scale of mapping organization (annexed) to the scald of 1/35000 using in detailed plans of the Mashhad Municipality are used; that in the studied area includes detailed specifications of all passages, plotting of zones, filled and empty spaces. In addition to the above maps, to update information, the field observations were used to modify the uses of indexes such as green spaces, business centers and public utilities, as well as access to residential areas including bus, taxi and bicycle stations. In the following, the gotten information from Mashhad Municipality includes new established statistics of 2015,

library studies and online maps of Google Earth were used.

The studied urban areas in the present study are selected from the urban scale that are selected and planned by the design consultant's detailed development plan of 9th district of Mashhad Municipality. For example, the R143 area, located at the beginning of the eastern side of the Hashemieh Blvd, with dimensions of 450 × 400 square meters, with low residential density has been studied and regulated by the detailed plan. This area in the present research, after accurate and precision study, includes 12 urban blocks, which are totally divided into 209 lots mostly residential. The mentioned area due to having accesses to the main roads uses 3 bus stations, 1 taxi station and 1 bicycle station (Naghsh Piravosh, 1389).

The above indexes are replaced in the matrix (analytical-comparative) that are set forth in the theoretical part of research based on the most recent editing of the form-based codes in smart growth framework. As stated above, in general, multi-criteria models can be divided into two discrete and continuous groups in terms of the number of alternatives. Types of multi-criteria decision-making methods are as follows: weightless methods, weighing methods on criteria, and weighting methods on options (Mohammad Moradi & Akhtar kavan, 2009).In weightless method, no any type of preference has specified by the decision maker; and only the decision matrix is expressed. In other word, the criteria and operation of each option on the criteria is specified. However, the decision maker expresses no any preference on criteria and/or alternative. In the process of multi criteria decision-making, each alternative is usually defined by two types attribute: qualitative and qualitative characteristics. Since converting qualitative characteristics to relative scale is difficult, most multi-index decision-making models use sequential scales and/or distances to convert qualitative features to a quantitative one (Mohammad Moradi & Akhtar kavan, 2009). A general method for measuring a qualitative index with a distance scale is to use a bi-polar scale (Likert scale). This measure is based on a ten-point scale, so that zero specifies the minimum possible value and ten determines the maximum possible value of the considered index. This matrix has been set on transect zoning (cross section from urban indexes to natural indexes) and with 8 dimensions of smart growth criteria was analyzed with SPSS software comprehensively. Then, in a hypotheses test by one sample T test comparing average by using SPSS software is judged; so that during the research based on the obtained results, the scientific hypothesis to be judged.

4. Research Findings

The form-based codes that was compiled by André Duany executively, in newest version in 2005 was edited and stipulated the following indexes for settlements (Duany A., 2005).

The summary of the regulation and indexes of the previous part is shown in the below table; including the first table of classification of aspects and indexes in the form of qualitative criteria:

Table 1. The dimensions and indexes of urban form assessment matrix (research finding) (Duany A., 2005)

					Criteria
		TND Allocation	TOD Allocation	Residential-density	**Density**
		Green space	Planter	Lot occupation	**Environment**
Public parking	Taxi station	Bus station	BRT	Metro station	**Transportation**
		Grid density	Bicycle pad	Line width	**Thoroughfares**
Hospital	Education	Retail	Civic	Mix use	**Land-use**
	Block perimeter	Lot width	setback	Lot area	**Physical-Form**
			Street tree	Streetlight	**Aesthetic**
			Built density	stories	**Configuration**

In this part, we examine the zoning of the urban form in 9th district; and compare the urban form indexes with the smart growth criteria and transect design.

This cut includes the most urban arena on Vakilabad Boulevard (M112) to the most natural arena (G322). Therefore, the proper diversity of the transect zones of the form-based code can be observed and analyzed in this section.

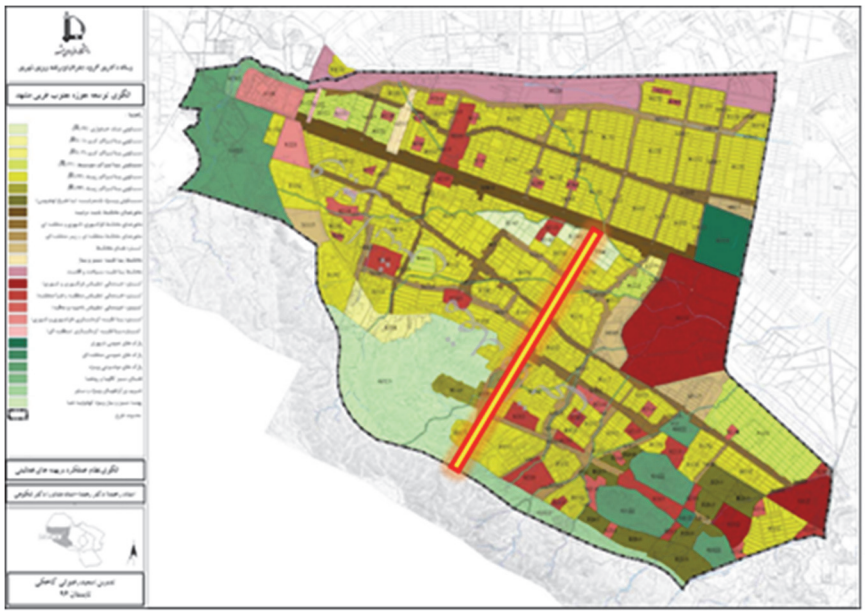

Figure 2. 9th district cross section (north south) of Mashhad (Naghsh Piravosh, 1389)

The units and designed areas in the cross-section have been taken from the development pattern of detailed plan of southwest area of Mashhad municipality; and their indexes have been summarized in a table.

Table 2. North-south cross section detailed map of 9th district of Mashhad (Naghsh Piravosh, 1389)

Unit area	***M111***	***M112***	***R132***	***R143***	***G122***	***G322***
Land-use	Residential tall buildings	Mixe-use	residential-high	Residential-low	Theme Park	Green Landscape
Density	500%	300%	240%	100%		
Floors.Nu	13	8	5	2		
Lot area	2000	1000	300	500		
Occupation	80-25%	80-40%	50	50		

The first stage of the research is the determination of the transect zone for each urban area by using the space matrix diagrams. The Spacematrix method has contributed to a clarification in the terminology currently being used by urban planners working with urban density. Spacematrix defines density as a multi variable phenomenon and makes a correlation between density and the built mass (urban form). Spacematrix uses the following measures: floor space index (FSI), ground space index (GSI), and network density (N). These three measures are represented in a three-dimensional diagram, the Spacematrix. Measures such as open space radio (OSR) or spaciousness, the average number of floors or layers (L) and the size of the urban blocks (w) can be derived from that. For the purpose of this research Network density is not taken into consideration and we thus work with only one of the three planes in the Spacematrix diagram. Here FSI on the y-axis gives an indication of the built intensity in an area and the average number of floors (L) on the x-axis reflects the compactness of the development. The OSR and GSI are gradients that fan out over the diagram. OSR describes the spaciousness (or pressure on the non-built space) with blue lines, and GSI reflects the coverage(with pink lines).

In this chart, the defined area is specified for each transect zones. This classification is took place with a smart growth approach and transect method. Now, by finding the locus of each urban area having a clear and explicit definition, it can be located in one of transect limitations. In other words, it can be proceeded for measuring a specific form of the city.

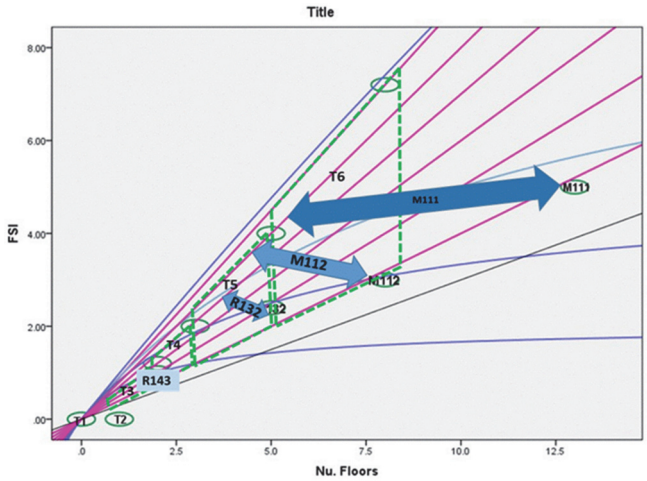

Diagram 1. The Compliance of neighborhood units in 9th district of Mashhad with the transect criteria with space matrix diagram (research finding)

By drawing the space matrix and placement of the designed areas of 9th district of Mashhad in the diagram, the following results are observed:

The area (M 111) is located in the special zone authorized for high-rise building that continuation of the defined criteria can be extended to the 6th T6 cross-section.

The area (M112) is located between the fifth and sixth (say T5 transect)

The area(R132) is located in the fifth T5 transect zone.

The area(R143) is located in the third T3 transect zone.

The area (G122) by considering the definition of park is a specific issue and due to allowed construction can be located in the T2 transect zone under the special criteria.

The area (G322) by considering the prohibition of construction and green zone of highway limitation can belong to the T1 transect zone.

The selected neighborhood units and areas in the 9th district, after determination of the transect zone, are studied in terms of the main indexes of urban smart growth and form-based codes.

Figure 3. The map of R143 area of 9th district of Mashhad (Naghsh Piravosh, 1389)

In the table 3, all 26 derived indexes from the urban form, which are categorized into 8 general groups, are collected and represented. This table shows the main criteria of scoring for the quality indexes of the urban form, which, according to the table descriptions, convert into quantitative and measurable indexes.

Table 3. The complete matrix of urban form assessment based on the crosscut zone (research finding)

T6	**T5**	**T4**	**T3**	**T2**	**T1**	indexes	Criteria
30-240units/Hec	15-60units/Hec	10-30units/Hec	5-15unit/Hec	1unit/8 Hec	1unit/40 Hec	Residential-density	Density
70-100%	0-30%	0-30%	Prohibited	No minimum	No minimum	TOD Allocation	
Prohibited	10-30%	30-60%	10-30%	No minimum	No minimum	TND Allocation	
90%	80%	70%	60%	By variance	By exception	Lot coverage	Environment
Tree- well-1.2-1.6m	Regular-planter-1.2-1.6m	Regular-planter-2.5-3.6m	Regular-planter-2.5-5m	Clasterd-swale-2.5-5m	Clasterd-swale-2.5-5m	Planter	
Play.-Square-Plaza	Play.-Green-Square-Plaza	Playgroun-Green-Square	Playground-Park-Green	Playground-Park	Playground-Park	Green space	
3 in 500m	2 in 500m	1 in 500m	1 in 500 m	No minimum	No minimum	Metro station	Transportation
3 in 500m	2 in 500m	1 in 500 m	1 in 500 m	No minimum	No minimum	BRT	
3 in 500m	2 in 500m	1 in 500 m	1 in 500 m	No minimum	No minimum	Bus station	
3 in 500m	2 in 500m	1 in 500 m	1 in 500 m	No minimum	No minimum	Taxi station	
3 in 500m	2 in 500m	1 in 500 m	1 in 500 m	No minimum	No minimum	Public parking	
3.0-3.6m	3.0-3.6m	2.7-3.0m	2.5-3.0m	Permitted	Permitted	Line width	Thoroughfares
mandatory	mandatory	mandatory	mandatory	mandatory	mandatory	Bicycle pad	
30	19	16	12	No minimum	No minimum	Grid density	
4	4	3	2	Not applicable	Not applicable	Mix use	Land-use
Retail-Gallery-Restaurant	Retail-Gallery-Restaurant	Retail-Gallery-Restaurant	Open-market	Open-market	Not applicable	Retail	
Fire-Police-Clinic	Fire-Police-Clinic	Fire-Police	Fire	Not applicable	Not applicable	Civic	
Childcare-Elementary	Childcare-Elementary	Childcare-Elementary	Childcare	Childcare	Not applicable	Education	
No minimum	140 m2	230 m2	460 m2	Not applicable	Not applicable	Lot area	Physical-Form
2 m- 3.5 m	2 m- 3.5 m	5.5 m- 7.5 m	10 m-more	No minimum	No minimum	setback	
5.5 m	5.5 m	9 m	15 m	Not applicable	Not applicable	Lot width	
600 m	600 m	730 m	910 m	Not applicable	Not applicable	Block perimeter	
Column-double	Column-double	Post-Column	Pipe-Post	Pipe-Post	Cobra Head	Streetlight	Aesthetic
Palm-Oval-Ball	Palm-Oval-Ball	Palm-Oval-Ball-Vase….	Palm-Oval-Ball-Vase….	Palm-Oval-Ball-Vase….	Palm-Oval-Ball-Vase….	Street tree	
2-6 st	2-4 st	1-3 St	1-2 St	Not applicable	Not applicable	stories	Configuration
540%	320%	210%	120%	Not applicable	Not applicable	Built density	

In the following pages, the studied areas in 9th district of Mashhad municipality are analyzed according to the above table. These areas are first classified in the previous section according to the space matrix method and transect zone; then they compare with the indexes of the specified transect zone. The following tables, respectively, examine matrixes of urban form in the areas including M111, M112, G122, and G322; in which quantitative indexes are used to measure the compatibility with smart growth. The main criterion of all indexes is presented from the form-based regulation of urban smart growth and by determination of transect zone by the space matrix diagrams.

