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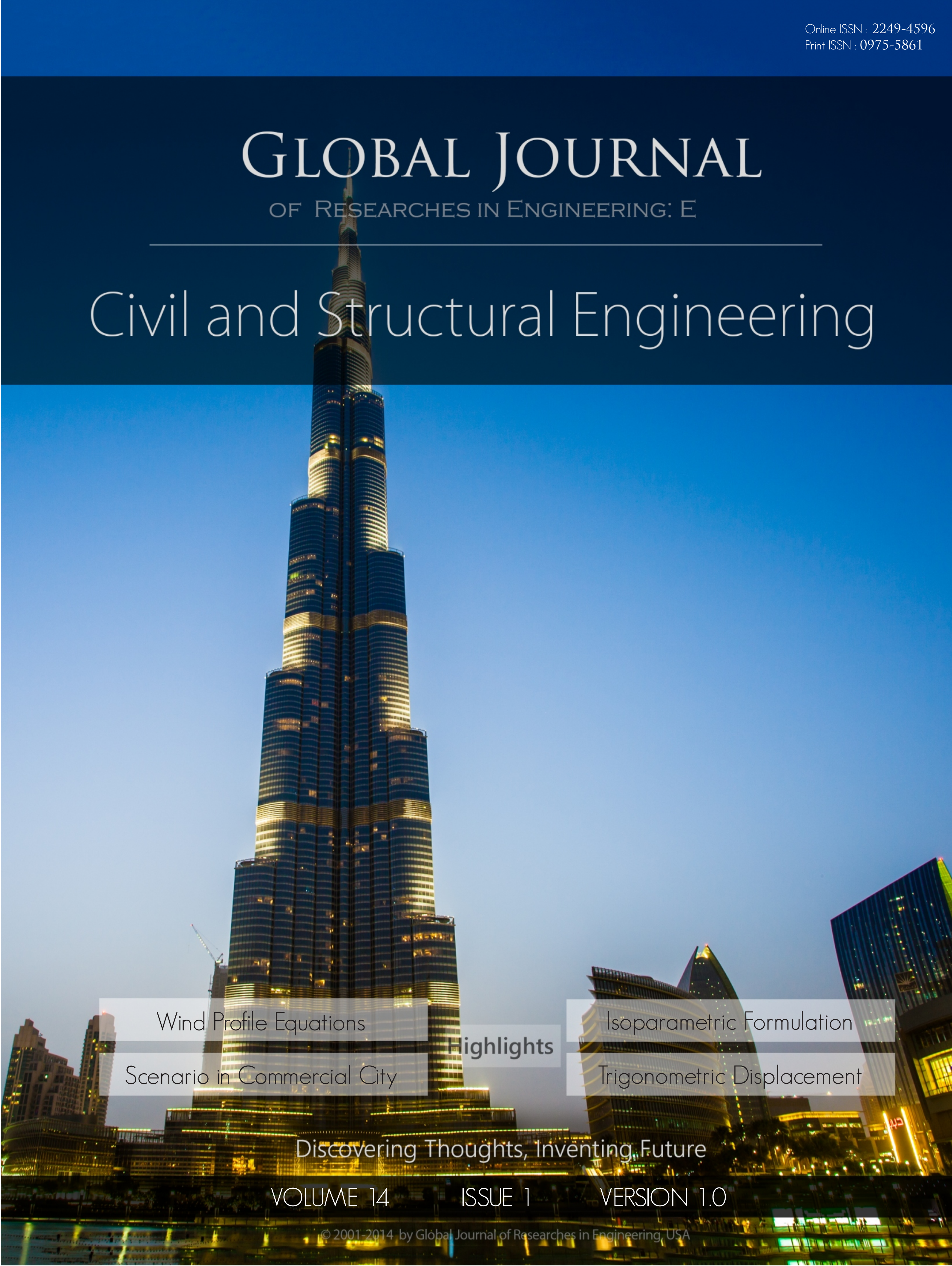

Highlights

Wind Profile Equations

Scenario in Commercial City

Isoparametric Formulation

Trigonometric Displacement

Discovering Thoughts, Inventing Future

VOLUME 14 ISSUE 1 VERSION 1.0

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Master in Business Administration, IESE, University of Navarra
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Validating Wind Profile Equations during Tropical Storm Debby in 2012

By Prof. S. A. Hsu
Louisiana State University, United States

Abstract- Comparisons of logarithmic and power-law wind profiles are made for offshore conditions during Tropical Storm Debby in 2012 over the Gulf of Mexico. It is found that both laws are validated up to 122m and that the power law is as good as the log law statistically. For practical applications, the exponent of power law can be determined from the gust factor measurement available routinely from National Data Buoy Center (NDBC) buoys.

Keywords: *logarithmic wind profile, power-law wind profile, gust factor, tropical storm debby.*

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VALIDATINGWINDPROFILEEQUATIONSDURINGTROPICALSTORMDEBBYIN2012

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I. Introduction

In the atmospheric boundary layer, vertical distribution of the wind speed (under strong wind conditions so that the thermal effects may be neglected, see Hsu, 2003) can be formulated according to the logarithmic wind profile (e.g. Panofsky and Dutton, 1984) as:

$$U_z = (U^*/k) \operatorname{Ln} ((Z-d)/Z_0) \quad (1)$$

Where U_z is the wind speed at height Z, U* is the friction velocity, k (=0.4) is the von Karman constant, d is the displacement height, and Z_0 is the roughness length.

Note that when Z is much larger than d, Eq. (1) may be reduced to

$$Uz = (U^*/k) \operatorname{Ln} (Z/Z_0) \quad (2)$$

Note also that, for offshore conditions, Z_o can vary with wave characteristics since the sea state is mobile depending on the wind speed, duration and fetch (Hsu, 1988).

Because the log-law requires several parameters including U*, d, and Z_0, the power-law wind profile has been widely used instead in the engineering community (e.g. Irwin, 2006) that:

$$U_2/U_1 = (Z_2/Z_1) \wedge p \quad (3)$$

For $Z_2 > Z_1$

Where U_2 and U_1 are the wind speed at Z_2 and Z_1, respectively, and p is the exponent, which is related to the gust factor, G, via following formulation (see Hsu, 2003 and 2008) and Hsu and Blanchard (2004) such that,

$$G = 1 + 2p \quad (4)$$

Author: Coastal Studies Institute, Louisiana State University, Baton Rouge, LA 70803. e-mail: sahsu@lsu.edu

The purpose of this study is to validate wind-profile equations, whether it is logarithmic or power, for over water applications.

II. Methods

In order to compare Equations (2) and (3) statistically, they are rearranged as follows:
From Equation (2), we have

$$\operatorname{Ln} Z = \operatorname{Ln} Z_0 + (k/U^*) U_z \quad (5)$$

This equation has a least-square linear regression form such that

$$Y = A + B X \quad (6)$$

Where Y = Ln Z, A = Ln Z_0 or $Z_0 = e^A$, $X = U_z$, and B = k/U*.

If the anemometer is located at 10 m, one can normalize the wind speed at higher elevation by NDBC measurements so that Equation (3) becomes

$$U_z/U_{10} = (Z/10) \wedge p \quad (7)$$

Where U_{10} is the wind speed at 10 m, which is routinely available from Buoy 42040.

III. Validating Wind Profile Equations

When Tropical Storm Debby in 2012 was over the Gulf of Mexico (www.nhc.noaa.gov), there were 3 meteorological stations, which measured wind speed at 3 different heights ranging between 10 and 122m above the sea surface. These data are available online from NDBC (http //www.ndbc.noaa.gov). Since these 3 stations were close-by, their data are listed in Table 1. Using the mean value for each height as listed in the Table, Figures 1 and 2 provide the analyses for the logarithmic and the power-law wind profiles, respectively. Since the coefficient of determination, R^2, values are very high, both profiles are verified. For operational applications off shore, it is found that the power-law is as good as the log-law. This finding is very important because over vast ocean, only one level measurement of wind speed from few buoys or ships is available.

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Table 1 : Simultaneous measurements of wind speed at 10 m at NDBC Station 42040, at 54.9m at 42376 and at 122m at 42364 during Tropical Storm Debby in 2012 over the Gulf of Mexico

Year	month	day	hour	min	wind	U122m	U54.9m	U10m
			UTC		direction	m/s	m/s	m/s
2012	6	25	19	30	340	13	10	8
2012	6	25	18	30	340	14	11	9
2012	6	25	16	30	350	15	12	11
2012	6	25	6	30	360	18	16	12
2012	6	25	4	30	360	19	18	14
2012	6	25	3	30	10	19	18	14
2012	6	25	0	30	360	24	22	16
2012	6	24	23	30	360	22	20	16
2012	6	24	20	30	360	19	17	14
2012	6	24	19	30	360	19	16	13
					mean	18.2	16	12.7

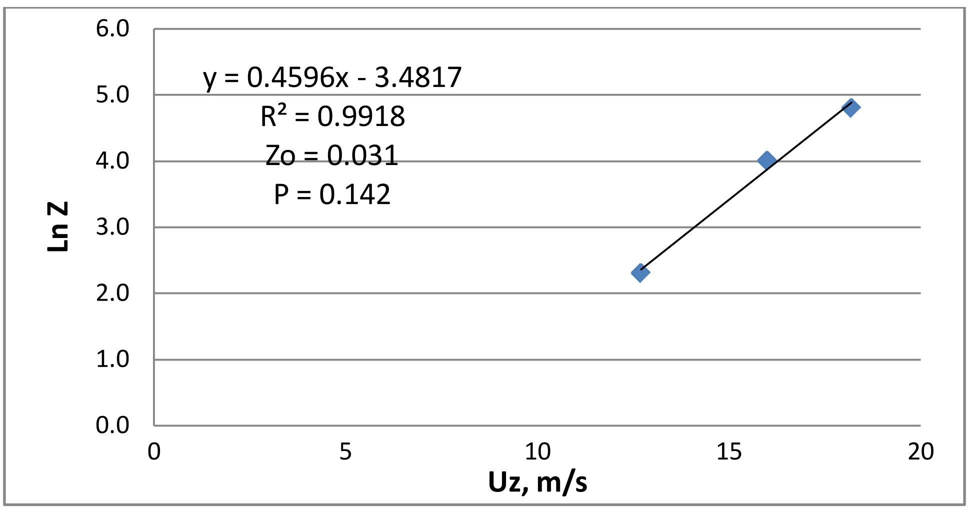

Figure 1 : Logarithmic wind profile over the Gulf of Mexico during Tropical Storm Debby in 2012

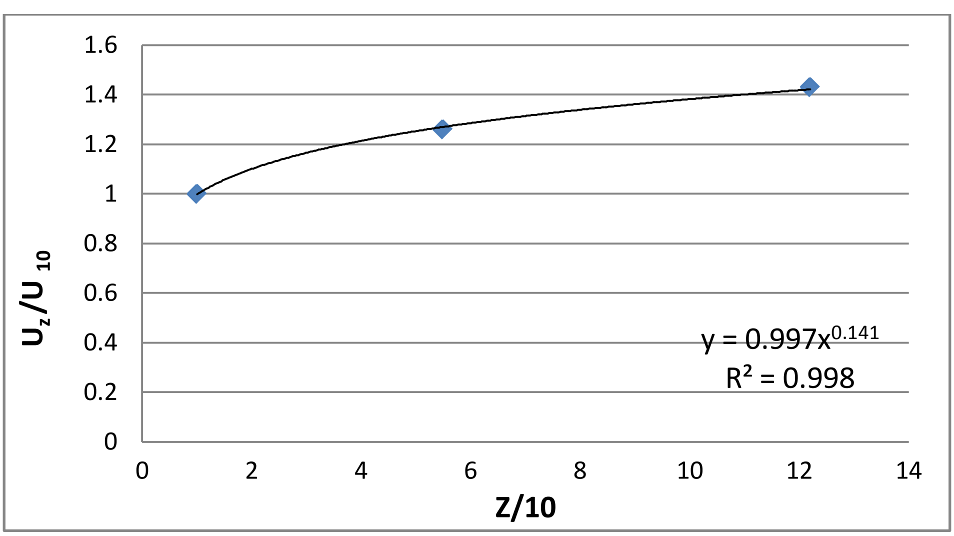

Figure 2 : Power-law wind profile over the Gulf of Mexico during Tropical Storm Debby in 2012

IV. Vertical Variation of the Gust Factor

Vertical variation of the gust factor for offshore conditions has been studied by Hsu (2012). Our results during Debby are shown in Figs. 3 and 4. It is found that for operational applications, the gust factor does not decease with height between 10 and 160 m as compared to that over land as shown in Fig. 5 near land-falling Hurricanes Frances and Jeanne in 2004 (based on Merceret, 2009) and Fig.6 for Typhoon Muifa in 2012 (based on An et al.,2012).

In addition, according to Hsu (2012), the mean overwater gust factor between 5 and 160 m during Tropical Storm Lee in 2011 is 1.273 with the standard deviation of 0.11 so that the coefficient of variation, which is the ratio of standard deviation and the mean, is 8.6% (which is within the 10% composite error margin in the field measurements for the wind speed). This means that p=0.137 is a good value to use for offshore conditions. Comparison of this p value with the power-law analysis shown in Fig.2 (where p=0.142) indicates that P = 0.14 should be useful for practical applications. Furthermore, by substituting this p (=0.142) value from fig. 2 into Eq.4, we have G=1+2*0.142=1.284, which is in good agreement with the normally quoted G value of 1.30. In other words, the common use of 30% gust factor for offshore applications receives further support from this study.