Table 4. The urban form indexes in R143 area (spss of research findings)

R143	score 10	score 8	score 6	score 4	score 2	score 0	R143	T3	indexes	Criteria
2	<15	15-18	18-21	21-24	24-27	27-30	27	5-15unit/Hec	Residential-density	Density
2	15-30%	10-15 or 30-35	10 or 35-40	5-10 or 40-45	0-5 or 45-50	0-5 or 50-55	>50%	10-30%	TND Allocation	
10	Prohibited	10%	15%	20%	25%	30%	Prohibited	Prohibited	TOD Allocation	
4	4m-5m	3m-4m	2m-3m	1m-2m	0-1m	0	1-1.5 m	Regular-planter-2.5-5m	Planter	Environment
8	park	Green	Square	Green-belt	playground	No park	Green-Park	Playground-Park-Green	Green space	
2	60	58	55	53	50	<50	50%	60%	Lot coverage	
2	>4	4	3	2	1	0	1	1 in 500 m	Metro station	Transportation
0	>4	4	3	2	1	0	0	1 in 500 m	BRT	
6	>4	4	3	2	1	0	3	1 in 500 m	Bus station	
2	>4	4	3	2	1	0	1	1 in 500 m	Taxi station	
2	>4	4	3	2	1	0	1	1 in 500 m	Public parking	
10	2.5-3m	2-2.5m	1.8-2.0m	1.5-1.8m	1.2-1.5m	<1.5 m	3	2.5-3.0m	Line width	Thoroughfares
10	1					0	1	mandatory	Bicycle pad	
2	12 mile/mile2	15mile/mile2	20mile/mile2	25mile/mile2	30mile/mile2	>30mile/mile2	30	12	Grid density	
10	4	3		2	1	0	4	2	Mixuse	Land-use
10	1					0	1	Open-market	Retail	
10	1					0	1	Childcare	Education	
10	1					0	1	Fire	Civic	
10	450-500m2	400-450m2	350-400m2	300-350m2	250-300m2	<250m2	500	460 m2	Lot area	Physical-Form
2	>10 m	8-10 m	6-8 m	4-6 m	2-4 m	0-2	3-25 m	10 m-more	setback	
2	13-15 m	11-13 m	9-11 m	7-9 m	5-7 m	<5 m	6	15 m	Lot width	
10	<912	900-1000 m	1000-1100m	1100-1200m	1200-1300m	>1300m	612	910 m	Block perimeter	
6	Pipe-Post		standard light		light	No light	Cobra Head	Pipe-Post	Streetlight	Aesthetic
10	standard				Minimum	No tree	palm-ball	Palm-Oval-Ball-Vase….	Street tree	
10	max-2						max 2	1-2 St	stories	Configuration
10	100%	120%	140%	160%	180%	>18-%	100%	120%	Built density	
6/230										

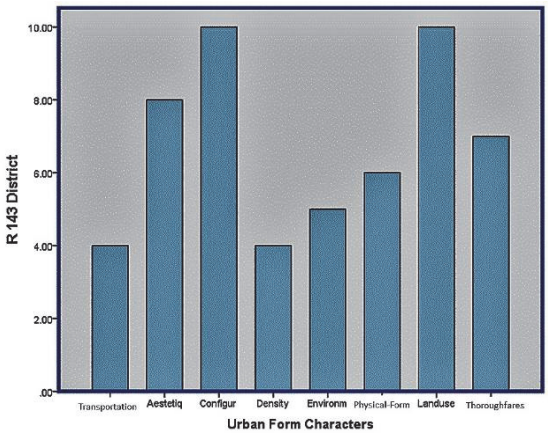

Diagram 2. Comparison of the urban form indexes in the studied zones R143 (spss, research findings)

Table4, include multi-criteria decision-making datas, examining the 26 indexes of smart growth in classification of various aspects. The inserted scores in the end column represent the degree of compliance and compatibility of these indexes with the urban smart growth regulations. The above scores are without weight and scale and are

set from zero to ten. In each row, in addition to the score of each index by facilities of statistical software, a portion of the related row corresponding to the number of points is colored. At the end of the column, the scores total average of each column is calculated and inserted. According to the gathered scores and averages, the first overall result is that the average score of the indexes is always more than 50%, which seems to be consistent with the urban smart growth regulations.

The obtained result from the comparison shows that in the above aspects and headings, configuration and Land-use indexes have the most similarity with the smart growth framework. It seems that the focus of comprehensive and detailed plans on zoning is the reason of this similarity. In addition,transportation and density indexes have the least similarities.

In the below diagram (No. 3), at the same time, all urban areas were investigated and the overall status of each six zones has been shown in a diagram. The highest conformity in the mixed zone was seen in M111 and the least conformity in residential zone was observed in R132.

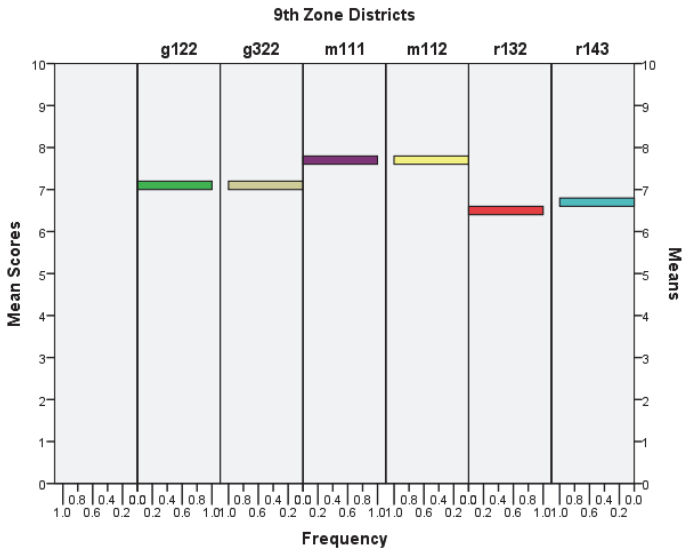

Diagram 3. Comparison of the urban form indexes in the studied zones in 9th district of Mashhad (spss, research findings)

To obtain a precise result, the statistical methods of the hypothesis test are used.

5. Hypotheses Test

The One-Sample T.test is a table that based on its contents it is possible to judge about acceptance or rejection of research. The H1 hypothesis is defined as follow:

H1**:**) Mean >= 50 if the average scores of smart growth in the studied zone is equal or more than 50.

H0 hypothesis is according to an average of smart growth scores less than 50%, which suggests the lack of observation of urban smart growth approach in the design of the considered area.

In the SPSS software, one of the solutions is to use a confidence interval for the difference in means. If the upper and lower limits of the confidence interval are positive, with clear probability (95% here) the difference mean will be a value greater than zero and positive. As a result, it can be included that the average will be over 50%; and if both upper and lower limits are negative, it means that with clear probability, the mean will be less than 50%.

R143 area: In this area, the indexes in the SPSS software are analyzed and after setting the confidence interval on 95% the following result is obtained:

Table 5. One sample test result for R143 urban area in 9th district of Mashhad (spss research finding)

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
R143	26	6.6154	3.78499	.74230

One-Sample Test

Test Value = 5

	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
R143	2.176	25	.039	1.61538	.0866	3.1442

The above statistical results with the probability of 95% have the considered confidence for being the numerical mean of the indexes above 50% in comparison with the form-based codes of urban smart growth. Therefore:

With a 95% probability, the numerical average of residential area R143 index with smart growth indexes has a compatibility higher than 50%.

By examining the assumptions of other urban areas, the following results are obtained:

With a 90% probability, the numerical average of residential area R132 index with smart growth indexes has a compatibility higher than 50%.

With a 95% probability, the numerical average of mixed corridor M111 index with smart growth indexes has a compatibility higher than 60%.

With a 95% probability, the numerical average of mixed corridor M112 index with smart growth indexes has a compatibility higher than 60%.

With a 95% probability, the numerical average of Green area G322 index with smart growth indexes has a compatibility higher than 50%.

With a 95% probability, the numerical average of Green area G122 index with smart growth indexes has a compatibility higher than 60%.

6. Conclusion

In this chapter in 9th district of Mashhad, firstly, for beginning the urban form studies, a suitable cross-section was drawn up including the most options of urban dense areas and marginal natural ranges. After selecting a northsouth cross-section in the considered area and extracting the urban form indexes, the obtained result is that the areas in the cross-section line of the 9th district located in the boundaries of the T1, T2, T3, T5, and T6 transect zones are suitable for establishing. These transect zones were located and determined based on space matrix diagrams. Thus the transect method can be applied in 9th district of Mashhad. The next step is to determine the main and detailed indexes of smart growth in each of the transect zones. In the urban smart growth approach, first, according to the transect classification, it was proceeded to determine the overall urban type from the first to sixth zone, then in each transect zone, the specific indexes of the zone are designated. Therefore, at this stage, the main indexes of the urban form referring to each transect zone were extracted. In this part of the research, the new edition of form-based codes (6.5) was used. The inferred indexes were assessed by multi-criteria decision-making method, and the desired result is obtained. The obtained matrix includes 26 different urban form indexes. The final step of the research is to conduct the field study on the urban smart growth in order to compare the collected indexes with the standards of the form-based codes in smart growth.

In this chapter, the designed areas and zones in the urban development patterns of 9th district of Mashhad City were inserted in the above matrixes.

The above tables include multi-criteria decision-making matrixes that examine 26 matrixes of urban form in the category of variety of aspects. The inserted scores in the end column represent the degree of compliance and compatibility of these indexes with the urban smart growth regulations. The above scores are without weight and scale and are set from zero to ten. In these scores, the zero indicates the full incompatibility and the number 10 represents full compatibility. Therefore, based on the average and middle statistical properties in the statistical tables, score fice, which represents 50% conformity with smart growth criteria, is considered as the boundary between smart urban growth and sprawl.

In each row, in addition to the score of each index, by using the statistical software facilities a part of the row

corresponding to the number of score is colored. At the end of the column, the average of the total scores of the column is calculated and inserted (Table 3).

According to the scores and averages, the first overall result is that the total average of indexes scores is always more than 50%, which seems to be in the boundary of compliance with the urban smart growth regulations.

In this part, the eight aspects of urban form indexes were analyzed in the form of statistical diagrams to provide an introduction for determining the weaknesses and strengths of urban regulations and plans.

Regarding hypothesis test, according to the compliance of more than 50% of the 26 indexes of urban areas and neighborhoods of the development pattern of No.9 district, generally it seems that the orientation of the new urban regulation and patterns is toward avoiding from dispersion and tending to the ecologic approaches and compaction in the smart growth concepts.

References

Berghauser, P. M., & Haupt, P. (2009). Space, Density and Urban Form. Netherlands.

Berghauser, P. M., Nes, A. V., & Mashhoodi, B. (2012). Combination of Space Syntax with Spacematrix and the Mixed Use Index. Eighth International Space Syntax Symposium. Santiago de Chile. PAPER REF # 8003

Daneshpoor, A., & Moradi, S. (2012). Explaining methods of Form-typology & their application in urban desighn. *Architectural & Urbanism Letter, 9*, 65-78. october15, 1391.

Duani, A., Speck, J., & Lydon, M. (2010). The Smart Growth Manual. McGraw Hill. https://doi.org/10.4067/S0718-34022012000100010

Duany, A. (2005). SmartCode 6.5. Retrieved from http://www.dpz.com

Duany, A., & Talen, E. (2001). Making the good easy: the smart code alternative. *Fordham Urban Law Journal, 29*(4), 1445-1464.

Farnahad, E. C. (2005). Developement & construction plan of Mashhad region. Mashhad: Road & Urbanism ministry.

Geller, S. R. (2010, Fall). The Legality of Form-Based Zoning Codes. *Journal of Land Use, 26*, 44. https://10.1080/13574809.2013.772883

Mahdizadeh, J. (2003). Urban Strategic developement planning(Iran today practices). Tehran: Road @ urbanism ministry.

Mohammad, M. A., & Akhtar, K. M. (2009). Methodology of multi-criteria decision making models. *Armanshahr, 113*.

Mohammadi, M., & Mahabadi, Z. (2014). Urban texture zonning by transect method (1th district in esfahan). *Iranian Restoration & Architecture Scientific Research Periodical,* 75-96.

Naghsh, P. C. E. (2010). Developement pattern & Detailed plan of west-south of Mashhad. mashhad: Planning & Developement organization of Mashhad.

Poormohammadi, M., Sadr, M. M., & Jamali, S. (2011, Automn). Vakavi Maktabhaye morphology shahri. *Geographic Studies of Dry Areas, 5*(2), 1-16. Retrieved, 8,18, 1390.

Rahnama, M., & Abbas, Z. G. (2008). Urbna physical-form measure. Mashhad: Jahad daneshgahi Mashhad.

Rezvani, K. S., & Ajza, S. M. (2017). Investigating the Transit Oriented Development in New Urbanism, Case Study: Subway Stations Development in Mashhad. *Modern Applied Science,* 159-168. https://10.5539/mas.v11n1p159

Rezvani, K. S., & Rahnama, M. R. (2016). Comparison of Renovation of Damaged Fabrics with Smart Growth Approach (Case Study: Mashhad). *Modern Applied Science,* 106-118. https://10.5539/mas.v10n10p106

Zarrabi, A., Saberi, H., & Mohammadi, J. (2011). Spatial analysis of smart growth indexes in esfahan city. *Human Geography Researches,* 1-17.

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The Linguistic Enlightenment Level of Eleventh (11th) Grade Students in Jordan and its Relationship with Some Variables

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Abstract

The present study aimed at identifying the linguistic enlightenment level of eleventh 11th grade students in Jordan. The study's sample consisted from two hundred (200) female and male students who were selected through using the random stratification method from Al-Karak public schools at Jordan. In order to fulfill the study's objectives, the researchers of the current study prepared a multiple - choice objective test that consisted from fifty (50) items. Each item includes four (4) choices. Those items cover three linguistic systems of Arabic: the syntactic, morphological and semantic systems. The study's results showed that students showed a low linguistic enlightenment level in the aforementioned linguistic systems. That was concluded through having an arithmetic mean of (27.52) and a relative weight of (55.04) %. The results also showed that there isn't any statistically significant difference between students' linguistic enlightenment levels – at the significance level of ($a \geq 0.05$) – which can be attributed to their academic stream (i.e. the scientific or literary stream). The results also showed that there are statistically significant differences between students' linguistic enlightenment levels – at the significance level of ($a \geq 0.05$) – which can be attributed to their gender in syntax, and morphology. The latter differences were for the favor of female students. However, there isn't any statistically significant difference between students' linguistic enlightenment levels – at the significance level of ($a \geq 0.05$) – which can be attributed to their gender in semantics.

Keywords: enlightenment level, linguistic enlightenment, eleventh (11th) grade

1. Introduction

1.1 The Problem

Enlightenment has been attracting much attention by researchers and students in various disciplines. That is attributed to its significance in upbringing the individual on the scientific, health, social, psychological, and linguistic levels in the light of the current era which is characterized with having rapid changes and developments. The term "enlightenment" appeared in Europe as a way of representing the ideologies that are characterized with having humanitarian, scientific and rational tendencies. Later on, the meaning of this concept expanded. For instance, it started to refer to the methods and means through which the individual expresses his understanding for the world and the roles he should play in it. In other words, it is an image for the individual's life through which the elements of the language he uses complement his acts, values, beliefs, knowledge and social attitudes which distinguish him from others in general and the ones who belong to his culture in particular.

Linguistic enlightenment consists from three main dimensions. The first dimension is the cognitive dimension which includes the knowledge, information, concepts, and rules that are related to Arabic language. The second dimension is the skills dimension which includes the mental, practical and social skills that are necessary for comprehending the language and dealing with it. The third dimension is the sentimental dimension which is represented in all the outcomes that are related to the passionate emotional aspect, such as: one's values, attitudes and tendencies towards language and awareness about its significance (Hamoudeh et al., 2012; Al-Twaijari, 2002).

There are various factors that participate in promoting linguistic enlightenment within the student. Such factors may include: student's family, media and the nature of the community he is living in. It should be noted that school – represented by its teachers - play the most significant role in promoting the linguistic enlightenment

within the student (Doveston, 2007). That is because teachers play the most significant role in making students comprehend the curriculum and fulfilling the sought outcomes from the concerned curriculum. Therefore, teachers must make students acquire some essential expertise related to Arabic language, such as: understanding its nature and its relationship with work and society, following up its developments and changes, identifying the problems and threats facing it, and analyzing the reasons and consequences of such problems and threats. Such essential expertise also include: learning how to make the right decisions related to this language, and mastering its main skills (listening, speaking, writing and reading). Teacher must also promote awareness among students about the significance of Arabic language and its role in life and the way it can be employed to solve their problems and achieve their well-being in a proper manner (Abu Odeh, 2006).

Language is considered one of the most significant requirements for achieving self-realization, and realizing one's own identity and existence (Al-A'mayrah, 2002). It is also considered a distinguished social phenomenon. To be more specific, it is considered the most significant phenomenon that the human race has achieved throughout history. That is because it reflects the society's identity and is considered one of the elements that participate in unifying the society. It gained such significance because it is a method used for expressing ideologies, communicating and sharing knowledge. For instance, humans use it to express their ideas and feelings. Through it, people shall be able to communicate with each other. It also represents a mirror that reflects one's mind because it is closely linked to one's ideology. It's also an intellectual tool that one uses to realize things and concepts and conduct operations (Salem, 2003).

Acquiring language skills – especially the reading and writing skills – is considered a significant predicator indicating that the student shall succeed in his later academic stages. Therefore, making students acquire such skills became a national target in many countries due to their significance in integrating one in the society on the economic, social and cultural levels. Acquiring language skills requires having teachers who are highly aware about the significance of such skills and informative about them. That is because teachers are considered the most significant source for promoting linguistic enlightenment among students (Karen, 2008; Aram, 2004).

The overall linguistic system consists from sub-systems. Such sub-systems include the sound system (i.e. the phonological system) which identifies the way words and their parts are pronounced in accordance with the patterns that are commonly known among the members of certain group. Linguistic sub-systems also include the semantic system which is concerned with the order of semantic units in accordance with their semantic characteristics that are commonly known. Linguistic sub-systems also include the syntactic system which is concerned with the order of words in a sentence in accordance with the identified or commonly known syntactic structure of the concerned language. Linguistic sub-systems also include the morphological system which is concerned with the structure, types, and derivations of words. Such sub-systems include the lexicographical system which refers to the overall words that are available in language which carry certain meanings and refer to certain contexts. Each system of those linguistic sub-systems is governed by its own functions, rules and regulations. They all complement one another to order words in an organized manner to produce a correct proper sentence that can deliver the meaning that the speaker has intended it to the listener properly (Zayed, 2011; Hamoudeh et al., 2012).

Using Arabic language in a correct proper manner throughout the various academic stages requires much hard work. It also requires combining efforts on various formal and informal levels. That is because students usually do not comprehend the information they receive about the linguistic disciplines of their language easily and do not show eagerness and excitement to learn such information. Such lack of eagerness, excitement and comprehension can be attributed to various aspects. Such aspects may include aspects related to the Arabic language teachers. For instance, most of those teachers are not able to teach such information in the way it ought to be taught. Therefore, many of the advocates of Arabic language have claimed for giving the Arabic linguistic disciplines the care and attention they desire (Al-Ebrahimi, 2017). Thus, the present study aimed at investigating the linguistic enlightenment level of eleventh (11th) grade students in Jordan.

1.2 The Importance of the Problem

Learning Arabic language in its written, read and spoken forms is considered one of the most significant goals that the teaching – learning process in Jordan seeks to achieve. That is because learning the language skills and mastering them are considered the only way for improving the teaching – learning process. Academics have emphasized the significance of making students acquire the Arabic language skills and become enlightened about them. However, there is a great debate between various groups about the extent of students' possession for those skills and the extent of applying them in their daily lives. Opinions on this matter vary. Therefore, the present study aimed at investigating the linguistic enlightenment level of eleventh (11th) grade students in

Jordan.

The significance of the present study arises from the significance of its field (i.e. the field of Arabic language). For instance, this language represents the Arab nation's identity, and is considered a symbol for its unity and a record for its civilizations. The researchers designed a scale (i.e. a test) that was passed to several arbitrators to measure the linguistic enlightenment level of eleventh (11th) grade students in Jordan. Other researchers can benefit from this scale through using it in similar studies for other academic stages, areas and variables. According to the best of the researchers' knowledge, the significance of the present study arises from being the first study that seeks to identify the linguistic enlightenment level of eleventh (11th) grade students in Jordan. Its significance also arises from seeking to provide suggestions and recommendations that shall be useful for the developers of Arabic language curricula, Arabic language teachers, supervisors, educators and researchers.

1.3 The Previous Studies

The researchers of the present study have reviewed several studies that are relevant to the topic of the current study. Such studies include the following:

Al-Dahri (2016) conducted a study titled (The linguistic enlightenment level and its relationship with secondary students' motivation to study Arabic language in Baghdad). The study's sample consisted from four hundred eighty (480) female and male students. In order to fulfill the study's objectives, the latter researcher designed a test that consisted from two parts. The first part is a pre-test and the second is a post-test. Students showed low linguistic enlightenment level. There are also statistically significant differences between students' linguistic enlightenment levels which can be attributed to their gender for the favor of the female students.

Al-Naqah and Al-Abed (2012) aimed at identifying the extent of basic stage students' competency in the listening skills. The study's sample was chosen from two schools located in Khan Younis in Palestine. This sample consisted of forty two (42) ninth grade students and forty four (44) tenth grade students. The latter researchers used a questionnaire and a test to identify the competence level of students in the listening skills. The respondents showed low competence level on all the listening skills, except in the skill of ordering the ideas mentioned in the audio text. The latter study concluded that there are no statistically significant differences between students' competence levels on all the listening skills which can be attributed to their grade.

Salim (2009) conducted a study that aimed to identify the linguistic enlightenment level of eleventh (11th) grade female students in Gaza and its relationship with their attitudes towards Arabic language. The study's sample consisted from two hundred twenty nine (229) female students who were selected from various sections in a purposive manner. The latter researcher used a questionnaire to collect the required data. Respondents showed that they have low linguistic enlightenment level.

Graham& Marcao (2008) aimed to examine the process of teaching French listening skills to students who showed low competence level. The study's sample consisted from sixty eight (68) students who showed low competence level in French language and were living in England. Respondents showed that they have low competence level in listening skills in the pre-test. However, such level was improved on the post-test after they attended a training program.

Al-Wahidi (2005) aimed to identify the extent of acquisition for the writing skills among the ninth grade students enrolled in the public, private and UNRWA schools of Bait Lahem / Palestine. The study's sample consisted from one hundred eighty eight (188) female and male students. Respondents showed low competence level in the writing skills of Arabic language. The results also showed that there are statistically significant differences between the respondents' competence levels in the writing skills of Arabic language which can be attributed to their gender for the favor of females.

Al-Jabareen (2004) aimed to identify the common syntactic and spelling mistakes among the eleventh (11th) grade students enrolled in the public schools subjected to the authority of South Hebron directorate of education. The study's sample consisted from three hundred (300) eleventh grade female and male students who were selected from the scientific and literary streams. The study's results showed that there are common syntactic and spelling mistakes among the eleventh (11th) grade students. The results also showed that there are statistically significant differences between the respondents' numbers of committed mistake which can be attributed to their gender. Such differences were for the favor of female students. The results also showed that there are statistically significant differences between the respondents' numbers of committed mistake which can be attributed to their academic stream for the favor of the students enrolled in the scientific stream.

All of the aforementioned previous results emphasized the significance of promoting linguistic enlightenment

among students. All of those studies also showed that there are low linguistic enlightenment among students (Al-Jabareen, 2004; Graham& Marcao, 2008; Al-Wahidi, 2005; Al-Naqah and Al-Abed, 2012; Al-Dahri, 2016; Salim, 2009). The results of some studies showed that there are statistically significant differences between the respondents' linguistic enlightenment levels which can be attributed to their gender for the favor of the female students (Al-Dahri, 2016; Al-Wahidi, 2005; Al-Jabareen, 2004). The results of some studies showed that there are statistically significant differences between the respondents' linguistic enlightenment levels which can be attributed for their academic stream for the favor of the students enrolled in the scientific stream.

All of the aforementioned studies aimed at investigating the linguistic enlightenment level among the students of the basic educational stage, except for the study of Al-Jabareen (2004) which targeted secondary stage students.

As for the present study, it differs from all of the aforementioned studies in its sample. To be specific, the sample of the current study was chosen from the eleventh (11th) grade students from the scientific and literary streams. They were chosen from the public schools of Karak / Jordan. Thus, no study of the above has targeted such a sample with seeking to investigate the same topic. The present study differs from all of the aforementioned studies in its instrument which was designed by the researchers of the present study. It also differs from the previous studies in the three linguistic systems it covers; the syntactic, morphological and semantic systems.

1.4 The Study's Questions, Terms Definition, and the Study's limits

The present study aimed at identifying the linguistic enlightenment level of eleventh (11th) grade students in Jordan. It also aimed at identifying whether there is any statistically significant difference between students' linguistic enlightenment levels which can be attributed to their academic stream or gender. In order to identify that, the researchers of the current study aimed at providing answers for the following questions:

1) - What is the linguistic enlightenment level of eleventh (11th) grade students in Jordan?

2) - Is there any statistically significant difference between students' linguistic enlightenment levels which can be attributed to their academic stream (the scientific or literary stream)?

3) - Is there any statistically significant difference between students' linguistic enlightenment levels which can be attributed to their gender (female of male)?

Definition of Terms:

1) - Linguistic enlightenment: The basic language skills that students must master. Those elements as a whole represent the students' linguistic knowledge. These skills are: (listening, speaking, writing and reading) (Al-Refa'i, 2008, p. 247).As for the operational definition of this expression, the researchers of the present study define it as being the availability of a certain level of language skills and knowledge among eleventh (11th) grade students in Jordan who are enrolled in the scientific or literary stream in a way that enables them to use Arabic language properly in their daily lives.

2) - The linguistic enlightenment level: This definition is defined operationally by the researchers of the present study as being the total score that the sampled student gets in the linguistic enlightenment scale (i.e. the study's test).

3) - The eleventh (11th) grade: It is the first grade in the secondary stage according to the educational system of Jordan. This grade is preceded by the tenth 10th grade, and is holding the eleventh rank in the public educational system (Al-Zboun et al., 2016, p. 91).

The Study's limits:

The present study is restricted to the following:

1) - The material limit: It refers to the three linguistic systems of Arabic language (i.e. the syntactic, morphological and semantic systems).

2) - The human limit: It refers to eleventh (11th) grade students in Jordan from the scientific and literary streams

3) - The spatial limit: It refers to the male and female secondary schools that are subjected to the authority of the directorates of education of Karak / Jordan

4) - The temporal limit: It refers to the first semester of the academic year (2016 / 2017)

2. Methodology and Procedures

In order to fulfill the study's objectives, a descriptive approach was adopted because its suits the nature of the study's topic and objectives.

2.1 The Study's Population:

The study's population consisted from all the male and female eleventh (11th) grade students (from the scientific and literary streams) who are enrolled in the public schools that are subjected to the authority of the directorates of education of Karak / Jordan during the first semester of the academic year (2016 / 2017). The study's population included two thousand fifteen (2015) female and male students distributed to forty three (43) secondary schools.

2.2 The Study's Sample:

The study's sample consisted from two hundred (200) female and male students who were selected from the scientific and literary academic streams. They are distributed to eight (8) secondary schools in Karak governorate. They were chosen through using the random stratification method. That can be illustrated through table (1) below.

Table 1. The distribution of the study's sample according to their academic stream (Scientific or literary) & gender

The School's Name	*Gender*	*Academic Stream*	*Frequency*	*Percentage%*
Al-Karak Secondary School for males	Male	Literary	25	26%
Mu'tah Secondary School for males	Male	Literary	27	
Abed Al-Wahab Secondary School for males	Male	Scientific	23	22.5%
Al-Safi Secondary School for males	Male	Scientific	22	
Al-Tiba Secondary School for females	Female	Literary	21	21.5%
Al-Mazra'ah Secondary School for females	Female	Literary	22	
Noor Al-Hussain Secondary School for females	Female	Scientific	32	30%
	Female	Scientific	28	
Total			200	100%

2.3 The Study'S Instrument

The researchers of the present study designed an objective test. Its final form consisted from fifth (50) items. Each item includes four (4) choices. Those items cover three linguistic systems of Arabic: the syntactic, morphological and semantic systems. The syntactic system is covered by twenty four (24) items, whereas the morphological system is covered by a sixteen (16) items. As for the semantic system, it is covered by ten (10) items. The items of this test were formed after reviewing the Arabic language curriculum, the teachers' guide and the general and specific outcomes. The test was designed after reviewing the scales used by other researchers (Salim, 2009; Al-Dahri, 2016; Bacanak and Gokdere, 2009; A'lam Al-Deen, 2007; Al-Refa'i, 2008, Al-Swairki, 2014). When drafting the test's items, the researchers of the present study decided to choose a standard form for all the items to ensure that the students shall concentrate and their concentration won't be dispersed. The researchers of the present study were also keen to making a balance in the length of the given choices and making sure that only one answer is correct.