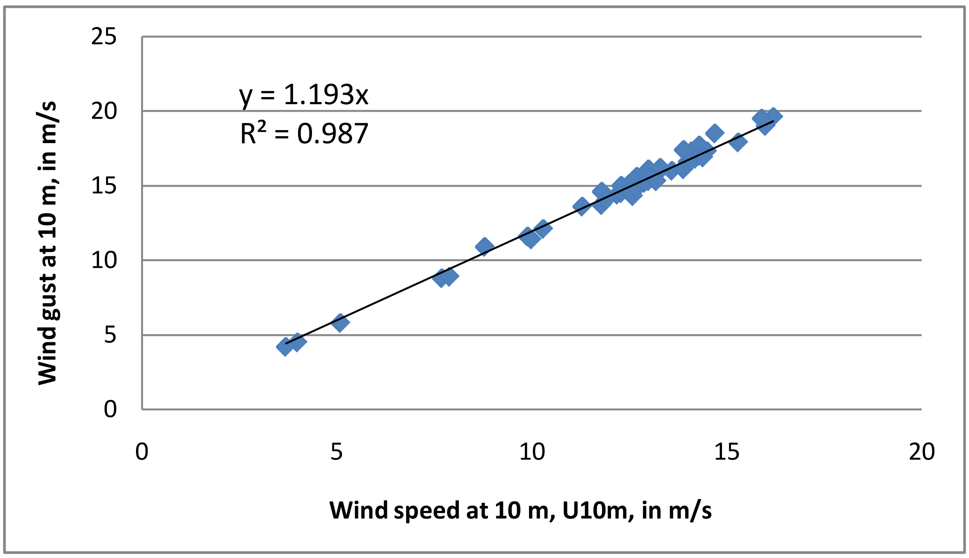

Figure 3 : Relationship between wind speed and wind gust at 10 m during Debby

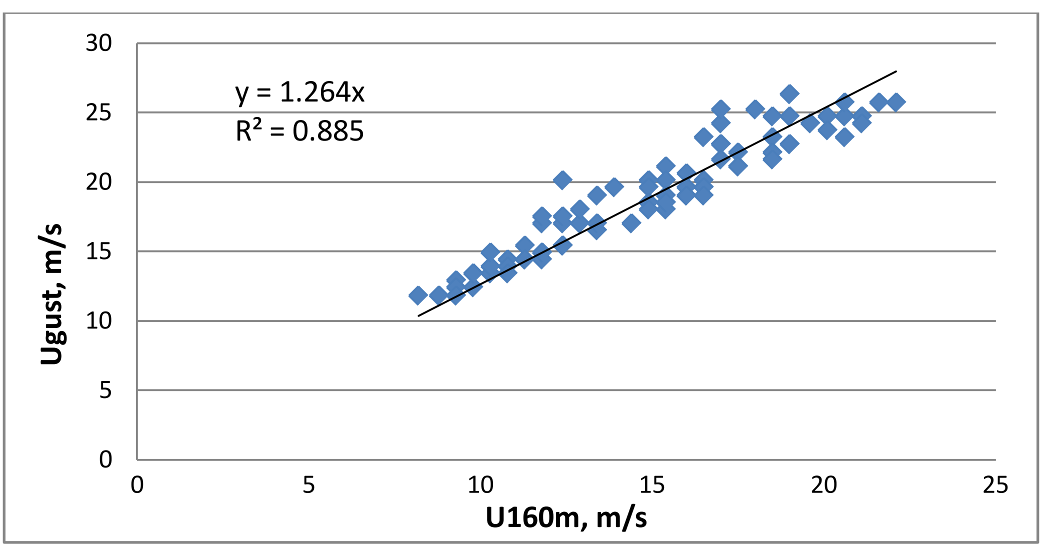

Figure 4 : Relationship between wind speed and wind gust at 160 m during Debby

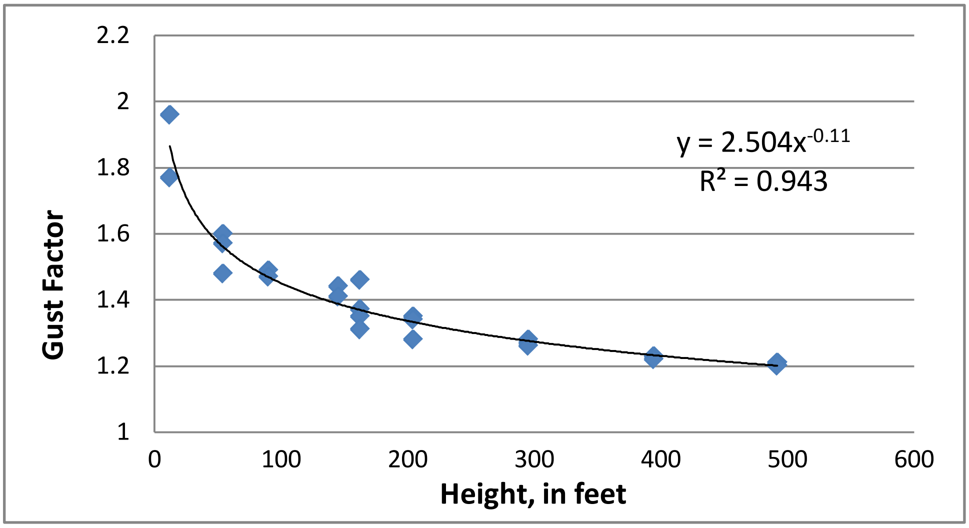

Figure 5 : Height variation in gust factor during land-falling Hurricanes Frances and Jeanne

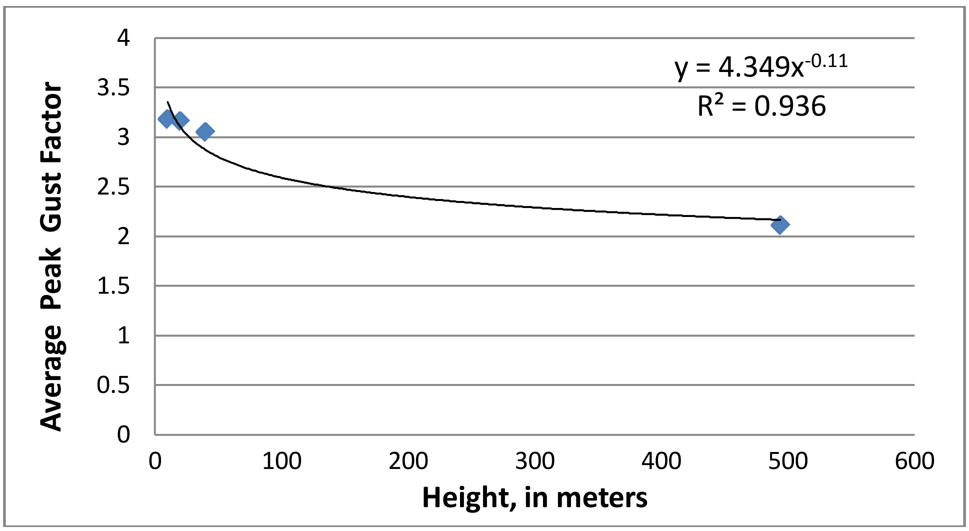

Figure 6 : Height variation in peak gust factor during land-falling Typhoon Muifa in 2011

V. Conclusions

On the basis of foregoing analyses and discussions, following conclusions can be drawn:

- A comparison between logarithmic and power-law wind profiles is made for offshore conditions (up to 122m or 400ft from the sea surface). It is found that, although the log law has more theoretical support, the power-law is as good as the log-law based on statistical analyses. Therefore, the powerlaw is recommended for operational applications since it involves only one unknown parameter, which is the exponent.
- The exponent of the power-law wind profile can be determined from the gust factor which is routinely available from NDBC measurements. It is also found the gust factor does not vary with the altitude statistically within 160m or 525ft from the sea surface. This finding, which is contrary to the common belief for onshore conditions, is very important for wind loading analyses for offshore structures as well as search and rescue mission planning during storms at sea.

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Challenges of Waste Generation & Improvement of Existing Scenario in Commercial City of Bangladesh

By Riyad, A.S.M. & Farid, Sk. Hossain
Khulna University of Engineering & Technology, Bangladesh

Abstract- Bangladesh is a densely populated country in the third world facing myriads of problems with the growth of population. The increased population leads to the growth of urban areas and slums which, in turn, generating a huge volume of waste. The huge generations of waste in different cities of Bangladesh like Khulna city increasing global anxiety day by day. In order to conduct the research, both primary and secondary data has been used. This paper highlights the status of waste generation and its management and a novel management process is proposed to increase the capacity. The waste generation rate of KCC is now 0.50 kg/cap/day producing around 950 tons of wastes, where about 36.84% being uncollected. The rubbishes, which remain uncollected, are dumped in open spaces, street and drains, clogging the drainage system, which create serious environmental degradation and treats to health. Moreover, the population growth rate is around 5% per year and waste generation rate will be about 1.7 times in 2025. Most of the urban local bodies are finding it difficult to keep pace with the demand for adequate solid waste management and conservancy services provided by the urban local bodies. So, both public and private sectors should take proper initiatives for effective solid waste management.

Keywords: population growth, solid waste, waste generation rate, municipal authorities, management.

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Keywords: population growth, solid waste, waste generation rate, municipal authorities, management.

I. Introduction

Due to rapid growth of population and unrestrained urban growth urban environment is debasing severely. For most of the cities in developing countries mass production and solid waste disposal is a palpable reason for the environmental degradation (Ashraf 1994). Due to swift urbanization two-thirds of the world's people living in cities by 2025 and urban populations in developing countries grow by more than 150,000 people every day (UNDESA 2005). The perpetually- increasing consumption of resources has resulted in enormous amounts of solid waste from industrial to domestic activities which can pose major threats to human health (Frosch 1996). The environment and human health face a severe impact due to the irrational disposal of solid waste (Rathi 2006). Municipal corporations of the developing nations are not capable to handle increasing amounts of waste and a significant portion of wastes are not properly stored, collected or disposed in the proper places for ultimate disposal due to lack of enthusiasm, consciousness, loyalty, as well as money (Ahsan et. al 2005, Riyad et. Al 2013). There is a need to work towards a sustainable waste management scheme, which requires institutional, financial, environmental, economic and social sustainability. Maximum reported values of solid waste generation have been derived empirically with assumptions regarding population, number of transports available for transportation of wastes (Anon 2001, Rahman et. Al 2013). Human activities generate waste and the extreme human activities concentrate, such as in urban centers, appropriate and safe solid waste management. Typically one to two thirds of the solid waste generated is not collected by many municipalities (Rahman et. al 2013, World Research Institute 1996). Many of these waste materials can be reused (Kumar and Bhowmick, 1998) and thus may eventually become valuable resources if they are removed from the waste stream (World Bank 1999). Bangladesh is a densely populated country; country's population will be about 17 cores by 2020 (BBS, 2001, Bahauddin & Uddin 2012). Khulna is a medium size city in the context of Bangladesh, even though it has a population of about 2 million people and the population growth rate is around 5% per year. Khulna was declared as a Pouroshava/Municipal council in 1884 and promoted to a Municipal corporation in 1984 on the platinum jubilee of Khulna Pouroshava. In 1990 Khulna has been confirmed as a City Corporation (Wikipedia). Day by day the amounts of solid wastes are increasing with the rapid increasing of population especially in city area. So, solid waste creates an endangered situation for waste management in urban life and deteriorates the daily life of people with the loss of economy and environment. This study aimed at investigating ongoing solid waste management practice in the perspective of large cities in Bangladesh and finally a general physical model was proposed in consultation with the relevant stakeholders for its long-term sustainability.

II. Methodology

Khulna, the third largest city of Bangladesh (*Fig. 1*), is located in the southern part of the country and is situated below the tropic of cancer, around the

Authors α σ: Dept. of Civil Engineering, Khulna University of Engineering & Technology, Khulna-9203, Bangladesh.
e-mails: riyadtowhid@yahoo.com, sk.farid151@gmail.com

intersection of latitude 22.49⁰N and longitude 89.34⁰E. The area of Khulna city is 47 square km (BBS, 2009) comprising 38 wards (LGED 2012). In Khulna City, a survey was conducted to find out the whole number of NGOs and CBOs, their goings-on MSW management activities, and the current scenarios of secondary disposal sites and roadside open dumping. A few meetings were organized with the conservancy department of the city corporation office to gather the data and information of MSW management. Secondary data, such as statistics and reports on the quantity of solid waste generated and its composition and management practices of Khulna has been collected by searching previous study, books and journals etc.

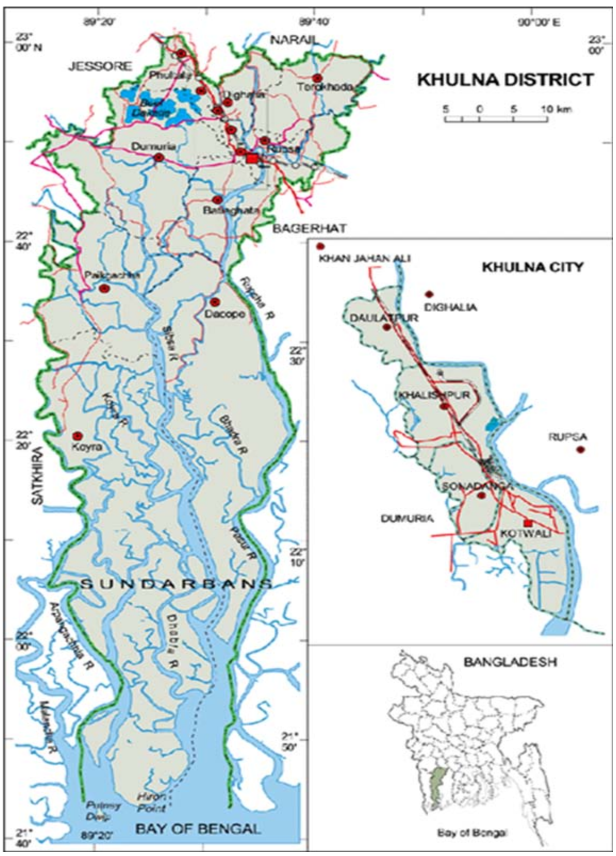

Figure 1 : Location of the study area

III. Results & Discussion

a) Present Scenario of Solid Waste Management

The major sources of solid wastes in Khulna are residences, whole and retail sale market places including shopping places, streets, hotels and restaurants, private clinics and hospitals, educational institutions, cinemas, railway, bus, and launch/steamer ghats, slaughter houses, etc. In a study by Ahmed (1991) in Bangladesh, it has been found that during wet season the waste generation rate increases by 15% to 50%. Table 1 depicts that solid waste generation in Khulna city is growing with the growth of population.

In majority of the urban areas, community bin system of waste collection is being practiced in Bangladesh. Recently, in some parts of Khulna city NGOs have introduced door-to-door collection of solid waste. But neither communal bin system coverage nor house -to-house waste collection system is adequate yet. KCC is liable for the operation and maintenance of municipal services, including solid waste management. Eight (8) functional departments and the conservancy department of Khulna City Corporation is liable for management, maintenance and monitoring of solid waste, street sweeping, public latrine and urinal, drain sludge, and street lighting. A total of 22 NGOs and CBOs are involved in MSW management in different wards of KCC in cooperation with the city authority and respective ward Commissioner. Prodipan and PRISM (Project in Agriculture, Rural Industries, Science, and Medicine) Bangladesh are the two national NGOs initiated MSW management in Khulna city and provide financial support to other small NGOs and CBOs. Another NGO, Rural Unfortunates Safety Talisman Illumination Cottage (RUSTIC) established in 1993 and initiated community based MSW management project in March, 1997. RUSTIC has been collecting waste from households since June 1997 (Rustic 2003). Some other NGOs are also involved in waste management in Khulna city, namely, World Vision, Muktir Alo, Samaj Progoti Sangsta (SPS), Bangladesh Resource Improvement Center (BRIC), Rupayan, An Organization for Socio Economic Development (AOSED), Nabarun Shangsad, Proshanti and Center for Human Development CHD). Some CBOs are involved as well in waste col lection services, namely, Protisruti, GOTI, (Ispahani Bananipara Community (IBC), SAMADAN, CLANSHIP, Nobo Jagoron, Ginna Para Community (GPC), Jubo Unnayan Soggatan (JUS) and Commitment (AOSED 2003, BRIC 2003, Muktir Alo 2002, Nabarun Shangsad 2003, PRISM 2002, Rupayan 2003, RUSTIC 2003, SPS 2003). Table 2 depicts that different organizations involved in solid waste management in Khulna city of Bangladesh.

Table 1 : Solid waste generation in Khulna city

Year	Population (million)	Waste generation rate (kg /day/capita)	Total waste generation (tones/day)	Waste collection (tones/day)	Collection efficiency (%)
2008	1.50	0.35	525	275	52.38
2013	1.90	0.50	950	600	63.16

(Source : Conservancy section, KCC 2013)

Table 2 : Name of organizations involved in solid waste management

Name of organizations	Ward no.
Prism Bangladesh	3,31
Prodipan	6,12,24,27,28
Society Progress Association (SPS)	9,15,16
Muktir Alo	21,23
Rustic	17,18
Rupayan	19,20
AOSED	25,16
Shabolombi	10
Prosanti	30
Protisruti	22
Nabarun Sangsad	24 (part)
Goti	20,25 (part)
BRIC	4,5,7
Centre for Human Resources Development (CHD)	16 (part)
Commitment	11
World Vision	18
Khulna City Corporation (KCC)	22,29

(Source : Conservancy section, KCC 2013)

b) *Yearly population and projected waste generation for next 12 years*

Though the national population growth rate is 1.579% (Mundi 2013). Khulna city with its emerging industrial and commercial activities population growth rate is higher than the national growth rate. Projected population is calculated by Exponential method of population projection which is expressed in Table 3.

Table 3 : Projection of population growth and attendant waste generation (2014-2025) of Khulna Statistical Metropolitan Area

Year	Waste/day/capita (kg)	Population (million)	Total waste/day (tones)	Total waste/year (tones)
2014	0.53	1.99	1055	385075
2015	0.56	2.09	1171	427415
2016	0.59	2.19	1292	471580
2017	0.62	2.30	1426	520490
2018	0.65	2.41	1567	571955
2019	0.68	2.53	1721	628165
2020	0.71	2.65	1882	686930
2021	0.74	2.78	2057	750805
2022	0.77	2.92	2249	820885
2023	0.80	3.06	2448	893520
2024	0.83	3,21	2664	972360
2025	0.86	3.37	2898	1057770

IV. Proposal for Sustainable Waste Management

Considering the present status of MSWM in the country, the researchers has summarized in a flow chart as depicted in *Fig. 2*. Every family and commercial institution should have separate bins to store separately the recyclable, non-recyclable and hazardous items of waste. Every house should have a

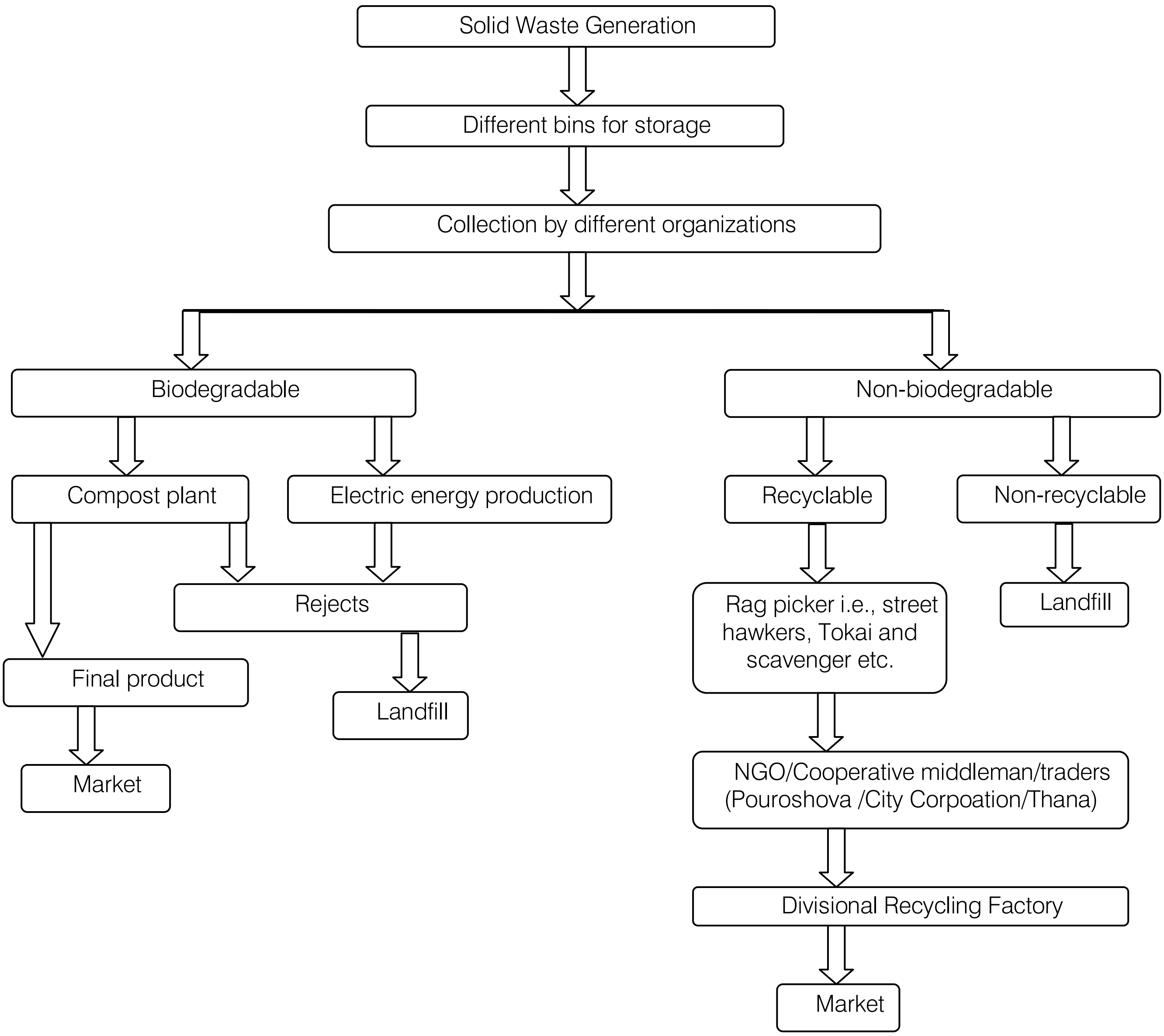

Figure 2 : Proposed management process of solid waste

common storage bin/container where all the families of the house should store the solid waste and KCC/different organizations should collect the waste from the common storage bin of the house by van. Wastes from households, commercial institutions, streets and drains should be carried to the primary collection bins by vans. A separate common bin should have for the hazardous items and organizations should carry and dispose it separately. Biodegradable items should be carried separately to the processing plant (compost or electric energy), the non-recyclable inorganic items should be carried and disposed separately and the recyclable waste should go to the recycling process. In medical, hazardous, non-hazardous, recyclable items should be stored in separate bin. Recyclable items should go to the recycling process by the own initiative of the hospital/clinic/diagnostic lab. In this process, recycling factory should have one divisional factory in every district. Modern technology should be used in every step of SWM such as collection, transportation, recycling, disposal and other processes.

V. Conclusion

The outburst of world population is changing the nature of solid waste management from mainly a low priority, localized issue to an internationally pervasive social trouble. Solid waste management scenario in Khulna City Corporation area is being deteriorated day by day as the situation is very difficult to handle the colossal volume of waste in KCC due to the irrepressible migration of rural people to urban areas for better life. There is an adequate legal framework existing in the country to address MSWM, what is causing its application. In spite of a strict legislation in place, open dumping is the most wide spread form of waste disposal. The possible causes for poor implementation could be a combination of technical, social, institutional and financial issues. Public awareness, political determination and public participation are essential for the successful implementation of the legal provisions and to have an integrated approach towards sustainable management of municipal solid wastes in the country. All the practices and efforts should reflect the better future but practically all the activities are not in planned manner and not to target oriented. As an emerging area, Khulna city should develop in a proper way to make beautiful, livable town in near future. Proper management and initiatives can lead organized and succeed outputs.

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Architectural Firms in Nigeria: A Study of Organizational Culture and Determinants

By Adedapo Oluwatayo, Dolapo Amole & Albert Adeboye
Covenant University, Nigeria

Abstract- Culture of organizations has received increasing attention in recent years. The questions that remain unanswered are however: what are the dominant cultural values of architectural firms and which characteristics of the firms determined the dominant culture of firms? To answer these questions, we carried out a survey of 92 architectural firms in Nigeria. The factor which best described the cultural values of the firms was innovation and staff orientation dimension, while the factor which least described the cultural values of the firms was the business- orientation dimension. The cultural value dimensions were explained by factors both internal and external to the firms. The results show that the age, size and legal ownership form of the firms were the firm characteristics which determined the dominant cultural values of the firms. The leadership style of the principal was also a major cultural value determinant. This suggests that each firm may need to adapt cultural values to their unique characteristics. The value of this study lies in its empirical nature in investigating the dominant cultural values of architectural firms, an area that hitherto had received little attention from scholars.

Keywords: *organizational culture, cultural values, architectural firms.*

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Adedapo Oluwatayo [α], Dolapo Amole [σ] & Albert Adeboye [ρ]

Abstract- Culture of organizations has received increasing attention in recent years. The questions that remain unanswered are however: what are the dominant cultural values of architectural firms and which characteristics of the firms determined the dominant culture of firms? To answer these questions, we carried out a survey of 92 architectural firms in Nigeria. The factor which best described the cultural values of the firms was innovation and staff orientation dimension, while the factor which least described the cultural values of the firms was the business- orientation dimension. The cultural value dimensions were explained by factors both internal and external to the firms. The results show that the age, size and legal ownership form of the firms were the firm characteristics which determined the dominant cultural values of the firms. The leadership style of the principal was also a major cultural value determinant. This suggests that each firm may need to adapt cultural values to their unique characteristics. The value of this study lies in its empirical nature in investigating the dominant cultural values of architectural firms, an area that hitherto had received little attention from scholars.

Keywords: organizational culture, cultural values, architectural firms.

I. Introduction

There is a growing body of research on the culture of service firms, (Chatman and Jehn, 1994); and a few of these studies focus on the culture of firms in the construction industry (Nummelin, 2006). Organizational culture has been shown to be an important component of the firm; serving very important functions. One of the reasons why the study of organizational culture is important is that it prompts researchers to question commonly held assumptions about organizations and their values contributes to organizational functioning (Racelis, 2005). Two functions of organizational culture that have been identified in literature are, to ensure the survival and adaptation of the firm to the external environment and to ensure its internal integration (Schein, 1985). Scholars (Denison, 1990 and Alvesson, 2002)) further subdivided the functions of culture. The proposed subdivisions by the aforementioned authors include conflict reduction; coordination and control; reduction of uncertainty, motivation and a source of competitive advantage. In addition to these, Baker, (2002) noted that culture in organizations promotes knowledge management, creativity, participative management, and leadership. An important aspect of culture, which serves these functions, is shared values (Chatman and Jehn, 1994). This is because members of the firms are responsible for delivering services. O' Reilly (1989) specifically stated that service firms direct members' actions by social control mechanisms such as cultural values.

Various factors influence a firm's organizational culture and different factors influence the organizational culture across firms of different industries (Cameron and Quinn 1999; Chatman and Jehn 1994). The factors that these authors propose include the external factors such as economic, political and clients' requirements. The internal factors include the size and age of the organizations as well as leadership styles of the managers. Wright (2005) demonstrated the influence of industry on organizational culture. This suggests that each industry should be studied to identify their peculiar organizational culture as well as the factors, which influence their culture. Despite the importance of understanding organizational culture however, there is a dearth of information on the culture of architectural firms. It is in light of this that we attempt to investigate the peculiar cultural values of architectural firms.

There have been differing definitions of the concept of culture. Various definitions include *shared assumptions or values (Cameron and Quinn, 1999; Reino and Vadi, 2010), meanings (Schein, 2004), symbols (Ouchi, 1981), and rituals (Pettigrew, 1979)*. Within organizations, culture is also manifested in organizational stories, jargon, humor, workplace arrangements, artifacts, formal structure, policies, and other explicit or inferred characteristics of culture. We adopt the description of culture proposed by Denison (1990), which states that culture entails the underlying values, beliefs, and principles that serve as a foundation for an organization's management system. These principles and practices endure because they have meaning to the members of an organization.

In this paper, we posed the following questions: What are the dominant values, which characterize the culture of architectural firms in Nigeria; and which characteristics of the architecture firms influence the values of the firms? By examining culture within the architectural firm as a professional service firm, this

Author α: Department of Architecture, Covenant University, Ota, Ogun State, Nigeria. e-mail: dapo.oluwatayo@covenantuniversity.edu.ng
Author σ: Department of Architecture, Obafemi Awolowo University, Ile-Ife, Osun State, Nigeria.
Author ρ: Department of Architecture, Covenant University, Ota, Ogun State, Nigeria.

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paper seeks to contribute to the literature in two ways. We intent to contribute to literature by presenting an industry- specific account of culture, thereby re-evaluating the generalizations of previous culture findings and the assertions that architecture firms are different from other professional organizations (Blau, 1984). In addition, we identify the specific characteristics of the architectural firms, which influence their cultural values.

II. Organizational Culture as Values

From the mention of organizational culture by Pettigrew in 1979, the study of organizational culture has been conceptualized in different ways. The concepts that stem from organizational theory include classical management perspective, which views organizations as social instruments for task accomplishment; and the contingency perspective, which views organizations as adaptive organisms existing by process of exchange with the environment (Smircich, 1983). Other perspectives in the study of organizational culture include symbolic, transformational, and cognitive organizational perspectives. While the symbolic organizational perspective views the organization as patterns of symbolic discourse, which facilitates shared meanings and values, the transformational perspective conceptualizes organizational forms and practices as manifestations of unconscious processes. The cognitive perspective in the study of organizational culture, which we adopts, views the organization as relying on a network of subjective meanings that organizational members share. This perspective views culture as an organizational variable that expresses the values and beliefs that organizational members have come to share. It is a way of perceiving and organizing phenomena, events, behavior and emotions (Smircich, 1983). In the cognitive perspective, thoughts are conceptualized as linked to actions.