The test forms were passes to an exploratory sample that was selected from the study's population, but not from the study's sample. This exploratory sample consisted from thirty five (35) students. The test forms were passed to the exploratory sample to identify the extent of their comprehension for the test's items and instructions. They were passed to them to identify the time needed for doing the test and measuring its validity and reliability. In order to calculate the time needed for the answering all the items, the arithmetic mean of the time needed by the first five students was calculated. It is 30 minutes. Then, the mean of the time needed by other five students was calculated and it is 60 minutes. After that, the total arithmetic mean was calculated and it is 45 minutes.

2.4 The Instrument's Validity:

In order to measure the test's validity, it was passed - in its initial form - to ten (10) arbitrators. Three (3) of them are specialized in the field of Arabic language and teach Arabic language to secondary stage students. The arbitrators also include supervisors and educators for the Arabic language course. These arbitrators also include three (3) university professors who teach curricula and teaching methods of Arabic language in Jordanian universities and two (2) university professors who are specialized in assessment and measurement. The initial

form of this test consisted from fifty four (54) items. In the light of the arbitrators' recommendations and suggestions, several deletions, additions, and modifications were made to produce the final form of the test. The final form of the test consisted from fifty (50) items.

2.5 The Test's Reliability:

In order to measure the test's reliability, the split half method was used. Pearson correlation coefficient was also calculated between the total sum of odd scores and the total sum of even scores - the split half method. The value of the Pearson correlation coefficient is (0.64). After that, it was corrected through Spearman's rank correlation coefficient. The total reliability coefficient of the test is (0.78). This value reflects that the test is relatively highly reliable.

2.6 The criterion adopted for classifying the scores and method of correction:

One score was given for each item. In case the student answered the item correctly, he / she shall get one score. In case he answered the item wrong, he / she shall get a zero. Thus, the maximum score of the test is 50 with covering three linguistic systems of Arabic; the syntactic (24 score), morphological (16 scores) and semantic and lexicographical (10 scores) systems. The student would obtain 50 scores in case he answered all the test's items correctly. He / she shall get a zero in case all of his / her answers are wrong. A model answers sheet was set to facilitate the process of correcting the students' answers sheets.

After reviewing the relevant previous studies and the opinions of specialists and educators, the following criterion was adopted to identify the linguistic enlightenment level of the respondents:

Less than 60 % is classified as low

60 % - 80 %% is classified as moderate

More than 80 % % is classified as high

2.7 The Study's Variables:

1) - The independent variables: Gender (i.e. male and female); The academic stream (i.e. the scientific and literary streams)

2) - The dependent variables: The linguistic enlightenment level of the eleventh (11th) grade students.

2.8 The Study's Procedures:

1) -The researchers of the present study reviewed the educational studies that are relevant for the study's topic

2) -The researchers of the present study reviewed some Arabic language curricula and their objectives.

3) -The researchers of the present study developed an instrument for measuring the students' linguistic enlightenment level (which is a test)

4) -In order to check the test's validity, it was passed to a group of arbitrators who are specialized in relevant specialties

5) -The coefficients of difficulty and discrimination were calculated for the test's items

6) -The number of the study's population was identified through referring to the directorates of education of Karak / Jordan.

7) -In order to measure the test's reliability, the test forms were passed to an exploratory sample that are chosen from the population, but not from the sample.

8) -The test forms were passed to the study's sample that was chosen through the random stratification method.

9) -The required data was collected and encoded. After that, it was administered into the SPSS program to be processed statistically.

10) -The results were presented, discussed & interpreted. In the light of those results, recommendations were suggested.

2.9 The Statistical Processing Methods:

In order to fulfill the study's objectives and answer the study's questions, the researchers of the present study used the SPSS program, and calculated the arithmetic means and standard deviations. In addition, the researchers conducted the independent samples t-test and one way analysis of variance (ANOVA).

3. Results and Discussion

3.1 Results Related to the First Question and Discussion:

Question (1): What is the linguistic enlightenment level of eleventh (11th) grade students in Jordan?

In order to answer question (1), the arithmetic means, standard deviations and relative weight were calculated and the total score was identified. In addition, the three linguistic systems were ranked according to the students' enlightenment level on each. That can be illustrated through table (2)

Table 2. The arithmetic means, standard deviations, relative weight, the total score and the rank of each linguistic system according to the students' enlightenment level about them.

The sub-systems linguistic system	*Maximum Score*	*Arithmetic Mean*	*Standard Deviation*	*Relative Weight*	*Rank*
Syntax	24	13.28	2.42	55.33%	2
Morphology	16	8.94	1.64	55.81%	1
Semantics and Lexicography	10	5.30	1.37	53%	3
Total	50	27.52	3.43	55.04%	

Through table (2), it can be noticed that the total arithmetic mean of the three linguistic sub-systems is (27.52) from the maximum score (50). As for the total standard deviation, it is 3.43 and the total relative weight is 55.05 %. Based on the total score of students' linguistic enlightenment, students showed low linguistic enlightenment level.

The arithmetic means are within the range of (5.30 – 13.28) and the relative weights are within the range of (53 %- 55.81 %). The morphological system was ranked first with having an arithmetic mean of 8.93, a standard deviation of 1.638 and a relative weight of 55.81 %.

The syntactic system was ranked the second with having an arithmetic mean of 13.27, a standard deviation of 2.42 and a relative weight of 55.33 %. As for the semantic system, it held the third ranked (i.e. the last rank) with having an arithmetic mean of 5.30, a standard deviation of 1.37 and a relative weight of 53 %. All of those values are considered low.

This result is considered in agreement with results concluded by (Al-Jabareen, 2004; Al-Wahidi, 2005; Salim, 2009; Al-Naqah and Al-Abed, 2012; Al-Dahri, 2016). However, it is not in agreement with the results concluded by Kuiper (2001). For instance, the study of Kuiper (2001) showed that students showed a high linguistic enlightenment level.

The researchers of the present study attribute this result to several reasons. Such reasons may include: the adoption of traditional teaching methods that depend on recitation and memorization. Such teaching methods are adopted by most Arabic language teachers. Such reasons also include the perception of language as being a group of facts that students must memorize. However, language should be perceived as being a habit that is practiced among other life functions like any other life skill that one acquires. Such reasons include the nature of the curricula. For instance, curricula are developed in a way that makes the teacher teach the language skills separately from one another. However, such skills should be taught as being a single unit because they are integral units and separating them should be formal. Such reasons include the absence of the practical application of classical Arabic language in situations that fulfill students' desires and make them excited. In fact, memorization makes students develop negative feelings towards Arabic language.

One of the most significant reasons for having poor linguistic knowledge about Arabic language is teaching it as being a course like any other course; neither perceiving it from religious perspective nor a national one. From a religious perspective, Arabic language is the language of the Holy Quran. From a national perspective, it is the language shared between members of the Arab nation. It is also considered one of the most significant requirements for achieving unity between those members and one of the most significant factors for achieving bonds between those members. In addition, previous studies showed that there is a strong relationship between students' language competency and their achievement level in various academic courses.

In addition, one should pay attention to the role of media – in its various forms – in promoting linguistic knowledge among students. For instance, media usually uses colloquial language that is not subjected to the rules of classical Arabic language. Such media participated in developing negative attitudes towards Arabic

language among students. The researchers of the present study believe that there is a strong relationship between the decline of the Arab nation currently and the status of the Arab language. That is because Arabic language develops and flourishes with the advancement of the culture and civilization of the members of that language.

3.2 Results Related to the Second Question and Discussion:

Question (2): Is there any statistically significant difference between students' linguistic enlightenment levels which can be attributed to their academic stream (the scientific or literary stream)?

In order to answer question (2), the researchers of the present study conducted the independent samples t-test. It was conducted to identify the differences between the students' linguistic enlightenment levels which can be attributed to their academic stream (the scientific or literary stream). That can be illustrated through table (3) below:

Table 3. The arithmetic means and standard deviations of the students' scores in the test in each linguistic system and the systems as a whole in accordance with the academic stream (the scientific and literary streams)

The linguistic sub-system	*Academic Stream*	*Frequency*	*Arithmetic Mean*	*Standard Deviation*
Syntax	Scientific	105	13.38	2.292
	Literary	95	13.17	2.554
Morphology	Scientific	105	8.91	1.605
	Literary	95	8.96	1.681
Semantics and Lexicography	Scientific	105	5.33	1.349
	Literary	95	5.27	1.337
Total	Scientific	105	27.63	3.337
	Literary	95	27.40	3.547

Through table (3), it can be noticed that there are superficial differences between the means of the scores of the students enrolled in the scientific stream and the ones enrolled in the literary stream in each system and the systems as a whole. For instance, the total arithmetic mean of the scores of the students in the scientific stream is (27.63) with having a standard deviation of (3.337). The total arithmetic mean of the scores of the students in the literary stream is (27.40) with having a standard deviation of (3.547). In order to identify the statistical significance of those differences, one way analysis of variance (ANOVA) was conducted in accordance with the students' academic stream. That can be illustrated through table (4) below:

Table 4. The source of variation, sum square (SS), degree of freedom (DF), mean square (MS), F value, and the significance level (Sig.) in accordance with variable of the academic stream

The linguistic sub-system	Source of variation	*Sum Square (SS)*	*Degree of Freedom (DF)*	*Mean Square (MS)*	*F Value*	*Sig.*
Syntax	Among group	2.253	1	2.253	0.385	0.536
	Within group	1160.067	198	5.859		
	Total	1162.320	199			
Morphology	Among group	0.095	1	1.605	0.035	0.851
	Within group	534.060	198	1.681		
	Total	534.155	199			
Semantics and Lexicography	Among group	0.177	1	0.177	0.094	0.759
	Within group	372.218	198	1.880		
	Total	372.395	199			
Total	Among group	2.606	1	2.606	0.220	0.639
	Within group	2341.314	198	11.825		
	Total	2343.920	199			

Through table (4), it can be noticed that there isn't any statistically significant difference between students' linguistic enlightenment levels – at the significance level of ($a \geq 0.05$) – which can be attributed to their academic stream (i.e. the scientific or literary stream). That applies on each system and the systems as a whole. This result

is not in agreement with the result of Al-Jabareen (2004). That is because the study of Al-Jabareen (2004) showed that there are statistically significant differences between students' linguistic enlightenment levels which can be attributed to their academic stream for the favor of the students enrolled in the scientific stream.

The researchers of the present study attribute the latter result to several reasons. Such reason includes having similar academic conditions surrounding the students in the scientific stream and the ones in the literary stream. Such conditions include the teachers' academic qualifications. The teachers who teach the students in the scientific stream are often the same ones who teach the students in the literary stream. Such conditions include having similar material conditions surrounding the students in the scientific stream and the ones in the literary stream. Such material conditions include the buildings, classrooms, technological instruments used for education, etc…

3.3 Results Related to the Third Question and Discussion:

Question (3): Is there any statistically significant difference between students' linguistic enlightenment levels which can be attributed to their gender (female of male)?

In order to answer question (3), the researchers of the present study conducted the independent samples t-test. It was conducted to identify the differences between students' scores which can be attributed to their gender (female or male). That can be illustrated through table (5) below:

Table 5. The arithmetic means and standard deviations of the respondents' scores on the test in each linguistic system and the systems as a whole in accordance with their gender (female or male)

The linguistic sub-system	*Gender*	*Frequency*	*Arithmetic Mean*	*Standard Deviation*
Syntax	Male	97	12.58	2.030
	Female	103	13.94	2.569
Morphology	Male	97	8.44	1.561
	Female	103	9.40	1.580
Semantics and Lexicography	Male	97	5.19	1.210
	Female	103	5.42	1.498
Total	Male	97	26.21	3.142
	Female	103	27.40	3.240

Based on table (5), it can be noticed that there are superficial differences between the total means of the female and male scores whether in each linguistic system and as the systems as a whole. For instance, the total arithmetic mean of the male students is (26.21) with a standard deviation of (3.142). As for the total arithmetic mean of the female students, it is 28.76 with having a standard deviation of (3.240).

In order to identify the statistical significance of those differences, the researchers conducted one way analysis of variance (ANOVA) in accordance with their gender (males of females). That can be illustrated through table (6)

Table 6. The source of variation, sum square (SS), degree of freedom (df.), mean square (MS), F value, and the significance level (Sig.) in accordance with their gender (female or male)

The linguistic sub-system	Source of variation	*Sum Square (SS)*	*Degree of Freedom (DF)*	*Mean Square (MS)*	*F Value*	*Sig.*
Syntax	Among group	92.999	1	92.999	0.000	0.000*
	Within group	1069.321	198	5.401		
	Total	1162.320	199			
Morphology	Among group	45.537	1	45.537	0.000	0.000*
	Within group	488.618	198	2.468		
	Total	534.155	199			
Semantics and Lexicography	Among group	2.687	1	2.687	1.439	0.232
	Within group	369.708	198	1.867		
	Total	372.395	199			
Total	Among group	325.112	1	325.112	31.886	0.000*

Within group	2018.808	198	10.196
Total	2343.920	199	

Through table (6), it can be noticed that there are statistically significant differences between students' linguistic enlightenment levels – at the significance level of (a≥ 0.05) – which can be attributed to their gender (male or female) in syntax, and morphology. These differences were for the favor of female students. However, there isn't any statistically significant difference between students' linguistic enlightenment levels – at the significance level of (a≥ 0.05) – which can be attributed to their gender in semantics. These results are considered in agreement with the results concluded by (Al-Dahri, 2016; Al-Wahidi, 2005; Salim, 2009; Al-Jabareen, 2004).

The researchers attribute having higher linguistic enlightenment level among females to several reasons. Such reasons include the culture and way of thinking of the people living in Karak. For instance, those people tend to stick to the female related traditions which provide females with more time to study. In addition, the females in that region tend to show more compliance to the rules and regulations. Such reasons also include the increasing demand for education by females and not having any work opportunity available for the females who do not hold any university degree. However, there are work opportunities available in some governmental institutions for the males who do not hold the Tawjihi certificate (i.e. the General Secondary Education Certificate). Such reasons also include the intensity of competition which is greater among females (whether the competition is between teachers or students). In addition, there is a high demand for working in the teaching profession because this profession is accepted by conservative societies. Therefore, it can be noticed that females are showing more interest than males in developing themselves on the academic and professional levels. Such interests shall be reflected on the students' performance.

Recommendations

The researchers of the present study recommended:

1) - Making guidance programs to promote awareness among students about the significance of Arabic language and its role in their lives.