Using the cognitive approach to the study of culture, we conceptualize culture as strongly held values. Reino and Vadi (2010) noted that values reflect the beliefs and understandings of individuals and groups about the means and ends of the organization. Value is a core element of culture and has therefore been the focus of most of the studies of organizational culture. Value, as defined by Enz (1988), is the beliefs held by individuals or group regarding the means and ends that organizations should identify in running of the enterprise and in choosing business actions. Enz further argued that norms, symbols, rituals, and other cultural activities revolve around values. These values form the heart of, and are used by organizational members to depict culture to themselves and to others (Schein, 2004). Although values are neither attitudes nor behaviours, (Stackman, Pinder and Connor, 2000), they set patterns for activities, opinions and actions (Ouchi, 1981).

Various dimensions of culture have been studied in literature. One of those dimensions is stability versus change, and innovation versus personal growth. This dimension relates to the propensities that individuals have towards stability or change (Hofstede et al, 1990). Denison and Mishra, (1995) suggested that innovation take priority when organizations try to promote risk, while organizations that are risk-averse focus personal growth. Culture is also conceptualized in terms of orientation and focus of organizations. This is related to whether the organization focuses on the people and processes within the organization or on the customers, competitors and the environment (Denison and Mishra, 1995). The dimension of orientation to work, task and co-workers was studied by O'Reilly, Chatman and Caldwell, (1991), and their studies focused on the balance between work as a production activity and as a social activity. The dimension of isolation versus cooperation relates to whether individuals accomplish most of the work or a premium is placed on collaboration or teamwork in an organization (Denison and Mishra, 1995).

Three popular approaches to measuring culture were identified in literature. The most popular was the Competing Value Framework (Cameron and Quinn, 1999). This was developed from Quinn and Rohrbaugh's Organizational Culture Assessment Instrument of 1981. With this framework, the authors argue that we can best understand organizational effectiveness when we organize it around opposite ends of flexibility and control, and internal and external orientations. Several studies have used this approach to determine type and strength of culture. The second approach called the Critical Incident Technique (Mallak et al, 2004) describes culture by identifying good and poor service episodes. The third approach, which is most relevant to this study, was the Organizational Culture Profile (O'Reilly, Chatman and Caldwell, 1991), which characterizes organizational culture in terms of values. The approach identifies a range of relevant values and assesses how strongly held and widely shared they are. We consider this approach most relevant to this study, since the aim is identifying the dominant culture of architectural firms in Nigeria and their determinants. O'Reilly, Chatman, and Caldwell (1991) identified seven dimensions of culture. Rousseau (1990), Chatman, and Jehn (1990) also found similar dimensions their studies. In fact, Saele (2007) noted that the dimensions give reasonable reliability and validity. The seven dimensions identified by O'Reilly, Chatman, and Caldwell (1991) are innovation, stability, people orientation, outcome orientation, detail orientation, team orientation, and aggressiveness. Researchers have also noted that dominance of cultural value dimensions varies between organizations. The characteristics specific to each organization may determine these variations (Reino and Vadi, 2010).

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The factors that influence the culture of organizations are both internal and external (Reino and Vadi, 2010). The external factors include some values of the society and the organization's specific environment (Erez and Gati, 2004; Cameron and Quinn 1999). Gordon (1991) identified competitive environment and client requirements, while Chatman and Jehn, (1994) identified technology as some external factors that influence culture. Other factors that are external to organizations are the national economy, political climate, infrastructure, government policies. Some authors suggest that variations in organizational culture occur mainly due to internal pressures (Cameron and Quinn, 1999). Zahra, Hayton, and Salvato (2004) also noted that culture develops over time because of the dynamic interplay between the owners' values, organizational history, as well as the competitive environment of the firm's major industry. Vadi and Alas, (2006), who noted that irregularities in the manifestation of culture could be attributed to organizational variables, corroborated this. One of such organizational variables is the age firms (Cameron and Quinn, 1999). Van Wijk et al, (2007) proposed that older organizations tend to be more stable. In addition, Durand and Coeurderoy (2001) and Alas (2004) also argued that older organizations are inflexible and conservative. Another organizational variable is the size of the firm. Schein (2006) noted that large organizations might be innovative, as they possess diverse skills and capabilities. However, small organizations are more flexible, with higher ability to adapt to changes, which also facilitates innovation. Similarly, Flynn and Chatman, (2001) noted that larger organizations are more bureaucratic and therefore less flexible.

In addition, Dastmalchian et al (2000) found a correlation between organizational size and intra-organizational relationships such as organizational formalization and centralization. Miller and Droge (1986) defined formalization as the extent to which the rights and duties of the members of the organization are determined and the extent to which these are written down in rules, procedures and instructions. Centralization also refers to the extent to which decision-making power is concentrated in top management level of the organization. These intra-organizational relationship variables may also influence culture. Some researchers also argue that privatization leads to significant changes in the culture of organizations (Zahra and Hansen, 2000; Cunha and Cooper, 2002). Most of these studies were conducted in the context of organizations, which were formerly owned by the government but were privatized to investigate the change in organizational culture that resulted from change in ownership form. Ownership is however one aspect of the firms that have been suggested to influence the culture of organizations (Schein, 2004). Leadership is another factor, which has been said to influence culture. In fact, Schein (2004) observed that founders of organizations teach their values and beliefs to new members of the organizations. Reiman and Oedewald (2002) put it succinctly by noting that managers are the creators of principles and values in organizations. With architectural firms, the founders are often the managers. These suggest the need to investigate the influence of the ownership form as well as the leadership styles of principals of firms on the culture of the firms.

A number of assertions and conclusions have been made about the culture of service firms and architectural firms in particular. Hofstede et al (1990) suggested that all service sector organizations would be more people oriented than outcome oriented. Ren, (2005) also argued that architectural firm differed from other service firms because of the strong emphasis on creativity and self-identification. This, he said results in smaller firms, compared to other service firms. He also noted that there is strong emphasis on teamwork in architectural firms. One however wonders if the value of creativity will be more dominant than teamwork in architectural firms or vice-versa. We therefore explores the dominant cultural values of architectural firms in Nigeria, and the characteristics, which influence these cultural values.

III. Research Methods

We conducted the research on architectural firms in Nigeria. We used the firm as the unit of analysis. The total population is the total number of architectural firms registered to practice in Nigeria by the Architects Registration Council of Nigeria (ARCON). The ARCON register (2006) revealed that 341 firms were registered to practice in Nigeria. However, 77.7 percent of these firms were located in six cities which were Lagos, Abuja, Kaduna, Enugu, Port-Harcourt and Ibadan We used the purposive sampling method to select cities where the highest number of architectural firms. Lagos had more than 50% of registered architectural firms in Nigeria (ARCON, 2006). Lagos, which used to be the seat of government some years ago, is often described as the man industrial and commercial centre of Nigeria. Hosting the next highest number of architectural firms was Abuja, Nigeria's political capital, known as the most planned and systematically built city in Nigeria. Enugu, home of the next highest number or architectural firms is an industrially rich area, while Kaduna, a city in the study is known as the foremost commercial and industrial hub in the north of Nigeria, Port Harcourt is described as a chief trade centre of Nigeria and the last city in the study, Ibadan, south-west Nigeria, is also an important centre of trade.

We calculated the sample size using a formula derived by Franfort-Nachimias and Nachimias

(1992:189). This gave a sample size of 157 firms, each of which we gave the questionnaires to fill. We received 92 usable questionnaires back, which represented 58.6% return rate. We administered questionnaire to the principal or a senior staff in each firm, administering one questionnaire per firm. This is because Sarros et al (2005) suggested that managers and senior executives are in the position to express firms' cultural identities since they are also in position to determine it.

Before data collection, we carried out interviews where the key informants were principals of two firms. We then fine-tuned the questions on cultural values, which were relevant to architectural firms. The questionnaire consisted three parts. In the first part of the questionnaire, we obtained information about the general profile of the firms. In the second part, we asked respondents to indicate on a 5-point likert response format how applicable statements constructed from seven dimensions of culture obtained from the works of O'Reilly et al (1991) and Chatman and Jehn (1994) were to their firms. The questions were related to the innovation, outcome orientation, aggressiveness, team orientation, stability, attention to detail and people orientation dimensions of culture. Sarros, Gray, Densten and Cooper (2005), noted that the Likert scale provides a more versatile means to investigate individual perception of culture. On the scale, 1 represented Not Applicable at All, 2- Minimally Applicable, 3- Moderately Applicable, 4- Applicable and 5= Very Applicable. In the third section of the questionnaire, we also used the likert response format was also used. In this section, we asked questions about the perceptions of the respondents on the influence of external factors on their firms. The likert scale that we used was 1 for Not Influential At All, 2 for Not Influential, 3 for Undecided, 4 for Influential and 5 for Very Influential. Table I illustrates this sample categorized by a number of demographic variables.

Table 1 : Profile of respondents

		Percentage
Location of Firm	Kaduna Lagos Abuja Enugu Port-Harcourt Ibadan	9.8% 54.4% 10.9% 13.1% 7.6% 4.4%
Age of firm	up to 5 years 6-10 years 11-15 years 16-20 years 21-25 years 26 years and above	9.9% 16.1% 27.2% 19.8% 13.6% 13.6%
Ownership Form	sole principal partnership limited liability company unlimited liability company public company	52.3% 21.6% 17.1% 8.0% 1.1%
Company size	1-5 staff 6-10 staff 11-20 staff 21-30 staff 31-40 staff 41-50 staff 51 staff and above	14.9% 33.3% 27.6% 8.1% 6.9% 5.8% 3.5%
Age of principal partner	below 30 years 30-40 years 41-50 years 51-65 years above 65 years	1.1% 22.4% 43.5% 27.1% 5.9%
Years of experience of principal partner	up to 5 years 6-10 years 11-15 years 16-20 years 21-25 years 26 years and above	1.5% 12.1% 15.2% 18.2% 21.2% 31.8%
Degree of Centralization of decision-making	low level of centralization moderate level of centralization high level of centralization	27.8% 31.9% 40.3%
Degree of formalization	informal fairly formal very formal	7.5% 37.5% 55.0%
Leadership style	mentor visionary and innovative leader efficient manager productivity oriented achiever	9.3% 38.4% 11.6% 40.7%

We use the Statistical Package for Social Scientists (SPSS) was used carry out a principal component analysis so as to identify the dominant cultural values of the architectural firms. With principal component analysis, we were able to discover the natural convergence and divergence of the variables investigated. This gave the underlying factors, which are uncorrelated, and best describe the cultural values of the architectural firms in the study (Pallant, 2011). We also carried out regression analysis to determine the firm characteristics, which influence cultural values. With this analysis, we investigated the probability that firm profiles and influences of the external factors will predict the dominant cultural values of the architectural firms in the study.

IV. Results

To test for the reliability of the variables used in measuring cultural values, we carried out a cronbach alpha test. The results show that the variables were internally valid as the value of the cronbach alpha was 0.73, which according to George and Mallery (2003) is acceptable. For the principal component analysis, we used the variable principal normalization method, with the criteria for convergence set at 0.00001. The factor analysis of the cultural variables shows that three (3) factors accounted for 58.67% of the variance in the result. To arrive at the number of factors, we used the Kaiser criterion, which sets the eigenvalue for selection of factor at a minimum of 1. With this criterion, only factors with eigenvalue greater than 1 were selected. The component loadings revealed the variables that the factors represented. The first factor, which accounted for 31.14% of the variance in the data represented new ideas and technology as determinants of strategy of firms (0.74), teamwork and staff development (0.70), driving staff to achieve results (0.70), and staff expression of personal styles and initiative (0.68) (Table II). Other variables that loaded highly on first factor were gender equity in hiring (0.67), innovation (0.65) and gender equity in task allocation. We described this dimension as innovation and staff orientation. The second factor (accounting for 14.001% of the variance), which we described as stability dimension loaded highly on risk-aversiveness (0.82) and tradition (0.75), while the third factor (accounting for 13.52% of the variance) loaded highly on the concern for profit (0.82) and aggressiveness in the pursuit of business opportunity (0.62) and is described as business orientation dimension of culture.

Table 2 : Factors of Cultural Values of Architectural Firms

Factor Description	Variables Represented	Factor Scores
Factor 1: Innovation and staff orientation (31.1%)	New ideas and technology as determinants of strategy of firms	(0.74),
	Teamwork and staff development	(0.70)
	Driving staff to achieve results	(0.70)
	Staff expression of personal styles and initiative	(0.68)
	Gender equity in hiring	(0.67)
	Innovation	(0.65)
	Gender equity in task allocation	(0.57)
Factor 2: Stability (14.0%)	Risk-aversiveness	(0.82)
	Tradition	(0.75)
Factor 3: Business orientation (13.5%)	Concern for profit	(0.82)
	Aggressiveness in the pursuit of business opportunity	(0.62)

The three dimensions of cultural values of the architectural firms sampled were subjected to further analysis to determine the characteristics of the architectural firms, which determined the dominant cultural values We carried out three categorical regression analyses to find out the factors, which were most closely associated with the differences observed in the cultural values of the architectural firms. We entered each dimension of culture as the dependent variable while the age, size, ownership form, location, level of formalization and centralization of the firm, as well as the age, experience and leadership styles of the principal were entered as independent variables. We also entered the external factors that may influence the firms as independent variables. We present the summary of the determinants of culture of the architectural firms sampled in Table III. The F value for the innovation and staff orientation ($p= 0.005$), stability ($p = 0.000$) and business orientation ($p = 0.000$) were significant. The levels of description of the overall variation were 26.9%, 45.9% and 55.7% for innovation and staff orientation; stability, and business orientation respectively. The variables that did not significantly influence the innovation and staff orientation dimension of culture were the age of the principal, the size of the firm and the external influences from the professional body and infrastructure. The levels of formalization of office activities and centralization of decision-making did not significantly influence the innovation and staff orientation as well as the stability dimensions of culture of the architectural firms. Other variables that were not significant predictors of the stability dimension were the leadership style of principal and external influences from the architectural professional body, information technology, and infrastructure. Three external variables (influences of clients, concern about sustainable environment and political climate) and one internal factor (the level of formalization of decision-making) were however not significant predictors of the business orientation cultural dimension.

Table 3 : Cultural values and firm characteristics

Firm Characteristics	Cultural Value Dimensions		
	Innovation and staff orientation ^ R^2 = 0.27 F = 1.22 Sig = 0.005	Stability ^ R^2 = 0.46 F = 2.76 Sig =0.000	Business orientation ^ R^2 = 0.56 F = 3.54 Sig = 0.000
Ownership form	0.30*	0.32*	0.21*
Age of Firm	-0.24*	-0.32*	-0.29*
Location of Firm	-0.39*	-0.38*	0.63*
Size of Firm	-0.31	0.33*	-0.21*
Age of Principal Partner	-0.16	0.43*	-0.18**
Experience of Principal Partner	-0.41*	0.31*	0.41*
Level of Formalization of Office Activities	-0.00	0.13	0.41
Level of Centralization of Decision-Making	-0.11*	-0.03	0.40*
Leadership Style of Principal	0.16**	0.07	0.24*
Influence of clients	-0.31*	0.56*	0.18
Influence of architectural professional body	0.13	-0.14	-0.22*
Influence of advances in information technology	0.25**	-0.09	0.22*
Influence of the national economy	0.21**	-0.13**	0.23*
Influence of the political climate of the country	0.30*	-0.27*	-0.08
Influence of current privatization programmes	-0.55*	-0.16**	0.27*
Influence of government policies	0.35*	-0.21**	-0.28*
Influence of infrastructure	0.09	0.13	0.29*
Influence of increasing concern about sustainable environment	0.24*	-0.31*	-0.20
Influence of other professionals	-0.43*	0.23*	-0.14*

^ *The values were the adjusted R2 values*

* *p <0.01*

** *p < 0.05*

We plotted the principal component analysis factor scores of all the firms on the three dimensions of culture against the firm characteristics as in Figures I to VIII. Since we already standardized the factor scores during principal component analysis, the mean score of each factor would be zero. When we plotted the factor score against the firm characteristics therefore, the scores of the firms varied from negative to positive. The graphs indicated how each factor score is ranked with each firm characteristic that we investigated. When we further examined the results, Figures I to VIII show that firms that rated business orientation high had younger principals, with few years of experience, while the firms that rated stability high had older principals, with higher number of years of experience. We also found that business orientation was rated high by principals who were described as efficient managers or productivity-oriented achievers; while innovation and staff management was rated high by principals who were described as mentors or visionary and innovative leaders. Small sized architectural firm (with 10 staff or less) in the architectural firms that we studied were business oriented. Similarly, sole principal firms rated business orientation high, while limited liability architectural firms rated innovation and staff orientation high. Unlimited liability architectural firms and public companies were however more stability oriented. We further found that old firms in the study were stability oriented; maturing firms (6-15 years) were business orientation high, while the very young firms were more innovation and staff oriented. It was interesting to note that the old and new capitals of Nigeria had firms which mostly valued innovation and their staff. Most of the firms in Port Harcourt are business-oriented while stability was valued by firms in Kaduna and Ibadan. We show in Figure IV that firms with low level of centralization of decision-making scored high in innovation and staff orientation while firms with high level of centralization scored high in business orientation.

Table 4 : Mean factor scores of firms on the influence of the external environment and the cultural value dimensions

External influences		Factor scores on dimensions of organizational culture		
		Innovation and staff orientation	Stability orientation	Business orientation
clients	Low	-0.43	**-0.16**	Not significant*
	High	**0.46**	-0.46	Not significant*
architectural professional body	Low	Not significant*	Not significant*	**0.25**
	High	Not significant*	Not significant*	-0.22
advances in information technology	Low	-0.89	Not significant*	**-0.28**
	High	**0.11**	Not significant*	0.07
national economy	Low	-0.15	**0.05**	-0.08
	High	-0.07	-0.05	**0.09**
political climate	Low	-0.18	**0.11**	Not significant*
	High	**0.02**	-0.15	Not significant*
privatization programmes	Low	-0.21	0.03	**0.06**
	High	**0.25**	-0.17	0.09
government policies	Low	-0.13	-0.12	**0.08**
	High	-0.10	**0.09**	0.04
infrastructure	Low	Not significant*	Not significant*	-0.07
	High	Not significant*	Not significant*	**0.11**
concerns about sustainable environment	Low	-0.14	**-0.01**	Not significant*
	High	**-0.07**	-0.12	Not significant*
other professionals	Low	-0.17	-0.10	**0.22**
	High	0.10	**0.11**	0.09

*$(p>0.05)$

The results (Table IV) also show the cross tabulation of the mean factor score of the firms on the cultural dimensions and the external influences of the firms. Innovation and staff management is rated high by firms highly influenced by advances in information technology, political climate of the country, privatization programmes of the government and concerns for sustainable environment but weakly influenced by clients. With high client, government policies and other professionals' influences as well as weak influences from the economy, political climate and concern for sustainable environment, the firms rated stability very high. The firms that rated business orientation high were highly influenced by the economy of the country and infrastructure but weakly influenced by the professional body, information technology, privatization programmes, government policies and other professionals.

V. Discussions

In this study, we set out to investigate the dominant cultural values of architectural firms in Nigeria and the characteristics of the firms that are related to the level of adoption of those values. The findings that we obtained from the study conform to the argument of Hofstede et al (1990) that architectural firms are more people- oriented than outcome-oriented. The study however found that staff orientation and was factored together with innovation. It thus appears that with the architectural firms, innovation and staff orientation go together. This is probably stems from the dependency of the architectural firms to service the needs of clients. The grouping of innovation and staff orientation for the architectural firm is interesting because it suggests that the innovation in the firms is highly dependent on the staff. Cultural differences between the firms were greatest on innovation and staff orientation, which encompasses easygoingness identified by Chatman and Jehn (1994) as the greatest asset in consulting firms. Contrary to the findings of Chatman and Jehn however stability accounted for a greater difference between the firms than business orientation (termed outcome orientation).

The very young firms valued innovation and staff management, which changed to business orientation as they advanced in age, while the old firms valued stability. The findings of that we obtained in this study thus confirm the assertion of Van Wijk et al (2007), Alas (2004); and Durand and Coeurderoy (2001) that older firms are stability oriented and conservative. In addition to the age of the firm however, we find that the age of the principal also influenced their cultural values. In particular, older principals also scored stability high as a cultural value. This probably suggests a need for stability with age either of the principal or of the firm. It is however impossible to say if older firms and principals have explored and established a tradition and desire to sit back to consolidate. This is because we conducted a cross-sectional and not a longitudinal study. Firms with young principals however valued business orientation. It is interesting however that the innovation and staff orientation values of the architectural firm was influenced by the age of the firm, but not significantly influenced by the ages of the principal. It thus appears that the innovation and staff orientation value is more dependent on the age of the firm, than on the age of the principal.

The findings we obtained from this study further supports the argument of Flynn and Chatman (2001) and Schein (2006) that large organizations are less flexible and small ones. Large architectural firms scored stability higher than other cultural values. Small organizations however scored business orientation higher than other cultural values. The innovation and staff orientation value was however not significantly influenced by the size of the firms. It may thus appear that although other small organizations are more innovative than larger ones (Schein, 2006), the innovation value in architectural firms is not influenced by the sizes of the firms.

We, through this study were able to empirically support other suggestions in literature. One of the suggestions is that ownership will influence culture (Zahra and Hansen, 2000; and Cunha and Cooper, 2002). We found that the public company with shareholder funds and the unlimited liability company with propensity for personal indebtedness valued stability above other cultural values. The results that we obtained further suggested however, that the dominance of the value of stability is also a function of the age and the size of the firms. The most innovation and staff oriented firms were those with the limited liability form of ownership, while the sole principal firms were the most business oriented. It therefore appears that the sole principal firms, trying to make a maximum profit valued business orientation, while the limited liability firms could experiment knowing their losses will be limited. Another point in the literature that we empirically confirmed is that leadership influence culture (Reiman and Oedewald, 2002). Principals who were described as mentors and visionary and innovative leaders valued innovation and staff orientation above business orientations, while it was the other way round for principals whose leadership style was either efficient management or productivity oriented achievement. This also suggests that innovation in architectural firms goes with staff orientation. In addition to the leadership style of the principals, the experience of the principal also influenced the values of the firms. Principals with very few years of experience valued business above stability, while the highly experienced principals valued stability. Innovation and staff orientation was however rated high by all architectural firms irrespective of years of experience. It thus appear that although innovation and staff orientation value of the firms varied significantly with the leadership style of the principal, it did not vary with the age and experience of the principal. Instead, the stability value of the firms varied significantly with the age and experience of the principals, but not with the leadership style of the firms.

The results that we obtained also suggest that business-orientation is mostly a result of high level of centralization of decision-making. It thus appears that while decision-making may be centralized when a firm has high business oriented cultural value, participation is important when a firm aims at innovation as a dominant cultural value. The fact that firms in the old and new capitals of Nigeria mostly valued innovation and their staff may be because of the need for iconic, state of the art designs required by the commercial, administrative and industrial buildings in those locations. Port Harcourt, a city that host many multinational oil companies in Nigeria had architectural firms that were mostly business- oriented. This may be a reflection of the trade vibrancy of the city. This findings suggest that there may be a limit to generalization of organizational values (Reino and Vadi, 2010)

We were able to also confirm the assertion of Erez and Gati (2004) that some values of the society and the organization's specific environment influence the culture of organizations by the findings of this study. Strong influence of the economy and infrastructure motivated the architectural firms to be business-oriented. This suggests that firms which try to beat a downturn in the economy, in spite of infrastructural inadequacies focus on building business values. The business- orientation drive of the firms thus appears to be a survival strategy. It was also interesting to note that the innovation and staff-orientation drive of the firms become strong in the face of advances in information technology, political climate, privatization programmes of government and concerns for sustainability. It appears that these firms, in an attempt to take advantage of new issues become more innovative, hence staff-oriented, as the innovation of architectural firms have been shown to be linked to their staff. The results that we obtained also suggest that firms which are strongly faced with requirements of clients, government policies and stern competition from other professionals were stability-conscious.

VI. Conclusion

In this study, we investigated the cultural values of architecture firms and the characteristics of the architecture firms influence the cultural values they adopted. We found the underlying structure of the culture of architectural firms using the dimensions derived by O'Reilly et al (1991). There was a further convergence of the seven dimensions investigated to give three dimensions. In particular, innovation converged with staff orientation, and team orientation. By this study, we provide empirical evidence for the cognitive perspective of culture. The results that we found support the proposition of Zahra, Hayton and Salvato (2004) that culture of architectural firms developed from interplay of the characteristics of the owner, the firm and the firm's external environment. Factors both internal and external to the firms determined the cultural value that was dominant in the firms. The results that we found further provide evidence for the assertion of Racelis (2005) that environmental changes necessitate cultural changes, and the cultural process is an adaptation to ecological and socio-political process, (Erez and Gati, 2004).

A major implication of these findings is that culture may be unique to each architectural firm as it is an adaptation to the owner and firm's characteristics as well as the external environment of individual firm. Culture may thus be a source of competitive advantage. The fact that innovation factored together with staff orientation may suggest that the workforce of architectural firms, apart from being critical asset because of their direct interaction with clients (Ettinger, 2009), are also an embodiment of the innovation of the firms. The results of the study also suggest that principals of firms faced with constraints of the economy and infrastructure may find it easy to adopt the business culture. Furthermore, the results suggest that new issues in the external environment of the firms may be tackled by adopting the innovation and staff- orientation cultural value, while those faced with requirements of clients, and government as well as competition from other professionals may strive for stability.

The results that we found in this study also show that the location of the firms influenced the dominant cultural values of the firms. This suggests that culture is place-specific and the adoption of culture should be based on the location of a firm. The factors within the states which influenced the culture of the firms were however not known. Further studies are required to investigate the factors within a location, which influences the culture of organizations.

There were also some limitations to the study. The firms that we sampled in this study were architectural service firms, which are professional service firms. These firms have peculiar characteristics (Maiser, 1993), thus, the results may not be applicable to other organizations. Although the use of questionnaire is a legitimate research approach, it does not capture more subtle aspects of culture. Further studies may also adopt other research methods to capture more subtle aspects of organizational culture. In addition, data for the empirical study were obtained from architectural firms in just one country. It may therefore not be representative of other countries. We did not investigate the fit between organizational culture, organizational characteristics, and external environment. Further studies may investigate this fit to see which cultural dimensions and organizational characteristics lead to higher performance in architectural firms.

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Firm Characteristics and Cultural Values