2) - Encouraging students to use classical Arabic language properly in all the courses rather than using it in the Arabic language course only.

3) - Encouraging Arabic language teachers to focus more on the semantic system because it is the key system that enables one to comprehend the other linguistic systems.

4) - Conducting more studies on other samples to check the reliability of the results of the present study.

References

Al-Dahri, S. (2016). The linguistic enlightenment level and its relationship with secondary students' motivation to study Arabic language in Baghdad (Unpublished MA thesis). The Middle East Univesity, Amman.

Al-Ebrahimi, M. F. (2017). The linguistic enlightenment level of Arabic language teachers of the primary educational stage. Retrieved from http://www.Qu.eduig/staff/makkikareem/2017/3/30

Al-Jabareen, A. (2004). The common syntactic and spelling mistakes of ninth 9th grade students in the public schools subjected to the authority of South Hebron directorate of education (Unpublished MA thesis). Al-Quds University.

Al-Naqah, S. A., & Al-Abed, E. S. (2012). The extent of students' competency in the listening skills. *The Islamic University Journal*, (1), 541-586.

Al-Wahidi, A. Y. (2005). The extent of acquisition for the writing skills among the ninth grade students enrolled in the schools of Bait Lahem (Unpublished MA Thesis). Al-Quds University, Al-Quds.

Hamoudeh, H., Mohammad, A. K., Abu, A. R. H., & Abu Fraiha, Elham (2012). Arabic language (101) (1st Ed.). Amman, Jordan: Dar Al-Massirah Publishing and Distribution House.

Mohammad, A. A. (2002). *Studies in language and education* (1st ed.). Amman,Jordan: Dar Wa'el Publishing and Distribution.

Mohammad, A. O. (2006). Assessing the scientific content of the tenth 10th grade technological culture curriculum in the light of the technological enlightenment dimensions (Unpublished MA thesis). The Islamic University of Gaza, Gaza.

Mohammad, A. S. A. (2014). The effectiveness of the language skills curriculum in making new students

acquires the language skills. *The Specialized Educational Journal, 3*(12).

Mohammad, A. Z., Al-Ja'afra, A. A. S., & Al-Mawadieh, R. (2016). *The educational system in Jordan* (1st ed.). Amman, Jordan: Dar Wa'el Publishing and Distribution.

Mohammad, S. (2003). An analysis for the curriculum (Our Arabic Language) of the sixth grade in Jordan, A research submitted for the curricula development seminar, Foundations and principles - King Saud University, Saudi Arabia.

Zayed, F. (2011). Modern methods for teaching Arabic language (1st ed.). Amman, Jordan: Dar Yafa Publishing and Distribution.

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The Impact of the Use of YouTube and Facebook on Students' Academic Achievement in Geography Course at the University of Jordan for the Bachelor's Degree

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Abstract

The aim of this study is to investigate the impact of the use of YouTube and Facebook on students' academic achievement in geography course at the University of Jordan for the bachelor's degree, and the effect of the variable of the cumulative average. The study was conducted in the first semester of the academic year 2017/2018. The study consists of two groups: the first was taught by using YouTube and Facebook and the number of its members is (43) students, and the second group which is the control group was (34) students**.**

A quasi-experimental approach was used and the study's tools were the educational material designed in a manner consistent with the methods of YouTube and Facebook, and a 25-point achievement test to measure the students' achievement in geography course. The validity and reliability of the study tools were verified by known scientific methods.

The results showed that there was a statistically significant effect on the achievement of the students of the University of Jordan in the geography course due to the variable of method of teaching and to the two experimental groups that were taught using the methods of YouTube and Facebook. There are too statistically significant differences ($\alpha = 0.05$) due to the cumulative average and the significance was in favor of those with good, very good and excellent assessments.

Keywords: Facebook, YouTube, achievement

1. Introduction

It has become possible to adopt a number of modern techniques that help in the development of educational learning process, which may assist in refining the skill of the student and teacher in accessing and using information in classrooms. Out of these modern educational techniques is the social networks such as Facebook and Twitter, Smartphone's and Internet-based communication software such as Skype and others**.**

The 2nd generation Web is based on a number of key tools, including blogs, social bookmarking and social networks that are interactive and connected to a virtual medium, which is considered one of the latest technologies used in education. It is called the 2nd generation of e-learning, it is learning via social Internet networks (Al-Masri, 2014).

The design of the social networks serves as a novel language of communication and connection amongst Internet users, relying on the techniques of the 2nd generation Web, which overcome the barriers of space and time. Besides this, they worked to consolidate social relations between users to break the fence of social isolation in a lot of individuals, these networks are characterized by interactivity and communication in a collaborative virtual medium (Hamdi, 2010).

Social networks are seen as Internet-based web sites where millions of people share common interests. These social networks allow users to share files and pictures, create blogs, send messages,share videos and have instant conversations**.**

Zaidah (2012) indicated that the reason for naming these networks sites with social networks is their high potential in communicating with friends and colleagues as well as strengthening the social bonds between their

members over the Internet. As a fact, the most eminent social networks in the world are Facebook, Twitter, WhatsApp, MySpace and others**.**

Types of social networking sites can be categorized into two types, namely: Closed communities as individuals communicate within a company, a university, an organization or a school, where they are invited to enter the website and participate in its activities through writing and exchanging views, files, photos and videos related to their works and tasks as well. Type 2 is a collection of social sites available to all Internet users, where many of them are allowed to participate in the various activities of the site as soon as they identify themselves to the site (Amasha, 2009).

What features the social communication networks is its appropriateness for educational uses; they provide participatory and collaborative activities among students, as well as their flexibility and easiness of use by different ages despite their rapid development (Poore, 2012). Piaget stressed that learning is built and developed through experience, that it is an active process, and a cooperative process. In light of this, the learner takes a prominent role in developing knowledge from experience, where cognitive growth comes through the interaction and participation of the individual with others and in their views concerning the lifestyle several themes and matters (Ghabari and Abu Shira, 2010).

Al-Khawalda (2010) points out that Facebook is not only a tool or a site to get to know new friends, communicate with friends, or know what is going on around the world, but also it is a great learning tool if used effectively and an important resource of information. As for teachers, they can use it in the classroom in order to improve communication, and integrate students into effective activities that differ from traditional teaching methods**.**

Ahmed (2010) focuses on the significance of Facebook as a social networking site that has gone viral rapidly in recent times, exceeding the geographical boundaries among people and friends, helping them communicate and exchange ideas and information and build social relations. As a matter of fact, Facebook cannot be considered merely a tool to entertain, amuse and communicate with friends, but can be considered an effective learning tool if properlyfunctioned and used. Teachers can use Facebook in the classroom to improve students' communication and participation in operative activities away from the traditional style practiced at schools.

Chapelle (2003) reported that technology has changed the teaching and learning methods of English language, as many websites offer opportunities for English language learners to converse and communicate with native speakers. The idea is that if a individual wants to learn English well, he has to go to where the native speakers live, and if the individual cannot go to an English-speaking country, he can compensate for this by signing into the chat rooms or discussion forums. She too pointed out that the considerable exposure of the individual to the language to be learned develops his ability to understand, especially the Spoken Language.

The use of social networking sites such as Facebook, Twitter, YouTube and others has spread widely throughout the world, resulting in breaking geographical boundaries and making it appear to be a small village bringing its people together. These sites have developed and become the most prevalent among Internet users; they facilitate the process of active interaction amongst the subscribers involved in providing various means of interest through various features such as instant messaging, videos, chatting, files sharing, e-mails, blogging and more (Khdar Allah, 2010; 0Karbiniski, 2010; Mwingo and Abu Darra, 2012; Charnigo and et al, 2007).

Shea and Sherer (2011) points out that many universities have established their own channels on YouTube to view their lecturing videos, and that YouTube is available for students and teachers to use effectively in and out of the classroom to help students learn, stimulate class discussions and achieve learning goals**.**

Trier (2007) stated that the best way to save and retain videos that an individual needs from YouTube is to create a private account on the site, which is free and easy to create, where the individual has only to go to the YouTube page on the Internet, register, and fill out some of the required key information, and then create a user name and password. Then, the individual can keep the videos in the Favorites icon on the same site, noting that this individual, who has his or her own account, can create a list of videos stored in the Favorites list to facilitate subsequent search for specific videos. According to Trier, what distinguishes YouTube is immediacy and availability; the teacher can quickly know whether the video he is in search of it is available or not**.**

Jones and Cutherll (2011) cited the possible uses of YouTube in the educational process, stating that YouTube videos can be used directly in the classroom as part of the teaching process. They can be used to introduce new concepts, display information during instruction, or at the end of the lesson to confirm number-one points. YouTube videos can also be used as an educational resource, where the teacher uses the video as a model for classroom activities and discussions**.**

Chenail (2011) noted that the YouTube site provides students, teachers and qualitative research's experts with a unique stock of videos that illustrates the concepts of basic qualitative research, the availability of opportunities to share qualitative data through interviews and field observations and display the fully completed researches. It also provides qualitative research's researchers with the ability to view and share their own learning resources to interested people**.**

Abu Hamda (2016) conducted a study aimed at identifying the impact of social media on improving the writing's efficiency of ninth graders in the West Bank, Palestine. The results of the study showed that students in the ninth grade have positive attitudes towards the use of social media as one of the tools of writing in English. The results also showed that there are statistically significant differences in the effect of social media on the ninth graders to master the skill of writing in English due to the variable of qualification**.**

Savas (2012) conducted a study aimed at finding out the impact of video use in the teaching courses of ESL teachers for third year students at the bachelor level at a public university in Turkey, where the sample consisted of (40) male and female students. The study's results showed the usefulness of the use of videos in teaching, as it contributed to improving their skills in English as well as improving their teaching skills of English.

Batainah (2010) conducted a study aimed at finding out the impact of video use on thenon-linguistic proficiency for English language learners in universities, where the study population consisted of (760) students specialized in English language and literature at the University of Jordan. The sample of the study consisted of (35) students and the researcher identified the non-linguistic elements, namely: gestures and signs and expressions of the face and eyes. The control group was taught traditionally, while the experimental group was taught using the video, and after two months, a post-exam was conducted, where the results of the study showed that there is a difference between the control group and the experimental group in the test in favor of experimental group**.**

Al-Masri (2014) conducted a study aimed atidentifying the impact of Facebook on the achievement of the ninth grade students in mathematics course in Amman. The results showed that there were statistically significant differences in favor of the experimental group due to the teaching method. The results too showed that there is a statistically significant difference due to the gender of the student and in favor of females. The study also showed that there is a statistically significant difference due to the interaction between the method of teaching and gender in favor of females who were taught with the use of Facebook.

Al-Enezi (2013) conducted a study aimed at identifying the effectiveness of using Facebook on the achievement in science course and the trend towards the knowledge society of the ninth grade female students in Madinah Al-Munawarah and detecting the existence of a relationship or lack thereof between the achievement of science and the trend towards the knowledge society. The researcher found that the use of Facebook has led to an increase in students' achievement, and that there is a relationship between achievement and the trend towards the knowledge society among the ninth grade students. In light of the results of the study, the study recommended of using Facebook to teach most of the curriculum, benefitting from the group service provided by Facebook in the creation of specialized and professionalgroups, supporting the trend of female teachers towards the use of Facebook and embodyingskills preparation programs of female teachers todeal with social media**.**

Based on the above, the problem of the study is summarized in the search for the impact of the use of YouTube and Facebook on students' academic achievement in geography course at the University of Jordan for the bachelor's degree.

2. The Problem & Purpose and Questions of the Study

The world is currently facing countless developments and changes, which may have a significant impact on society in general and on students in particular. One of the most significant developments in the world of the Internet is the social networks including Facebook, Twitter and others. Social media sites (Facebook and YouTube) are considered the new technologies that help in the development of educational learning process, as it is experiencing a dynamic movement of development and spread, where Facebook has been successful since its inception. Though these websites were established primarily for social networking between individuals, the use of Facebook and YouTube extended to the educational processby developing educational programs and activities for students in order to take advantage of the student's time and develop his personality; the educational process is not only teaching a lesson, but also an educational and active process with clear objectives aimingat building the personality of the student in all respects. More tellingly, the educational process tries to find an integrated balance among all traits of his personality, as it helps in refining the skills of students and teachers to access and share information in classrooms to improve communication and integrate students into effective activities.

Students are currently suffering from a lack of learning in geography course and its skills due to the

overcrowding of students in classes, the lack of time to perform enrichment and therapeutic activities, the traditional methods of teaching that do not take into account the needs of students, their interests, their tendencies and their desires as well as the absence of technology, the lack of classes for educational tools and the highly required skills. Accordingly, all of this led to weakness in the student's achievement and their importance to the individual at the academic level as a tool for acquiring knowledge and at the social level as a means of communicating with others**.**

In their (2015) study, Hussein and Ghoul pointed to the impact of using Facebook method on the achievement of ninth grade students in English language and the impact of the cumulative average on this and the interaction between them. They also clarified that the achievement of ninth grade students in English language has increased using Facebook compared to the traditional method**.**

There was a bad need for educational strategies to keep up with the contemporary times, along with teaching methods that develop students' confidence in their skills and abilities in learning geography and try to overcome the traditional ways of bridging the gap between the requirements of the current age and the students' aspirations.Therefore, the problem of the study has crystallized the answers to the following questions**:**

1. Does the academic achievementof the students of the University of Jordan at the bachelor's degree differ in geography according to the method of teaching (YouTube, Facebook or the traditional method?
2. Does the academic achievementof the students of the University of Jordan at the bachelor's degree differ in geography according to the student's cumulative average (excellent, very good, good or acceptable?

At last, the study aimed at finding out the impact of the use of YouTube and Facebook on students' academic achievement in geography course at the University of Jordan for the bachelor's degree compared to the traditional method and the impact of the cumulative average**.**

3. The Importance of Study

The subject of this study is significant from both theoretical and practical aspects**:**

- Consistent with the instructions of the Ministry of Higher Education in Jordan to introduce the idea of e-learning in teaching courses to suit technological development**.**

-Raising awareness of YouTube and Facebook as one of the sources of electronic educational videos that serve the educational learning process**.**

-Using a contemporary method of education that enhances students' self-learning and interaction with the curriculum electronically**.**

Owing to the lack of studies on the significance of both YouTube and Facebook according to the researchers, this study confirms the importance of keeping up with the scientific and electronic progress in raising the level and efficiency of students in the geography course of students of the University of Jordan, which contributes to the development of methods and approaches of education among students through the modern and developed strategies provided by the teachers.

The current study is expected to open venues for other studies to address the impact of the use of social media sites on student's achievement and motivation towards learning, and the impact of these websites on the process of effective teaching and the possibility of its activation and application too.

4. The Tools, Scope and Limitations of Research

The study is subject to the following limits**:**

Spatial limitations: The study was applied to the students of the University of Jordan for the bachelor's degree**.**

Time Limitations: This study was applied in the first semester of the academic year 2017/2018**.**

Human Limitations: Students of the University of Jordan for the bachelor's degree**.**

Objective Limitations: The study was limited to the first unit in the geography course'stextbook for the students of the University of Jordan for the bachelor's degree in Jordan. The textbook will include educational videos, electronic learning games, activities, assignments and electronic tests designed for Microsoft Office programs and others.

The study relied on the use of tools prepared by the researchers to measure the impact of using YouTube and Facebook on the academic achievement of the students of the University of Jordan in geography course.

5. The Study's Definitions

1. Facebook: A social media network available on the Internet, through which information, feelings and ideas are sharedamong people (Al-Masri, 2014).

Procedural Definition: The use of Facebook in the teaching of geography course is practiced so as to present the educational material through the formation of a closed group of students to view the required tasks, and the dissemination of various files, namely: educational images and videos, PowerPoint slides and useful links, where students see the educational task, read, understand and discuss it among them. Facebook is also used to broadcast significant events, receive and submit of school assignments and ensure the achievement of educational objectives through electronic tests that the faculty member publishes on Facebook**.**

2. YouTube: A website that allows its users to upload, watch, share, comment on and view live video recordings for free**.**

Procedural Definition: A website that contains all the geography course videos that help students acquire any skills related to the content of the curriculum, where students can download, watch and share videos related to the subject of the module**.**

3. Academic Achievement: What the learner acquires such as skills, knowledge and different sciences, as a result of a variety of learning processes that indicate his cognitive mental activity and is measured by the degree he achieves in a standardized exam when he is asked to do so (Al-Jalali, 2011).

Procedural Definition: The amount of experiences, knowledge, information and concepts acquired by the learner on the content of the scientific course and measured by the total scores obtained by the learner in the test prepared for this purpose.

6. The Study's Methodology and Procedures

6.1 The Study Approach

The study used the quasi-experimental method to identify the impactof using YouTube and Facebook on the achievement of the students of the University of Jordan for the bachelor's degree in geography course compared to the traditional method in addition to the effect of the cumulative average on this and the interaction between them, considering that this approach is the most appropriate for the objectives and questions of the study.

6.2 The Study's Sample

The sample members were selected purposely to provide the required capabilities for this study from the male and female students of the University of Jordan for the bachelor's degree. The groups were randomly selected, where the number of students was 77 students, divided into two groups: the first group with 43 students taught by using YouTube and Facebook, and the second group with 34 students taughtby using the traditional method.

Table (1) shows the distribution of students according to the teaching strategy and the cumulative average**.**

Table 1. Frequency and percentages by method of study and study variables

Categories	Frequency	Percentage
Group	YouTube and Facebook	Group 43 55.8
Traditional	Method	34 44.2
Cumulative	Average acceptable	35 45.5
Good		14 18.2
Very Good		15 19.5
Excellence		13 16.9

6.3 The Study's Tools

The aim of this study was to identify the impact of using YouTube and Facebook on the academic achievement of the students of the University of Jordan for the bachelor's degree in geography course compared to the traditional method and the effect of the cumulative average. To achieve these goals, the researchers developed

the following tools:

6.3.1 First: Educational Material Designed in Facebook and YouTube.

The first unit of geography textbook for bachelor's degree at the University of Jordan for the first semester (2017/2018) was selected for its relevance to the study's objectives, methodology and educational activities proposed by the researchers**.**

The behavioral objectives were prepared and formulated along with preparing a material which matches the use of YouTube and Facebook in teaching. The material included the educational objectives, content, teaching strategies, sources of learning and teaching aids and assessment, as it was formulated to be 12 teaching hours over 4 weeks. The educational material has been developed in accordance with the proposed educational activities of Facebook and YouTube with being committed to the course content. Instructing activities for teaching the unit were conducted using YouTube and Facebook, including educational videos designed through powerdirector software, moviemaker software, educational videos through YouTube, images, written texts and worksheets as they have an active role in enriching learning. Various Power Point slides were also presented to show the material in an exciting and interesting manner designed in a way that fits with the content of the unit and all designed in a manner that adds fun, action, thrill and amusement, and all were posted on the YouTube and Facebook pages to suit the content of the subject.

6.4 The Educational Material's Validity and Reliability

The reliability of the educational material has been verified by presenting it with all of its educational activities on (15) specialized experts in the field of education and information technology, methods of teaching, geography, measurement and evaluation in the following universities: University of Jordan, Hashemite University and Yarmouk University. The material was amended in accordance with the observations of 80% of the experts, where each expert was provided with a copy of the designed material and was asked to express an opinion on the clarity, accuracy and sequence of the educational material, appropriate use of sounds and colors, background suitability and appropriateness of the lines, as well as the adequacy and integrity of the linguistic content. Based on the observations of the experts, which were all centered on the sequence of the teaching material, the consistency of colors and language formulation, these materials have been amended and developed until they reached the final form. The study was conducted on an exploratory sample outside the sample of the study, which consisted of (12) students from the University of Jordan for three weeks, where the suitability of the educational material for the study was confirmed, and students were asked about the difficulties encountered in the educational material or things that they did not understand. As for the sample, the sample showed that the material is interesting, easy and understandable, and therefore, the educational material is ready to be applied in the final form.

6.4.1 Second: The Academic Achievement Test

In order to achieve the objectives of the study, a study test was constructed consisting of (25) objective questions of the type of multiple choice, prepared according to the specifications of the unit of geography of Jordan for the first semester (2017/2018), so that students choose the correct answer to the question from four choices whose one of them is true. The test allocated (25) points per unit, and each paragraph a grade according to the grades assigned in the specifications table. The students' academic achievement in geography course can be inferred through the total mark they take in the achievement test in the unit of geography of Jordan in their course.

7. The Test's Validity

In order to verify the validity of the test, it was presented in its initial form to a group of 15 experts who are specialized in curriculum and teaching, teaching methods, geography, measurement andassessment and educational technology, and amended according to the observations of 80% of the experts. To ensure the reliability of the test, the method of testing and retesting was applied so that it was applied in the final form to apilot sample of 12 students from the University of Jordan for the bachelor degree who studied the unit of geography of Jordan outside the sample of the study. These studentsshare the same characteristics of the sample of the study as the circumstances, possibilities and facilities provided.

8. The Test's Reliability

To verify the reliability of the test according to the reliability coefficient for the academic achievement test, it has been found equal to (79.), and the reliability coefficient value is acceptable for study purposes. According to the difficulty and discrimination coefficient of the test paragraphs, the difficulty coefficients on most test paragraphs were appropriate (0.33 - 0.83). These percentages are considered acceptable for study purposes as some paragraphs were amended and the inappropriate paragraphs were deleted as well. As for the discrimination

coefficient of the paragraphs, they ranged from (.30) to (.60), where the paragraphs are generally distinct, in an acceptable sense for the purposes of study. Weak paragraphshave been modified in terms of discrimination too. According to the coefficient of internal reliability using the Cronbach's alpha Formula, its value was (.80) and is acceptable for the purposes of study.

9. The Study's Variables

The study included a number of variables, namely:

A. Independent Variable: 1-It includes the method of teaching as well as two levels**:**

Teaching can be done through: A - YouTube and Facebook B - The Traditional Way**.**

2. Cumulative Average with four levels: A- Excellent B- Very Good C- Good D- Acceptable**.**

B. Dependent Variables: are the averages of students' academic achievement in the post-test**.**

Study's Design

EG1: O X1 O

CG1: O O

Where**:**

EG: Experimental Group**.**

EG1: A group that will be taught using YouTube and Facebook**.**

CG: Control Group that will be taught in the traditional way**.**

O: Achievement test (pre-test and post-test).

X1: Processing using Facebook and YouTube.

10. Statistical Processing

In order to answer the study questions, the study adopted the appropriate statistical methods obtained from data analysis, the use of descriptive and indicative statistical methods of Arithmetic mean and standard deviation, and the use of the ANCOVA analysis to adjust the pre-differences from the measurement of the study variables and to find the difference between the average of performance of experimental groupsand control groups in the post-test of academic achievement.

11. The Study's Results and Discussion

Second: Results related to the first question

Question 1: Does the academic achievement of students of the University of Jordan differ for the bachelor's degree in geography course according to the method of teaching (YouTube, Facebook and the traditional way?

In order to answer this question, the Arithmetic means, standard deviations and modified averages were obtained for the academic achievement of the students of the University of Jordan for the bachelor's degree in geography course according to the variable of teaching method (YouTube, Facebook and the traditional method). Table (2) shows this.

Table 2. Arithmetical means and pre and post standard deviations of the experimental and control group

Group	Number	Pre-test		Post-test	
		AM	SD	AM	SD
Experimental	43	0.09	0.71	19.85	0.36
Control	34	0.46	0.63	13.72	3.46

Table (2) shows that there are apparent differences between the average of performance of the experimental and control groups in the achievement test. To determine whether these differences are statistically significant at the level of $\alpha = 0.05$, ANCOVA was performed as shown in Table (3).

Table 3. ANCOVA analysis of the effect of the teaching method on post-achievement

Source of Variance	Total of Squares	Degrees ofFreedom	Mean ofSquares	Value F	Level of Significance
Common pre-achievement		1	**7.020**	966	.321
Group		1	**904.320**	128.29	.000*
Error		75	**669.611**		
Total		76	**1574.000**		

*Statisticalsignificance at level (α = 0.05)

Table (3) shows statistically significant differences in the post-achievement of students between the control and experimental groups where the value of (F) was 128.29. This value is statistically significant at the level of significance (α 0.05 =) after the differences were statistically determined in the pre-test by using (ANCOVA). The differences were in favor of the experimental group where the experimental arithmetic mean of the experimental group was (19.85) and the control group was (13.72).

It is clear from the above that there is a significant impact on the academic achievement of the geography course on the students of the University of Jordan due to the variable of method of teaching for the experimental group taught by using YouTube and Facebook, and that the average of scores of the experimental group students taughtby using YouTube and Facebook exceeds the average of scores of students of the control group taughtby using the traditional method. This indicates the effectiveness of the use of both YouTube and Facebook in the process of teaching of geography course to the students of the University of Jordan**.**

More tellingly, it sounds that the method of YouTube and Facebook, including the class interaction with all its sortssuch as the voice and image and the movement of social communication has increased the motivation of students and strengthened the concepts and content of students**.**The reason may be that the students learned in a way they have not experinced before, allowing them to read and review the material more than once and at any time. Moreover, this current method enhanced their knowledge of the educational material and contributed to the development of learning in an interesting and attractiveway, especially as they deal daily with the channels of social communication**.**

The results also showed that there was a significant impact on the academic achievement of the geography courseon the students of the University of Jordan due to the variable of method of teaching for the experimental group that was taught using YouTube. This result is consistent with a number of previous studies that indicated that teaching using YouTube has a positive impact on students' learning in general and in particluar academic achievement, such as Eick and King (2012) and Tan and Pearce (2011), who pointed to the importance of using educational videos because of their impact on increasing student’s achievement in various subjects, both school and university.

This finding is attributed to the fact that learning through YouTube has become one of the basic learning resources in the student's life at the present time, for it provides illustrations, growth of knowledge and easiness of searching for sources of knowledge. It too gives students limitless space for self-learning and knowledge acquisition as desired by the student, as opposed to other learning sources in which knowledge is defined with narrower boundaries. It can also contribute to the development of students' learning with all its different skills, by helping the learner plan to learn, set goals, determine and mange time and decide the appropriate place to learn**.**This finding is consistent with the results of the Eck and King study (Eick and King, 2012).

It is possible that the current result is attributed to the advantages enjoyed by Facebook, which are expected to serve students' learning and contribute to improve their educational level. Out of these advantages is that this type of learning enables the learner to review and study his educational material more than a once without feeling bored at the time he wants and where he wants and this in general increases the motivation to learn, which increases the direct academic achievement. The method of learning through Facebook is a noveltechnique for students, which has raised their interest and increased their motivation to learn as this is confirmed by the results of previous studies such as the 2014 study of Hussein and AL Ghoul and the 2014 study of Al-Masri.

11.1 Third: Results Related to the Second Question

Question 2: Does the academic achievement of students of the University of Jordan differ in the undergraduate level in geography course according to the student's cumulative average, namely: excellent, very good, good or acceptable?

In order to answer this question, the Arthimitic means and standard deviations were obtained for the academic

achievement of the students of the University of Jordan for the bachelor's degree in geography course according to the student's cumulative average, namely: excellent, very good, good, acceptable?And the table below illustrates this:

Table (4). Arthimitic means and standard deviations of the academic achievement of the students of the University of Jordan for the bachelor's degree in geography course according to the variable of cumulative average of the student

Categories	**The number**	**Arthimitic Mean**	**Standard Deviation**
Accepted	**35**	**12.53**	**3.909**
Good	**14**	**17.00**	**3.234**
Very good	**15**	**18.00**	**4.592**
Excellent	**13**	**19.69**	**3.093**
Total	**77**	**15.40**	**4.755**

Table (4) shows an apparent difference in the Arithmetic averages and standard deviations of the University of Jordan students' academic achievement for the bachelor's degree in geography course because of the difference of categories of the variable of the cumulative average of the student (excellent, very good, good or acceptable). To illustrate the significance of the statistical differences between the arithmetic averages, a single variance analysis was used according to Table (5).

Table (5). Analysis of the single variance of the effect of the cumulative average of the student on the academic achievement of the students of the University of Jordan for the bachelor's degree in geography course

The Source	Total number of Squares	Degrees of Freedom	The mean of Squares	Value P	Statistical Significance
Among groups	670.277	3	223.426	15.559	.000
Within groups	1048.243	73	14.359		
The total	1718.519	76			

Table (5) shows that there are statistically significant differences at the level of significance ($\alpha = 0.05$) due to the cumulative average on the academic achievement of the students of the University of Jordan for the Bachelor's degree in geography course. In order to show the statistically significant differences between the arithmetic means,Least Significant Difference (LSD) post-comparisons were used as shown in Table (6).