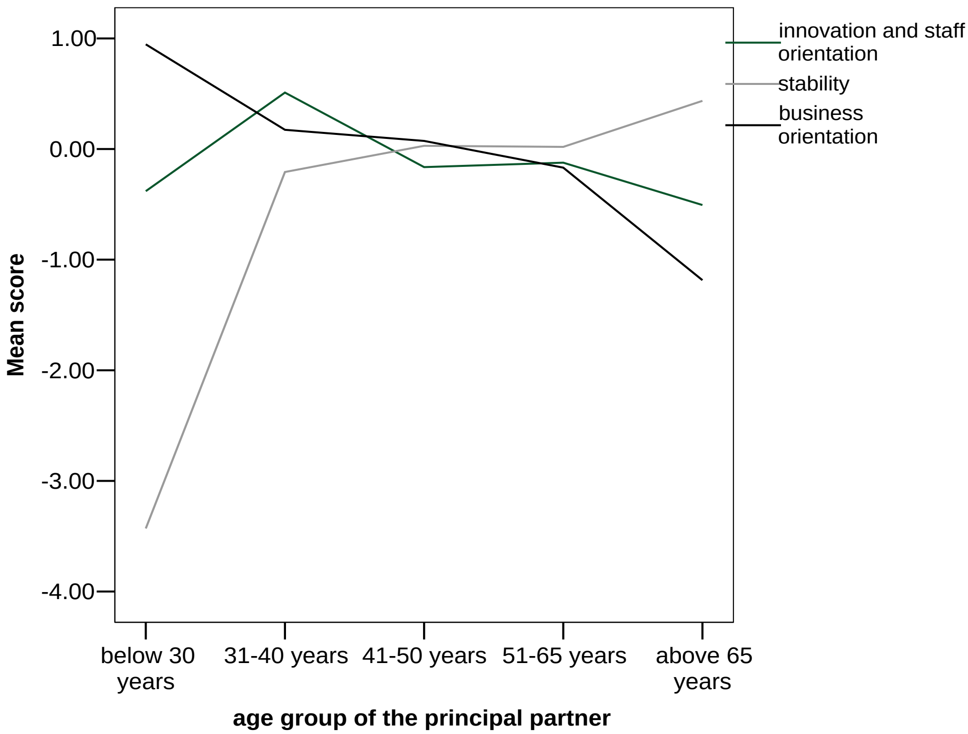

Figure 1 : Age of principal and cultural value

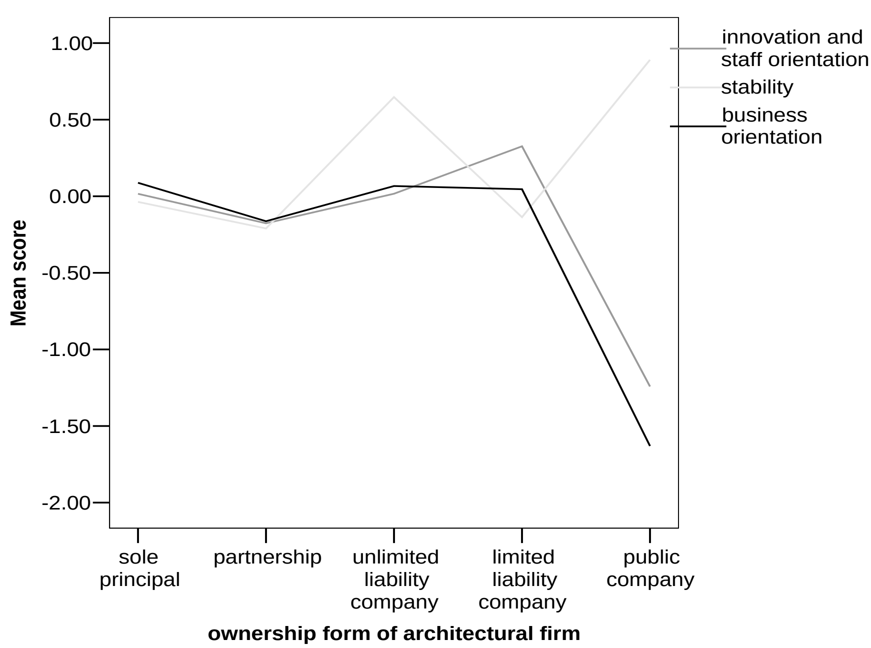

Figure 2 : Ownership of firms and cultural value

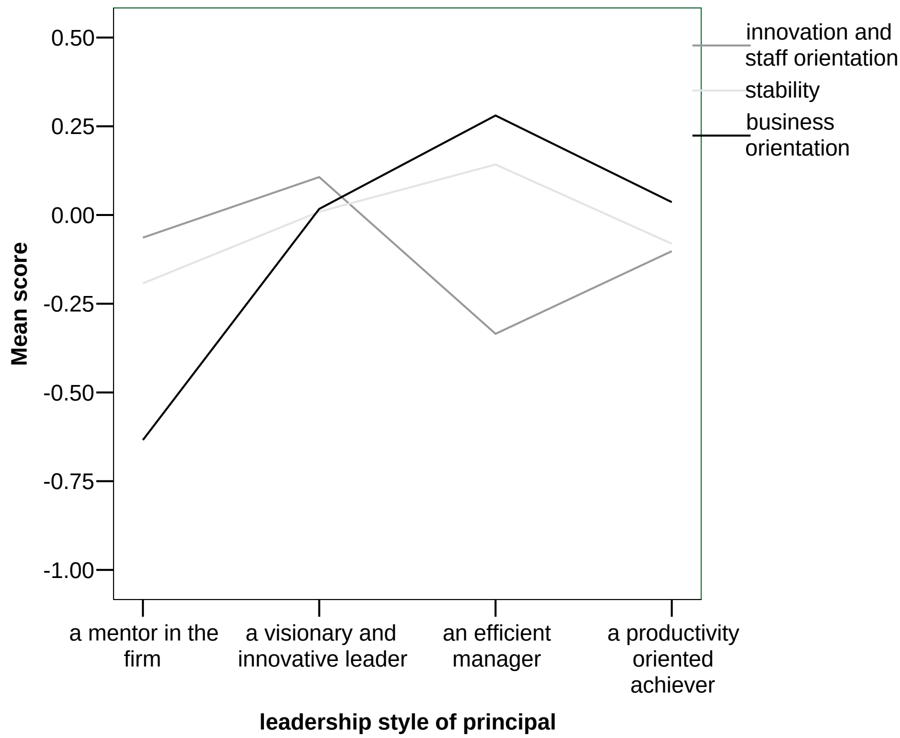

Figure 3 : Leadership style of principal and cultural value

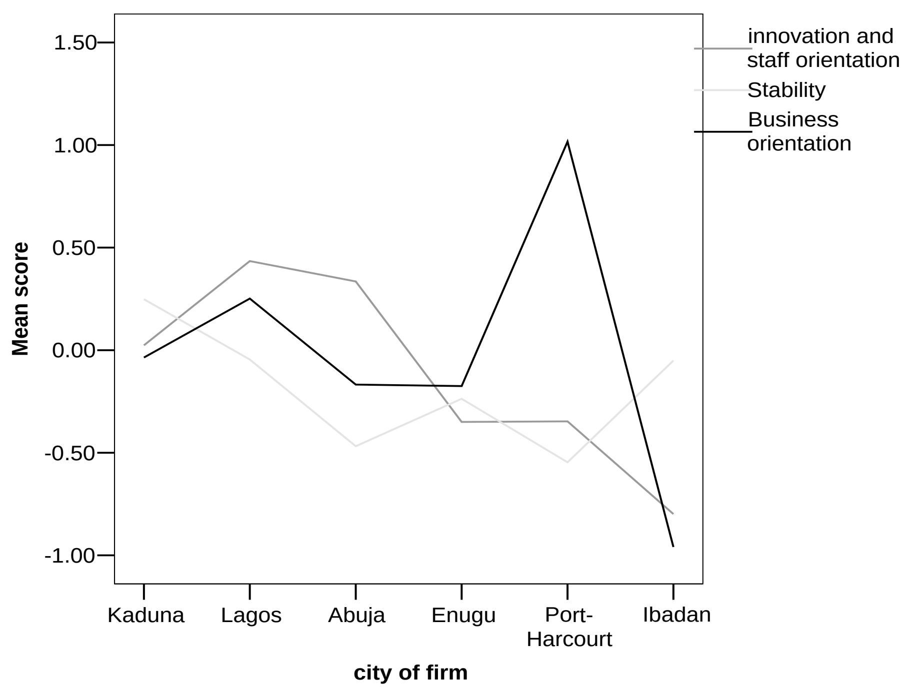

Figure 4 : Location of firm and cultural value

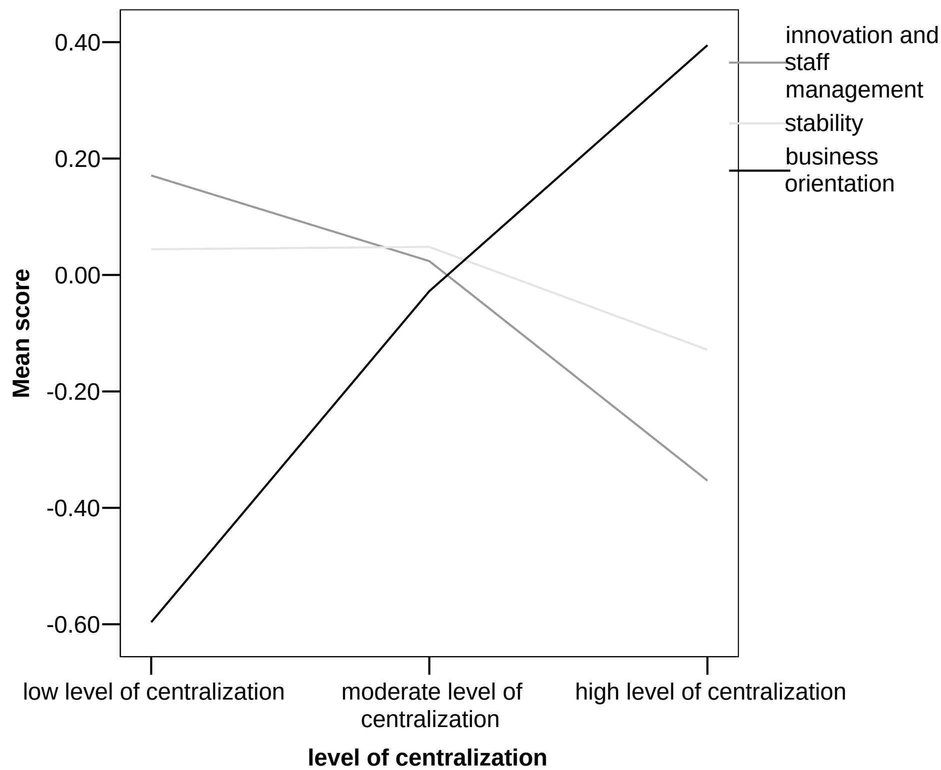

Figure 5 : Degree of centralization of decision-making and cultural value

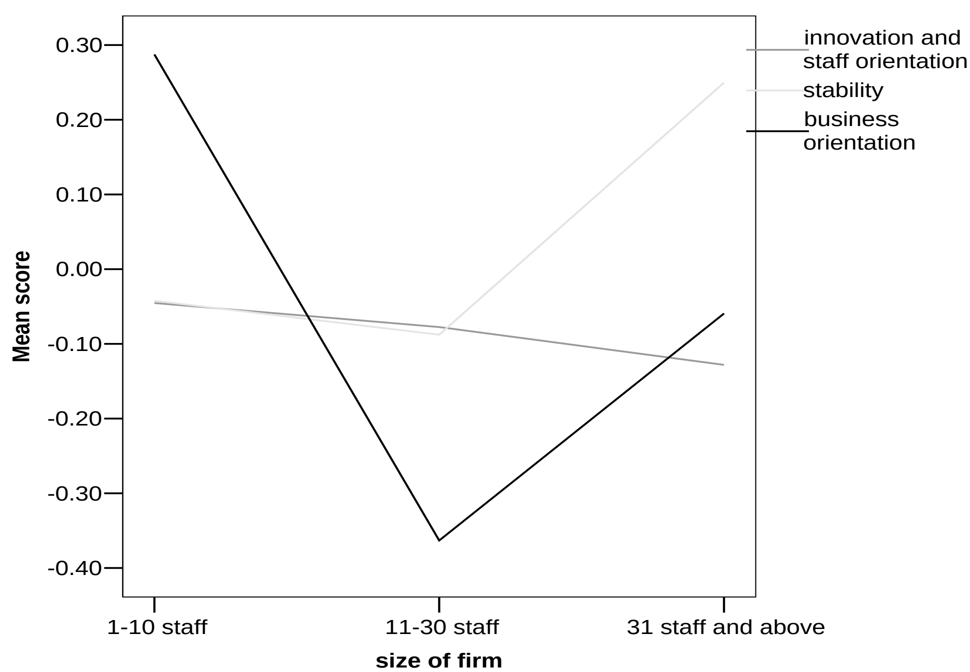

Figure 6 : Size of firms and cultural value

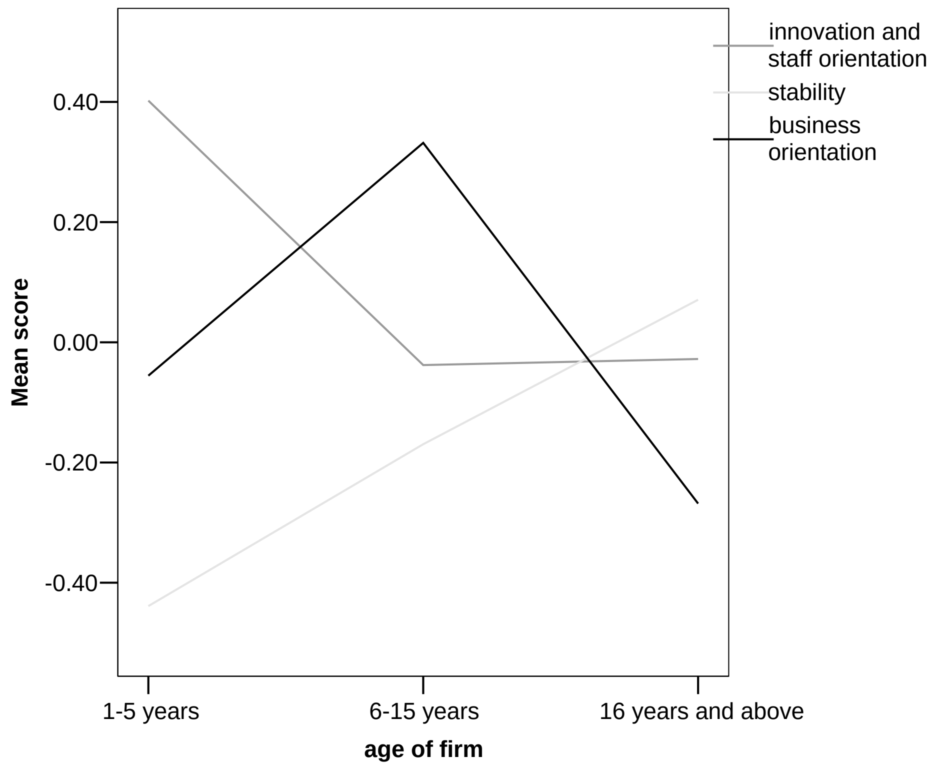

Figure 7 : Age of firm and cultural value

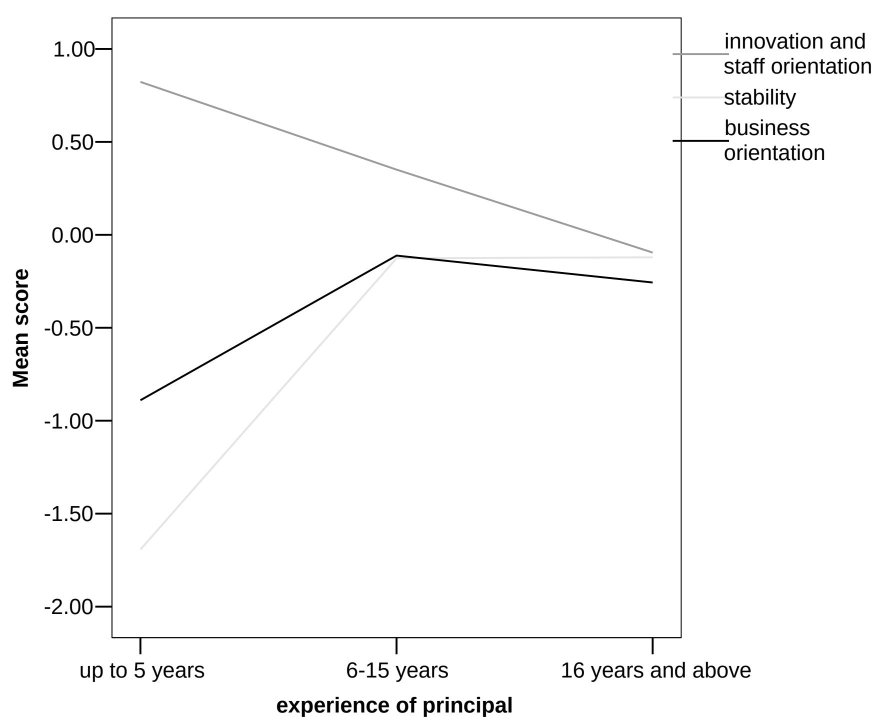

Figure 8 : Experience of Principal and Culture

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C^0- Continuity Isoparametric Formulation using Trigonometric Displacement Functions for One Dimensional Elements

By Esmaeil Asadzadeh & Mehtab Alam
Jamia Millia Islamia University, India

Abstract- This is an original research on the selection of the trigonometric shape functions in the finite element analysis of the one dimensional elements. A new family of C0- continuity elements is introduced using the trigonometric interpolation model. To relate the natural and global coordinate system for each element of specific structure (i.e. transformation mapping) in one dimensional element a new trigonometric function is used and the new determinant has been introduced instead of polynomial function and Jacobian determinant. The new introduced trigonometric determinant allows for the state of constant strain within the element satisfying the completeness requirement. However, this cannot be achieved using the Jacobian determinant to relate the coordinates while using the trigonometric functions. The finite element formulation presented in this paper gives comparable results with exact solution for all kinds of one dimensional analysis.

Keywords: finite element method, c^0- continuity element, trigonometric shape functions, isoparametric concept.

GJRE-E Classification : FOR Code: 090599, 090506

Strictly as per the compliance and regulations of :

C^0- Continuity Isoparametric Formulation using Trigonometric Displacement Functions for One Dimensional Elements

Esmaeil Asadzadeh [α] & Mehtab Alam [σ]

Abstract- This is an original research on the selection of the trigonometric shape functions in the finite element analysis of the one dimensional elements. A new family of C^0- continuity elements is introduced using the trigonometric interpolation model. To relate the natural and global coordinate system for each element of specific structure (i.e. *transformation mapping)* in one dimensional element a new trigonometric function is used and the new determinant has been introduced instead of polynomial function and Jacobian determinant. The new introduced trigonometric determinant allows for the state of constant strain within the element satisfying the completeness requirement. However, this cannot be achieved using the Jacobian determinant to relate the coordinates while using the trigonometric functions. The finite element formulation presented in this paper gives comparable results with exact solution for all kinds of one dimensional analysis.

Keywords: finite element method, c^0-continuity element, trigonometric shape functions, isoparametric concept.

I. Introduction

Finite element method (FEM) is the approximate piecewise analysis in the domain of interest, researchers have put in efforts to select an appropriate interpolating function which can very closely approximate the field variable and converge to the exact solution. Polynomials have been studied for many years, starting in the 19th century, and they have shown to have mostly good approximation properties. Nevertheless, they are not ''good for all seasons'' [1]. In [2], it was shown that for differential equations with rough coefficients, the finite element method using polynomial shape functions can lead to arbitrarily ''bad'' results. Effective shape functions should have good approximation properties in entire domain of the interest. To increase the accuracy of the solution various procedures for error estimation have been devised and mesh refinement is used. Various procedures exist for the refinement of finite element (FE) solutions. More researches have been reported on the references [4-14].

By considering the linear-strain triangular (LST) element it can be seen that the development of element matrices and equations expressed in terms of a global coordinate system becomes an enormously difficult task [15]. The isoparametric method may appear somewhat tedious (and confusing initially), but it leads to a simple computer program formulation, and it is generally applicable for one-, two- and three-dimensional stress analysis and for nonstructural problems. The isoparametric formulation allows elements to be created that are nonrectangular and have curved sides [16].

In this paper, we first illustrate the trigonometric isoparametric formulation to develop the shape functions of C^0 continuity of the family of one dimensional bar elements and to derive the strain matrix, stiffness matrix and then force vector. Use of the bar element makes it relatively easy to understand the method because it involves simple expressions. Then quantitative concepts for assessing and comparing effectiveness of these families of shape functions are given. Focus on the principles that should govern the selection of the trigonometric shape functions are discussed, and one dimensional elements are studied by employing these new shape functions obtained from trigonometric displacement functions to analyze the bars carrying the self-weight and the results have been compared with the exact solutions of classical methods of solid mechanics.

II. Isoparametric Concept and Coordinate Systems

The term isoparametric is derived from the use of the same shape functions (or interpolation functions) to define the element's geometric shape as are used to define the displacements within the element. Isoparametric element equations are formulated using a natural (or intrinsic) coordinate system T that is defined by element geometry and not by the element orientation in the global coordinate system. In other words, axial coordinate T is attached to the bar and remains directed along the axial length of the bar, regardless of how the bar is oriented in space [16]. The relationship between the natural coordinate system T and the global coordinate system X for each element of specific structure is called the *transformation mapping* and must be used in the element equation formulations. The coordinate systems are shown in fig. 1.

Author α: Ph.D. Student, Department of Civil Engineering, Jamia Millia Islamia University, 110025 Maulana Mohammed Ali Jauhar Marg, New Delhi, India. e-mail: es.asadzadeh@gmail.com
Author σ: Professor, Department of Civil Engineering, Jamia Millia Islamia University, 110025 Maulana Mohammed Ali Jauhar Marg, New Delhi, India.

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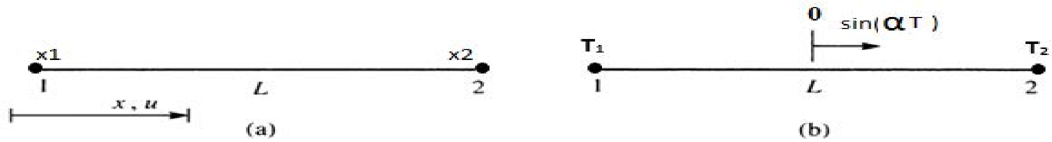

Figure 1 : Bar element in (a) a global coordinate system X and (b) a natural coordinate system T

The natural coordinate system **T** is a dimensionless quantity varying from T_1 to T_2 at node 1 and node 2 respectively. In natural coordinate system the position of any point inside the element is varying by Sin (αT). The natural coordinate system is attached to the element, with the origin located at its center, as shown in Fig. 1(b). The **T** axis needs not be parallel to the **x** axis, this is only for convenience.

For the special case consider a circle of unit radius shown in Fig.2, when the **T** and **x** axes are inside the circle and parallel to each other. The **T** and **x** axes having the origin located at the center of the element are coincided at the center of the circle ($X_c = \frac{x_1+x_2}{2}$). For the special case when α= $\frac{\pi}{2}$ and the $-1 \le T \le 1$ and $-1 \le x \le 1$ the global and natural coordinates can be related by

$$X = X_c + \frac{L}{2}\sin(\frac{\pi}{2}T) \qquad (1)$$

Where X_c is the global coordinate of the element's centroid.

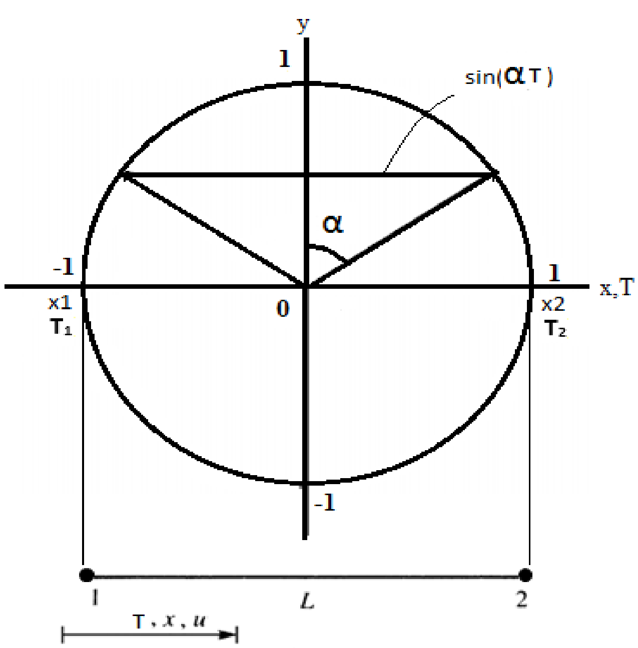

Figure 2 : Transformation mapping of global and natural coordinate system for bar element inside a circle

The displacement function within the bar which relates the displacement at any point inside the element to the nodal displacements is given by

$$U = \sum N_i U_i \qquad (2)$$

The function which relates the coordinate of any point within the element to the global coordinate is given by

$$X = \sum N_i X_i \qquad (3)$$

By using the equation (3) the shape functions have been used for coordinate transformation from natural coordinate system to the global Cartesian system and mapping of the parent element to required shape in global system successfully achieved. This formula is given by Taig [17].

In Eq. (3) the summation is over the number of nodes of the element. N is the shape function, U_i are the nodal displacements and X_i is the coordinates of nodal points of the element. The shape functions are to be expressed in natural coordinate system.

The equations (2) and (3) can be written in matrix form as

$$\{U\} = [N]\ \{U\}_e \qquad (4)$$

$$\{X\} = [N]\ \{X\}_e \qquad (5)$$

Where {U} is vector of displacement at any point, $\{U\}_e$ is vector of nodal displacements, $\{X\}_e$ is the vector of nodal coordinates and {X} is the vector of coordinate of any point in global system.

III. Interpolation Model and Shape Functions for Two Nodded Element

The quality of approximation achieved by Rayleigh–Ritz and FE approaches depends on the admissible assumed trial, field or shape functions. These functions can be chosen in many different ways. The most universally preferred method is the use of simple polynomials. It is also possible to use other functions such as trigonometric functions [18, 19]. While choosing the interpolation model and shape functions, the following considerations have to be taken into account[3, 20].

a) To ensure convergence to the correct result certain simple requirements must be satisfied as following criteria.

Criterion 1. The displacement shape functions chosen should be such that they do not permit straining of an element to occur when the nodal displacements are caused by a rigid body motion.

Criterion 2. The displacement shape functions have to be of such forms that if nodal displacements are compatible with a constant strain condition such constant strain will in fact be obtained.

Criterion 3. The displacement shape functions should be chosen such that the strains at the interface between elements are finite (even though they may be discontinuous).

b) The pattern of variation of the field variable resulting from the interpolation model should be independent of the local coordinate system.

c) The number of generalized coordinates should be equal to the number of nodal degrees of freedom of the element.

The interpolation model of the field variable (displacement model inside the element) in terms of nodal degrees of freedom is given by trigonometric sine function as

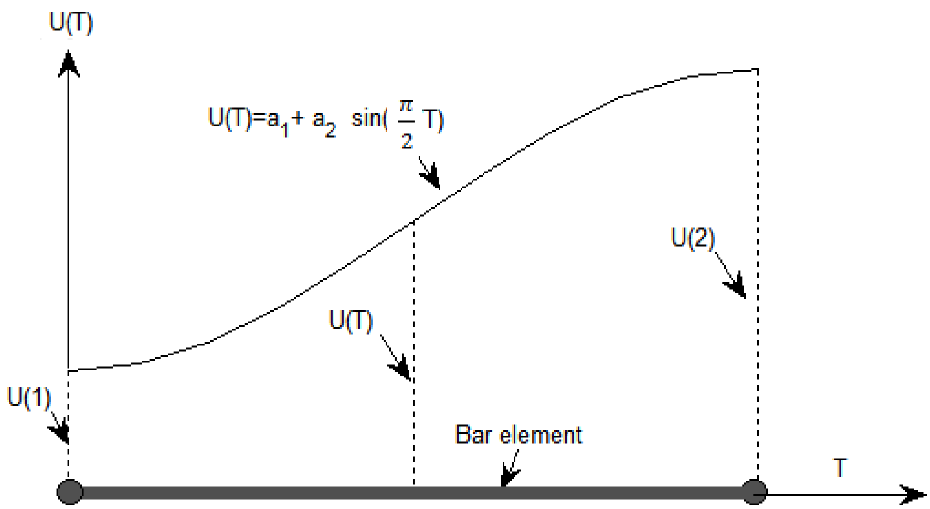

Figure 3 : Two nodded bar element and variation of displacement inside the element in natural coordinate system for $-1 \le T \le 1$

$$U(T) = a_1 + a_n \sin(\tfrac{\pi}{2}T) \quad \text{Where} \quad -1 \le T \le 1 \qquad (6)$$

Where a_1 and a_n, are the coefficients known as generalized coordinates and must be equal to the number of nodal unknowns M. In equation (6), the nodal values of the solution, also known as nodal degrees of freedom, are treated as unknowns in formulating the system or overall equations. To express the interpolation model in terms of the nodal degrees of freedom of a typical finite element **e** having *M* nodes, the values of the field variable at the nodes can be evaluated by substituting the nodal coordinates into the Eq. (6). The Eq. (6) can be expressed in general form of

$$\vec{U}_{(T)} = \vec{\eta}\vec{a} \qquad (7)$$

Where, $\vec{U}_{(T)} = U(T)$,

$$\vec{\eta}^T = \{1 \quad \sin(\tfrac{\pi}{2}T)\} \qquad (8)$$

$$U(1) = a_1 + a_2 \sin(-\frac{\pi}{2})$$

$$U(2) = a_1 + a_2 \sin(\frac{\pi}{2})$$

And, $$\vec{a} = \begin{Bmatrix} a_1 \\ a_2 \end{Bmatrix}$$

The evaluation of equation (7) at the various nodes of element **e** gives

$$\begin{Bmatrix} \vec{U}(at\ node\ 1) \\ \vec{U}(at\ node\ 2) \end{Bmatrix}^{(e)} = \vec{U}^{(e)} = \begin{bmatrix} \vec{\eta}^T(at\ node\ 1) \\ \vec{\eta}^T(at\ node\ 2) \end{bmatrix}\vec{a} \equiv \lfloor \eta \rfloor \vec{a}$$

$$\begin{Bmatrix} \vec{U}(1) \\ \vec{U}(2) \end{Bmatrix}^{(e)} = \vec{U}^{(e)} = \begin{bmatrix} 1 & \sin(-\frac{\pi}{2}) \\ 1 & \sin(\frac{\pi}{2}) \end{bmatrix}\begin{Bmatrix} a_1 \\ a_2 \end{Bmatrix} = \begin{bmatrix} 1 & -1 \\ 1 & 1 \end{bmatrix}\begin{Bmatrix} a_1 \\ a_2 \end{Bmatrix} \equiv \lfloor \eta \rfloor \vec{a} \qquad (9)$$

Where $\vec{U}^{(e)}$ is the vector of nodal values of the field variable corresponding to element **e**, and the square matrix $\lfloor \eta \rfloor$ can be identified from Eq. (9). By inverting Eq. (9), we obtain

$$\vec{a} = [\eta]^{-1}\,\vec{U}^{(e)} \qquad (10)$$

Substituting the Eq. (10) Into Eq. (7) gives

$$\vec{U} = \vec{\eta}^T \vec{a} = \vec{\eta}^T [\eta]^{-1}\,\vec{U}^{(e)} = [N]\vec{U}^{(e)} \qquad (11)$$

$$\text{Thus } [N] = \vec{\eta}^T [\eta]^{-1} \qquad (12)$$

Where, $[N]$is the matrix of interpolation functions or shape functions.