Table (6). LSD post-comparisons of the effect of the cumulativeaverageof the student on the academic achievement of the students of the University of Jordan for the bachelor's degree in geography

	Arithmetic Average	Acceptable	Good	Very Good	Excellent
Acceptable	14.50				
Good	18.09	4.47*			
Very Good	19.50	5.47*	1.00		
Excellent	21.63	7.17*	2.69	1.69	

*Significance at level ($\alpha = 0.05$)

Table (6) shows the following**:**

There are statistical significant differences of ($\alpha = 0.05$) between the acceptable on the one hand and all of the good, and very good and excellent on the other hand, and the differences were in favor of both good, and very

good and excellent**.**

This aforementioned result may be a normal result because those who have high averages are more willing and tend, dependingon their academic achievement and their high abilities, to learn using technological innovations such as YouTube and Facebook. The method of YouTube and Facebook, including videos, software, activities, assignments, electronic tests and immediate feedback, and communicating with the teacher and colleagues make high-average students tend to accept to learn in this way as it increases their motivation and activity as well as their desire to learn. This method also opensnew venues of science and knowledge in geography course for students in a way making them superior to their colleagues who have an acceptable average and with a statistically significant difference, who were, by virtue of their averages, less motivated and inclined to learn in this way. More importantly, this applies to students with good, very good and excellent cumulative averages due to their high abilities to excel in terms of statistics, noting that this result is consistent with the results of the study (Hussein and Al-Ghoul, 2014).

12. Conclusions

- There is a significant impact on the academic achievement for the geography course of the students of the University of Jordan due to the variable of method of teaching, in favor of the experimental group taught by using YouTube and Facebook. This refers to the impact of the use of YouTube and Facebook in the teaching of geography course to the students of the University of Jordan**.**
- There are statistically significantdifferences between the students with acceptable average on the one hand and all of the good, very good, and excellent on the other hand, and the differences were in favor of both good, and very good, and excellent, and attributed to the teaching method, in favor of the experimental group taught by using YouTube and Facebook. This refers to the impact of using YouTube and Facebook**.**
- There are statistically significantdifferences between the level of high experience on the one hand and each of the low and medium experiences on the other hand and the differences were in favor of the level of high experience due to the teaching method, and for the benefit of the experimental group taught by using YouTube and Facebook. This refers to the impact of using YouTube and Facebook.

13. Recommendations

In light of the results of the study, the researcher recommends the following**:**

1. Activating YouTube and Facebook in teaching geography course because of their effectiveness in education.
2. Paying attention to students of low and medium averages to raise their academic and technological level and take advantage of the potentials of YouTube and Facebook in their education.

References

Abu Hamda, E. (2016). The Impact of Social Communication and Improving the Literary Efficiency of Grade 9 Students in the West Bank, Master Thesis, An-Najah National University, Nablus, Palestine.

Ahmed, Y. (2010). Using the Facebook social network in education. Retrieved from http://docs.com/COD6

Amasha, M. (2009). E-learning and social networking services. *Journal of Informatics,* (27), 24-30. Retrieved from http://informatics.gov.sa/details.php?id=313

Anzi, J. (2013). Effectiveness of the use of social networks in the collection of science and the trend towards the knowledge society of the third grade students in Medina. PhD Thesis, Umm Al Qura University, Kingdom of Saudi Arabia.

Bataineh, A. (2010). The Effect of Using Videos on University EFL Learners' Nonverbal Competence. *Journal of IslamicUniversity*, (2), 1295-1322 .

Chapelle, C. (2011). English Language Learning and Technology, 1stEd., (2003), John Benjamins Publishing Co., Philadelphia - USA.

Chenail, R. (N/A). YouTube as a Qualitative Research Asset: Reviewing User Generated Videos as Learning Resources. *The QualitativeReport,* (1), 229-235.

Egyptian, A. (2014). The Effect of Facebook on the Achievement of Ninth Grade Students in Mathematics, Master Thesis, Hashemite University, Zarqa, Jordan.

Eick, C., & King, D. (2012). Nonscience Majors' Perceptions on the Use of You Tube Video to Support Learning in an Integrated Science Lecture. *Journal of College Science Teaching, 42*(1), 26-30.

Galali, G. (2011). Educational achievement, Dar Al-Masirah, 1, Amman.

Hamdi, R. (2010). *Social Networking Risks. Journal of e-Learning.* Retrieved from http://emag.mans.edu.eg/index.php?sessionID=17

Hsu, W. (2011). YouTube in an EFL Compassion Class. *Arab WorldEnglish Journal (AWEJ),* (2), 91-132.

Hussein, J., & Aynas, G. (2014). The effectiveness of using Facebook in the achievement of the English language in the ninth grade students, research under publication.

Ibrahim, M. (2013). The Impact of Using Facebook on Developing Written Performance in English for Ninth Grade Students, Master Thesis, An - Najah National University, Nablus, Palestine.

Jarrett, K. (2010). YouTube: Online Video and Participatory Culture, Continuum. *Journal of Media & Cultural Studies, 24*(2), 327-330.

Jones, T., & Cuthrell, K. (2011). YouTube: Educational Potentials and Pitfalls, Computers in the Schools, 75-85.

Khawaldeh, A. (2010). Facebook in Education, Retrieval from: http://www.islamic-ec.edu.jo/ Education. Aspx # a47.

Mekheimer, M. (2011). The Impact of Using Videos on Whole LanguageLearning in EFL Context. *Arab World English Journal (AWEJ), 2*, 25-39.

Ministry of Education, Jordan (2006). Teacher's Guide.

Savas, P. (2012). Micro-teaching Videos in EFL Teacher Education Methodology Courses: Tools to Enhance English Proficiency and Teachers Skills among Trainees, Procedia - Social and Behavioral Sciences, 55, 730-738.

Wang, J., Chun-Fu, C., Lin, W., & Emily, W. (2013). Meaningful engagement in face book learning environments: Merging social & academic lives. *Turkish On line Journal of Distance Education, 1*, Art. 26 .

Yang, C., Hsu, Y., & Tan, S. (2010). Predicting the Determinants of Users' Intentions for Using YouTube to Share Videos. *Moderating Gender Effects, Cyperpsychology, Behavior, and Social Networking,* (2), 141-152.

Zaidieh, A, (2012). The Use of Social Networking in Education: Challenges and Opportunities. *World of Computer Science and Information Technology Journal,* (1), 18 -21.

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Web Services: A Comparison of Soap and Rest Services

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Abstract

The interest on Web services has been growing rapidly in these couple of years since their start of use. A web service would be described as a method for exchanging/communicating information between devices over a network. Often, when deciding which service would fit on the architecture design to develop a product, then the question rises which service to use and when?

SOAP (Simple Object Access Protocol) and REST (Representational State Transfer) are the two most used protocols to exchange messages, so choosing one over the other has its own advantages and disadvantages. In this paper we have addressed the differences and best practices when to use one over the other.

Keywords: SOAP, REST, XML, HTML, Client/Server

1. Introduction

In these days of modern technology development, there are a lot of ways that can be used to create enterprise applications. The choice of selecting one over the other should be solely based on technical arguments and their capabilities delivered by each alternative. Thus, web services have gained an enormous popularity in how devices communicate between each other. Briefly, web services (Mironela, 2009) are self-describing and modular business applications exposing business logic as a service over the Internet. They are delivered through programmable interfaces, while their functionality can be consumed and invoked through their IP address. (Wagh, 2012; Halili & Dika, 2012)

There are a lot of technologies that can make this communication possible, such as RMI (Remote Method Invocation), CORBA or DCOM. But, when it comes to security or compatibility, these technologies seems to cause a lot of troubles. Instead, the modern technology is generally based on two new models: SOAP and REST. (Tihomirovs & Grabis, 2016)

Both, SOAP and REST are based on service-oriented architecture. Their development process includes something called Web API, which represents the interface for consuming their service.

Various applications such as conferencing, web or social applications can be developed using these web services, because there is not required any prior knowledge before usage, what makes them platform independent and loosely coupled. (Adamopoulos, 2014)

SOAP is designed to be a lightweight, platform independent protocol for decentralised, distributed environment which uses Internet and XML to exchange information between nodes. It represents a messaging protocol, which uses XML to define the communication and HTTP to transmit these messages. It is a stateless, one-way message communication between nodes or devices, from sender to receiver. (Halili et al., 2012)

In the other hand, REST represents a client-server architecture where the client sends the requests, while the server processes them and returns the responses. It was introduced in 2000, by Roy Fielding. Unlike SOAP, REST services does not limit itself to XML, instead, it also supports JSON (JavaScript Object Notation), plain text, etc. (Halili & Kasa, 2011)

In this paper we will compare the two services and explore the differences that they have in the underlying technology, implementation, strength and weaknesses.

The paper is organized as follows. In the sections 2 and 3 I will provide information about SOAP and REST web services, their advantages and disadvantages. In section 4 will be shown a comparison table, and the paper is

closed by providing a conclusion about which one is more preferable for usage.

2. SOAP

Simple Object Access Protocol (SOAP) is a messaging protocol that allow applications to communicate using HTTP and XML. It represents a fundamentally stateless, one-way message exchange paradigm between nodes. By combining one-way exchanges with features provided by the underlying transport protocol and/or application specific information, SOAP can be used to create more complex interactions such as request/response, request/multiple response, etc. (Mumbaikar & Padiya, 2013; Halili, Rufati & Ninka, 2013)

The process of invoking web services is very important; therefore the SOAP protocol is established to exchange messages between service providers and consumers. It is a structured XML message format for exchanging data in a distributed environment. It uses an underlying transport protocol (HTTP, SMTP etc) through binding. By the time of writing this paper there are two version of SOAP: SOAP version 1.1 and SOAP version 1.2 which has brought some new benefits: It is cleaner, faster, it has better web integration and more it is versatile.

There are three main types of SOAP Nodes:

- SOAP Sender – Generates and transmits a SOAP message,
- SOAP Receiver – Receives and processes the SOAP message and it also may generate SOAP response, message or fault as a result, and
- SOAP Intermediary (Forwarding or active) – It is both, a SOAP receiver and a SOAP sender. It receives and processes the SOAP header blocks targeted at it and resends the SOAP message towards an SOAP receiver. This process is illustrated in the figure below:

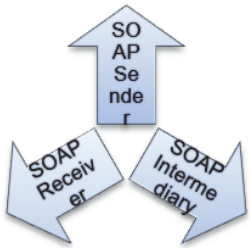

Figure 1. SOAP Nodes

The SOAP message has a structure, which is characterized with two SOAP-specific sub-elements within the overall SOAP Envelope (env:Envelope), namely a SOAP Header (env:Header) and a SOAP Body (env:Body).

As mentioned before in this paper, SOAP is a lightweight independent protocol. It is independent and lightweight because it does not matter what OS or what platform is the service used from: it responds in the same way in any platform or OS. All this is possible because of XML and HTTP protocols.

There are two types of SOAP messaging requests: Remote Procedure Call (RPC) and Document request. Each of them are treated in the following subsections.

2.1 Remote Procedure Call

A Remote Procedure Call represents execution of a procedure in another remote address, usually on another computer in the same network, which is previously coded and it is called as a normal procedure local call. Thus, the programmer will only have to develop the code once, and it does not matter if the call is performed in local or remote circumstances.

This procedure represents a client-server model interaction, which is implemented through a request/response methodology. These requests and responses are formatted in XML Usually, this communication is synchronous, which means that when a request is sent, the app is blocked until the response is processed and returned.

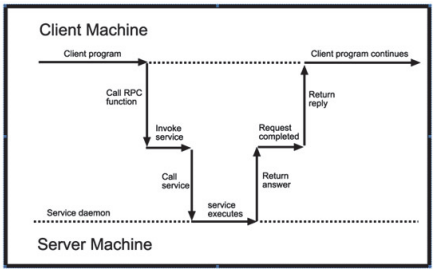

Figure 2. RPC Lifecycle

2.2 Document Requests

While transmitting information from the client to server or vice versa through document requests, the XML document is passed in the body of the SOAP message instead of as parameter.

For example, a service named PurchaseOrder expects a document (XML document) as the input message. When the request is sent through SOAP message, requesting the PurchaseOrder operation, it must contain a purchase order document as input in the SOAP message. The requests is processed as soon as it reaches the server, and when processing is done, another XML document is returned as response, which might contain any kind of information related to that purchase.

```
POST /api/api.asmx HTTP/1.1
Host: api.createsend.com
Content-Type: text/xml; charset=utf-8
Content-Length: length
SOAPAction: "http://api.createsend.com/api/Subscriber.AddAndResubscribe"

<?xml version="1.0" encoding="utf-8"?>
<soap:Envelope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns::
  <soap:Body>
    <Subscriber.AddAndResubscribe xmlns="http://api.createsend.com/api/">
      <ApiKey>string</ApiKey>
      <ListID>string</ListID>
      <Email>string</Email>
      <Name>string</Name>
    </Subscriber.AddAndResubscribe>
  </soap:Body>
</soap:Envelope>
```

```
HTTP/1.1 200 OK
Content-Type: text/xml; charset=utf-8
Content-Length: length

<?xml version="1.0" encoding="utf-8"?>
<soap:Envelope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns::
  <soap:Body>
    <Subscriber.AddAndResubscribeResponse xmlns="http://api.createsend.com/
      <Subscriber.AddAndResubscribeResult>
        <Code>int</Code>
        <Message>string</Message>
      </Subscriber.AddAndResubscribeResult>
    </Subscriber.AddAndResubscribeResponse>
  </soap:Body>
</soap:Envelope>
```

Figure 3. Example of Document request and response

2.3 RMI vs Document Request

RPC interface is meant to be relatively static, which means that any changes on its interface requires additional changes in the implementation of that service. Changing its description would also crash the platforms relying on the service. While, using document messaging requires less such limitations, and any change that might occur in XML schema would not break the structure of the service implementing it. This, because the response is an XML document instead of a structured return value.

Other advantages of Document requests over RPC are reliability, scalability and performance. When the call is performed from the client, it does not have to block the whole process waiting for a response, and can easily be processed asynchronously or placed in the queue. It is more reliable, because the response is sent to the client even in the case that, for some reason, the client might have gone offline after performing the request. It improves scalability because, depending on the architecture the application is build, processing the response can very easily be spread over more instances in the infrastructure.

3. Restful Web Services

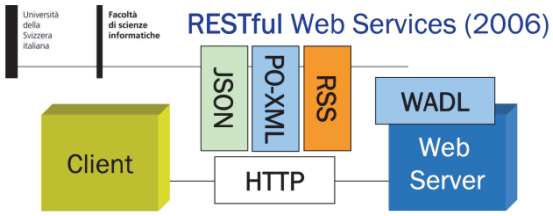

Figure 4. Architecture of RESTFul web services, and the commuunication between Client and Server

REST - (Representational state transfer) as the name implies, it has to do with client and server relationship and how state is stored. REST architecture is based on the client/server architecture style. Thus, the requests and responses are built based on the transfering process of the resources. All resources are identified by unique Uniform Resource Identifier (URI), which typically represents a document that captures the state of the resource. Generally, the REST style architecture is much lighter compared to SOAP. It does not require formats like headers to be included in the message, like it is required in SOAP architecture. In the other hand it parses JSON – a human readable language designed to allow data exchange and making it easier to parse and use by the computer. It is estimated to be at around one hundred times faster than XML.

```
{
        "firstname" : "John",
        "lastname" : "Smith"
}
```

Figure 5. A simple JSON document

There are several principles that designing RESTFul Web Service requires. Addressability is a REST principle where the datasets are modeled to operate as URI marked resources. Statelessness is another principle that the designer of a REST service will have to follow. This means that every transaction must be independent and must not be related to any previous transaction, as all the data required to perform and process the request are contained on that request, thus, the server will not have to maintain client session data. Uniform interface requires that an interface is uniform and standard used to access the resources, i.e. using fixed set of HTTP methods. If the service designer holds to these principles, than it is almost guaranteed that the REST application will be simple and lightweight.

In other words, how can we define the basics of the problem in REST architecture? Imagine there is a computer A in Tetova, it interacts with computer B in Berlin related to a resource available on Computer C in New York. None of them belongs to the same domain. In the REST style there are defined nouns and verbs. URI's are the equivalent of nouns and there are trillions of nouns for the entire concept in all the heads and files of all the users in the world.

Back when we studied in the beginner school, we in grammatical exercises we have studied about Nouns and verbs, the verbs describe an action related to nouns, whilst in REST architecture style verbs (loosely) describe actions that are applicable to nouns or with other words URI's. There are four universal verbs introduced in REST like described in Figure 6.

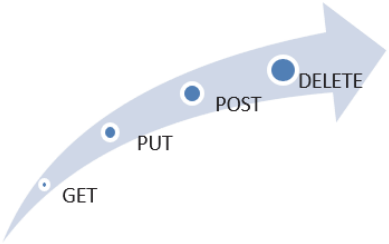

Figure 6. Basic methods of RESTFul architecture

The web application which follows the REST architecture we call it as RESTful web service. Restful web services uses GET, PUT, POST and DELETE http methods to retrieve, create, update and delete the resources. (Sinha et al., 2014)

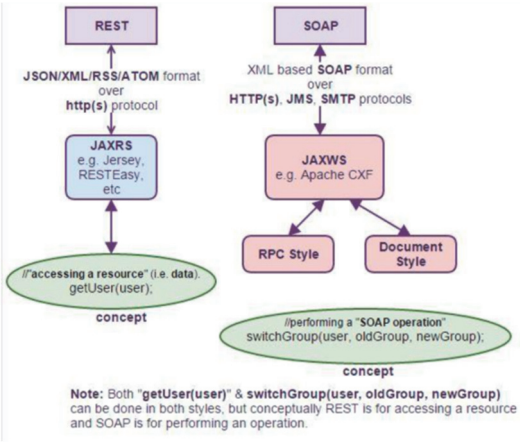

Figure 7. Flowchart showing hor REST and SOAP access methods

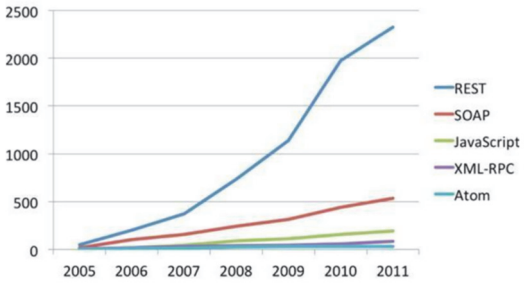

Figure 8. Several platform usage over years

REST is becoming the go to for system interaction which includes the usage of RESTFul web services mostly the way cloud providers expose their services. In the present days, we can easily conclude that most of the new projects are based on RESTFul architecture, in order to create and provide professional services. Not only the tech giants like Facebook, Google or Twitter use REST these days. This, because thanks to the REST architecture, every application is able to scale horizontally in the easiest possible way.

3.1 Advantages of Rest

- REST uses smaller message format and provides cost efficiency over time and better performance because of the JSON messages with which makes the communication. and there is no intensive processing required
- Learning curve is reduced
- It supports stateless communication
- It's simple to learn and implement
- Efficiently uses HTTP verbs
- Light bandwidth since its passes message is JSON
- (JavaScript Object Notation) format also it can use
- multiple other formats
- For security it uses HTTP standards
- REST can be consumed by any client
- It makes data available as resource. (Kumari, 2015)

3.2 Disadvantages of REST

- It's not suitable for large amount of data
- Comparative SOAP it does not cover all varieties of web service standards like Security, Transactions etc.
- REST is not reliable
- REST requests (especially GET) are not suitable for large amount of data
- Latency in request processing times and bandwidth usage
- REST APIs end up depending on headers for state (such as to route subsequent requests to the same back-end server that handled the previous update, or for authentication.) Use of headers is clumsy and ties the API to http as a transport.

4. Comparison between the Two Services

Following is shown a table containing information about both, SOAP and REST web services, where can easily be seen their comparison.

Table 1. Comparison between SOAP and REST (Wagh & Thool, 2015)

SOAP	REST
Changing services in SOAP web provisioning often means a complicated code change on the client side.	Changing services in REST web provisioning not requires any change in client side code.
SOAP has heavy payload as compared to REST.	REST is definitely lightweight as it is meant for lightweight data transfer over a most commonly known interface, - the URI
It requires binary attachment parsing.	It supports all data types directly.
SOAP is not a wireless infrastructure friendly.	REST is a wireless infrastructure friendly.
SOAP web services always return XML data.	While REST web services provide flexibility in regards to the type of data returned.
It consumes more bandwidth because a SOAP response could require more than 10 times as many bytes as compared to REST.	It consumes less bandwidth because it's response is lightweight.
SOAP request uses POST and require a complex XML request to be created which makes response-caching difficult.	Restful APIs can be consumed using simple GET requests, intermediate proxy servers / reverse-proxies can cache their response very easily.
SOAP uses HTTP based APIs refer to APIs that are exposed as one or more HTTP URIs and typical responses are in XML / JSON. Response schemas are custom per object	REST on the other hand adds an element of using standardized URIs, and also giving importance to the HTTP verb used (i.e. GET / POST / PUT etc
Language, platform, and transport agnostic.	Language and platform agnostic
Designed to handle distributed computing environments.	Assumes a point-to-point communication model - not for distributed computing environment where message may go through or more intermediaries.
Harder to develop, requires tools.	Much simpler to develop web services than SOAP
Is the prevailing standard for web services, and hence has better support from other standards (WSDL, WS) and tooling from vendors.	Lack of standards support for security, policy, reliable messaging, etc., so services that have more sophisticated requirements are harder to develop.

5. Implementation of a Demonstration REST Service

As support for all the job done about this research paper, there has been created a sample web service aiming to illustrate the whole concept.

Because of the space consumed by demostrating it, the SOAP approach of the service is not included on this paper.

The service is done by following the REST principles. The service creates a ToDo list, which can provide all of the "ToDos" or give you details about a particular item in the list. The service is done by using Flask, a

lightweight Python framework, but it can be done in any other language that supports web. (Grinberg, 2013)

```
tasks = [
 {
“id”: 1,
      “title”: “Buy groceries”,
      “description”: “Milk, Cheese, Bread”,
      “done”: False
 },
 {
“id”: 2,
      “title”: “Learn Python”,
      “description”: “Learning Python is interesting”,
      “done”: False
 }
]
```

The snippet represents the sample data that will be used to demonstrate the service.

The very first method to be treated is *get_tasks* which as a result, returns the list of all tasks. In REST terms, it is a *GET* method. Following are represented the code and the execution of the same.

```
function get_tasks:
   if(loggedIn)
      return tasks
   else
      return error:authentication failed
```

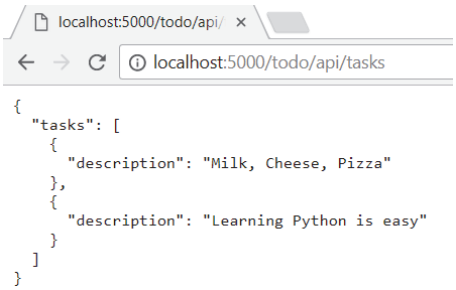

Figure 9. The response for get_tasks method

If the user needs only a particular item of the list, REST principles provide a simple solution for that. Instead of getting all items, and then cycling the whole array to find the particular item, REST services offer the item to be accessed directly. get_task(:id) is such a method, where id represents the id of the item the user needs.

```
function get_task(id)
   declare task from tasks where task.id is equal to id
      if task not null
         return task
      else
         return error: not found
```

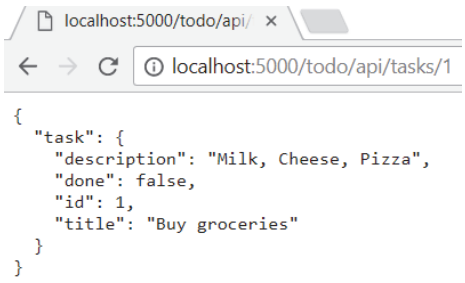

Figure 10. The response for get_task(:id)

Other features like adding items to the list or deleting items from the list, work in pretty much the same way. To put a new item, the same url as get_tasks is user, but instead, the method is set to POST, and a JSON formatted document containing task details is required as parameter. To delete an existing item from the list, requires DELETE method type and specifying the id of the task to delete.

6. Conclusion

REST defines the architectural style of the World Wide Web. After all the comparison and stating their underlying technologies, process, ease of use, and their design it's safe to say that RESTful web service will continue to dominate more and more the technology space in the coming years when it comes to building an backend RESTful api. The RESTful web services are lightweight, easy to consume, self descriptive, fast, have support for all data types, consumes less bandwidth and it is more simpler to develop and maintain.

It is also worth mentioning that, REST is not a service that everyone could deal with. Let us take for example some basic HTTP APIs that someone builds and just calls it RESTful web service, but in fact, it is not even close to REST. Sometimes, REST can be really hard to deal with, especially in the very early stages of designing. But, after growing up in both, technical and economical way, it pays off with the small changes required to adapt to evolution. If you need something done quickly and easily, don't bother about getting REST right. It's probably not what you're looking for. If you need something that will have to stay online for years or even decades, then REST is for you.

References

Adamopoulos, V. T. (2014). *The Effectiveness of Promotional Events in Social Media*. Retrieved from https://www.misrc.umn.edu/wise/2014_Papers/94.pdf

Grinberg, M. (May, 2013). *Designing an RESTful API with Python and Flask.* Retrieved from https://blog.miguelgrinberg.com/post/designing-a-restful-api-with-python-and-flask

Halili, F., & Dika, A. (2012). *Choreography of Web Services and Estimation of Execution Plan*. In Proc. Book of IEEE International Conference of Information Technology and e-Services (ICITeS), pp.168-174, Sousse, Tunis, March 2012. ISBN: 978-1-4673-1166-3, IEEE CN: CFP1245S-ART.

Halili, F., & Kasa, M. (June 2011). *Analysis and Comparison of Web Services Architectural Styles, and Business Benefits of their Use*. In Proc. Book of International Conference of Information Technologies and their importance in the economic development, 701-712, Tirana. ISBN: 978-99956-59-13-4.

Halili, F., Idrizi, F., Lena, U., & Kasa, M. (February, 2012). Towards the UML Design of Web Services. In *International Journal of Science, Innovation and new Technology (IJSINT), 1*(3), 73-78, ISSN: 2223-2257.

Halili, F., Rufati, E., & Ninka, I. (2013). *Service Composition Styles – Analysis and Comparison Methods*, in Proc. Book of IEEE CICSyN2013 5th International conference on Computational Intelligence, Communication Systems and Networks, pp.278-284, 5-7 June, Madrid, Spain. ISBN: 978-0-7695-5042-8, BMS Number: CFP1381H-CDR.

Kumari, V. (May 2015). Web Services Protocol: SOAP vs REST. *International Journal of Advanced Research in Computer Engineering & Technology (IJARCET), 4*(5).

Mironela, P. (2009). *The Importance of Web Services using the RPC and REST Architecture*, IEEE, International Conference on Computer Technology and Development, 2009.

Mumbaikar, S., Padiya, P. (May 2013). Web Services Based On SOAP and REST Principles. *International Journal of Scientific and Research Publications, 3*(5), ISSN 2250-3153.

Sinha, R., Khatkar, M., Gupta, S. C. (September 2014). *Design & Development of a REST based Web service platform for mobile applications integration on Cloud.* IJISET - International Journal of Innovative Science, Engineering & Technology, (7).

Suda, B. (2003). *SOAP Web Services*. University of Edinburgh, School of Informatics, Computer Science.

Tihomirovs, J., & Grabis, J. (2016). *Comparison of SOAP and REST Based Web Services Using Software Evaluation Metrics.* Riga Technical University, 19, 92-97P.

Wagh, K. (2012). *A Comparative study of SOAP Vs REST Web Services Provisioning Techniques for Mobile Host*, Journal of Information Engineering and Applications, ISSN 2225- 0506 (Online), 2(5), 2012.

Wagh, K., & Thool, R. (2015). A Comparative Study of SOAP Vs REST Web Services Provisioning Techniques for Mobile Host. Marathwada Mitra Mandals Institute of Technology Pune, India - Shri Guru Gobind Singhji Institute of Engineering & Technology, Nanded, India.

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