Equation (11) expresses the interpolating function inside any finite element in terms of the nodal unknowns of that element, $\vec{U}^{(e)}$. A major limitation of trigonometric interpolation functions is that one has to invert the matrix $[\eta]$ to find $\vec{U}$, and $[\eta]^{-1}$ may become singular in some cases.

a) Two Nodded Bar Element With Trigonometric Shape Functions

There are two unknowns for two nodded bar element, therefore there must be only two shape functions N_1 and N_2 which are derived by following the foregoing procedure. The shape functions are given as

$$\begin{cases} N_1 = \dfrac{\sin\left(\frac{\pi}{2}\right) - \sin\left(\frac{\pi}{2}T\right)}{\sin\left(\frac{\pi}{2}\right) - \sin\left(-\frac{\pi}{2}\right)} \\ N_2 = \dfrac{\sin\left(\frac{\pi}{2}T\right) - \sin\left(-\frac{\pi}{2}\right)}{\sin\left(\frac{\pi}{2}\right) - \sin\left(-\frac{\pi}{2}\right)} \end{cases} \qquad (13)$$

Therefore, the shape functions are

$$\begin{cases} N_1 = \dfrac{1-\sin\left(\frac{\pi}{2}T\right)}{2} \\ N_2 = \dfrac{\sin\left(\frac{\pi}{2}T\right)+1}{2} \end{cases} \qquad (14)$$

It must be noted that $-1 \le T \le 1$.

The variation of the resulting shape functions are shown in Fig. 4. The essential properties of shape functions are that they must be unity at one node and zero at the other nodes. It can be seen that by shifting the T to T_1 and T_2 we get

$$\begin{cases} At\ node\ 1\ where\ T = T_1 = -1 \\ N_1 = 1 \\ N_2 = 0 \end{cases} \qquad \begin{cases} At\ node\ 2\ where\ T = T_2 = 1 \\ N_1 = 0 \\ N_2 = 1 \end{cases}$$

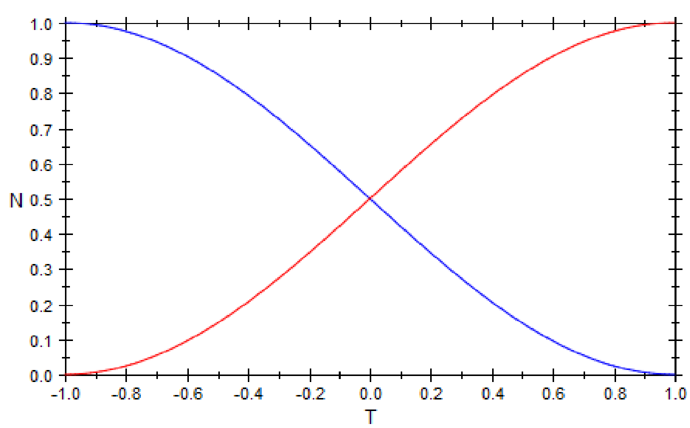

Figure 4 : Variation of shape functions for two nodded bar element

To have the C[0] continuity element the sum of the shape functions must be 1($i.e. \sum N_i = 1$) and the first derivative of the field variable must be zero ($i.e. \sum \frac{\partial N_i}{\partial T} = 0$). As there are two nodal unknowns U_1 and U_2 for node 1 and node 2 respectively, therefore in the natural coordinate system it can be written as

$$U = N_1 \vec{U}_1^e + N_2 \vec{U}_2^e \qquad (15)$$

$$\begin{cases} N_1 + N_2 = 1 \\ \dfrac{1-\sin\left(\frac{\pi}{2}T\right)}{2} + \dfrac{\sin\left(\frac{\pi}{2}T\right)+1}{2} = 1 \end{cases}$$

And

$$\begin{cases} \dfrac{\partial N_i}{\partial T} = \dfrac{\partial N_1}{\partial T} + \dfrac{\partial N_2}{\partial T} = 0 \\ \dfrac{\partial N_i}{\partial T} = \dfrac{-\frac{\pi}{2}\cos(\frac{\pi}{2}T)}{2} + \dfrac{\frac{\pi}{2}\cos(\frac{\pi}{2}T)}{2} = 0 \end{cases}$$

It can be seen that the two essential requirements of the C^0 continuity element are satisfied.

It is of interest to mention that there is clear difference between the interpolation model of the element $\vec{U}_{(T)} = \vec{\eta}\vec{a}$ that applies to the entire element and expresses the variation of the field variable inside the element in terms of the generalized coordinates a_i and the shape function N_i that corresponds to the i^{th} nodal degree of freedom $\vec{U}_i^e$ and only the sum $\sum N_i \vec{U}_i^e$ represents the variation of the field variable inside the element in terms of the nodal degrees of freedom $\vec{U}_i^e$. In fact, the shape function corresponding to the i^{th} nodal degree of freedom N_i assumes a value of 1 at node *i* and 0 at all the other nodes of the element[20].

b) Mapping of the element in global coordinate system

The mapping of the parent element in global coordinate system can be done by using eq. (2) which can be written in matrix form as

$$\{\boldsymbol{X}\} = [N_1 \;\; N_2]\begin{Bmatrix} x_1 \\ x_2 \end{Bmatrix} \tag{16}$$

The trigonometric shape functions in Eq. (14) map the T coordinate of any point in the element to the X coordinate. It is clear that by substituting T= -1 and T=1, we obtain $X=x_1$ and $X=x_2$ respectively.

c) Strain – displacement and stress - strain relationship

To formulate the element strain matrix [B] to evaluate the element stiffness matrix [K] the isoprametric formulation is used. The strain is defined in terms of the natural coordinate system T varying inside the element from the center of the element to -1 or 1. To determine the strain which is the first derivative of the displacement with respect to X the chain rule of the differentiation must be used. This is given as

$$\frac{du}{dT} = \frac{du}{dx}\frac{dx}{dT} \qquad where\; X = X_c + \frac{L}{2}\sin(\frac{\pi}{2}T) \tag{17}$$

Therefore

$$\frac{du}{dx} = \frac{\frac{du}{dT}}{\frac{dx}{dT}}$$

It is clear that $\frac{\partial U}{\partial T} = [\frac{-\frac{\pi}{2}\cos\left(\frac{\pi}{2}T\right)}{2} \;\; \frac{\frac{\pi}{2}\cos\left(\frac{\pi}{2}T\right)}{2}]\begin{bmatrix} U_1 \\ U_2 \end{bmatrix}$ and $\frac{dx}{dT} = \frac{L}{2}\frac{\pi}{2}\cos(\frac{\pi}{2}T)$, therefore the Eq. (17) becomes

$$\epsilon = \frac{du}{dx} = \frac{1}{L}[-1 \;\; 1]\begin{Bmatrix} U_1 \\ U_2 \end{Bmatrix}^{(e)} \tag{18}$$

Strain displacement relation is given as [3]

$$\epsilon = \sum B_i{}^e \vec{U}_i^e \tag{19}$$

Or in matrix form as

$$\{\epsilon\} = [B_i]^e\{U_i\}^e \tag{20}$$

Where, $\{\epsilon\}$ is strain at any point in the element, $\{U_i\}^e$ is displacement vector of nodal values of the element and $[B_i]^e$is strain displacement matrix.

By comparing the Eq. (20) with expression given for the strain in Eq. (18) we have the strain displacement matrix of the bar as

$$[B] = \frac{1}{L}[-1 \quad 1] \tag{21}$$

The essential necessity of liner interpolation functions is that the strain must be constant inside the element for with C^0- continuity. As it can be seen in Eq. (21) the strain is constant and is same as the stain matrix for bar element using the polynomial functions.

The stress strain relation is given by constitutive

$$\{\sigma\} = [D]\{\varepsilon\}^e = [D]\,[B]\{U_i\}^e \tag{22}$$

Where, $\{\sigma\}$ is the stress, $\{\varepsilon\}$ is the strain and $[D]$ is the matrix of constants of elasticity.

The stiffness matrix can be evaluated by using the following equation [16].

$$[k] = \iiint_0^v [B]^T[D][B]\,dV \tag{23}$$

The Eq. (23) can be written in the global coordinate system as

$$[K] = \int_0^L [B]^T[D][B]A\,dx \tag{24}$$

Where A is the cross section area of the bar

The eq. (24) is in terms of the global coordinate system and must be transformed to the natural coordinate system; because matrix [B] is, in general, a function of T. This general type of transformation is given by References [3, 16, and 21]. This can be done by following procedure

We know that $X = X_c + \frac{L}{2}\sin(\frac{\pi}{2}T)$, hence it can be written that

$$\frac{dx}{dT} = \frac{L}{2}\frac{\pi}{2}\cos(\frac{\pi}{2}T) \qquad therefore \qquad \frac{L}{2}\frac{\pi}{2}\cos(\frac{\pi}{2}T)\; dT = dx \tag{25}$$

By inserting Eq. (25) in Eq. (24), we can write the stiffness matrix in global coordinate system as

$$[k]=\int_0^L [B]^T[D][B]A\,\frac{L}{2}\frac{\pi}{2}\cos(\frac{\pi}{2}T)\ dT \qquad (26)$$

Or

$$[k]=\int_0^L [B]^T[D][B]A\left|J\right|\,dT \qquad (27)$$

Where, $\left|J\right| = \frac{dx}{dT} = \frac{\pi}{2}\frac{L}{2}\cos\left(\frac{\pi}{2}T\right)$ is the Jacobian determinant for one dimensional element with trigonometric displacement functions and relates an element length in the global coordinate system to an element length in the natural coordinate system. This is different from the Jacobian determinant for one dimensional element with polynomial displacement function given by $\frac{L}{2}$ but the concept is same.

By inserting the modulus of elasticity E= [D], Eq. (27) becomes

$$[k]=\int_0^L [B]^T\,E\,[B]A\,\frac{L}{2}\frac{\pi}{2}\cos(\frac{\pi}{2}T)\ dT \qquad (28)$$

By substituting the strain displacement matrix given in Eq. (21), the stiffness matrix can be evaluated as

$$[K] = \int_{-1}^{1}\frac{EA}{L^2}\begin{bmatrix}-1\\1\end{bmatrix}\begin{bmatrix}-1 & 1\end{bmatrix}\frac{L}{2}\frac{\pi}{2}\cos(\frac{\pi}{2}T)\,dT = \frac{EA\pi}{4L}\int_{-1}^{1}\begin{bmatrix}-1\\1\end{bmatrix}\begin{bmatrix}-1 & 1\end{bmatrix}\cos(\frac{\pi}{2}T)\,dT$$

Upon integrating we get the stiffness matrix as

$$[K] = \frac{EA}{L}\begin{bmatrix}1 & -1\\-1 & 1\end{bmatrix} \qquad (29)$$

It can be realized that the stiffness matrix is the same as that of given for the two nodded bar element evaluated employing the polynomial functions.

d) Derivation of the system equations in terms of the natural coordinate system

The body and surface forces in terms of the natural coordinate system can be evaluated by the following formulas

$$\{F\}^e = \iiint_V [N]^T[X_b]\,dV - \iint_S [N]^T[T_x]\,dS \qquad (30)$$

Where, $\{F\}^e$ is the consistent load vector, X_b is the body force and T_x is the surface force or the traction force. Eq. (30), is in terms of the global coordinate system and by using the Jacobian determinant can be written in terms of natural coordinate system. For example for a bar having constant cross section it can be written as

$$\{F\}^e = \iiint_V [N]^T[X_b]A\,dx - \iint_S [N]^T[T_x]\,dx \qquad (31)$$

By using the Eq. (25) in the natural coordinate system it can be written as

$$\{F\}^e = \iiint_V [N]^T[X_b]A\,\frac{L\pi}{4}\cos(\frac{\pi}{2}T)\ dT - \iint_S [N]^T[T_x]\,\frac{L\pi}{4}\cos(\frac{\pi}{2}T)\ dT \qquad (32)$$

Where, the product of A and L represents the volume of the element and X_b the body force per unit volume, then $[X_b]A\frac{L\pi}{4}\cos(\frac{\pi}{2}T)$ is the total body force acting on the element and T_x is traction force-per-unit-length, $[T_x]\frac{L\pi}{4}\cos(\frac{\pi}{2}T)$ is now the total traction force.

The element equilibrium equation is

$$[K]\{U\}^e = \{F\}^e \qquad (33)$$

The above equation of equilibrium is to be assembled for entire structure and boundary conditions are to be introduced. Then the solutions of equilibrium equations result into nodal displacements of all the nodal points. Once these basic unknowns are found, then displacement at any point may be obtained by Eq. (11), the strains may be assembled using the Eq. (12) and then stresses also can be found using the Eq. (22).

e) Shifting the domain from $-1 \le T \le 1$ *to* $0 \le T \le 1$

To shift the domain of the trigonometric function successfully from $-1 \le T \le 1$ to $0 \le T \le 1$ we consider a special case when the global coordinate system X and natural coordinate system T coincide and the centre of the circle shown in Fig.2 becomes the origin of the natural coordinate system T. It means that we consider only half of the element length shown in Fig.1. Therefore, the coordinates X and T can be related by

$$X = L\sin(\frac{\pi}{2}T) \qquad (34)$$

The shape functions are given as

$$\begin{cases} N_1 = 1 - \sin\left(\frac{\pi}{2}T\right) \\ N_2 = \sin\left(\frac{\pi}{2}T\right) \end{cases} \qquad (35)$$

The variation of the resulting shape functions are shown in Fig. 5.

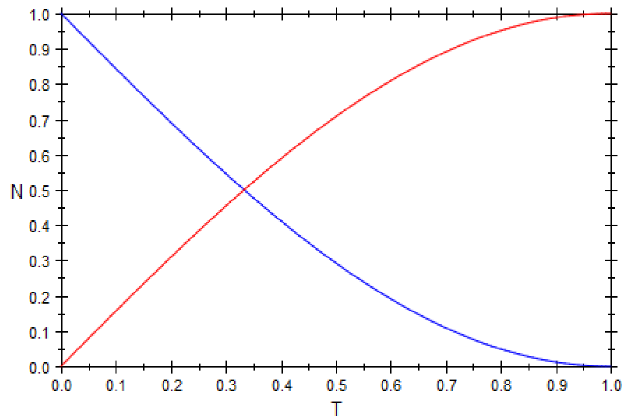

Figure 5 : Variation of shape functions for bar element in natural and global coordinate system

To relate the natural coordinate T (where, $0 \le T \le 1$) and global coordinate X (where, $0 \le x \le 1$) the Jacobian determinant given in Eq. (25) becomes

$$\frac{dx}{dT} = \frac{L\pi}{2}\cos(\frac{\pi}{2}T) \quad therefor \quad \frac{L\pi}{2}\cos(\frac{\pi}{2}T)\ dT = dx \tag{36}$$

The strain displacement matrix [B] will be same as given in Eq. (21) and the stiffness matrix [K] same as Eq. (29). The consistent forces will be as

$$\{F\}^e = \iiint_V [N]^T [X_b] A \frac{L\pi}{2}\cos(\frac{\pi}{2}T)\ dT - \iint_S [N]^T [T_x]\ \frac{L\pi}{2}\cos(\frac{L\pi}{2})\ dT \tag{37}$$

It must be noted that the limits of the integrations will be 0 to 1.

IV. Interpolation Model and Shape Functions for Three Nodded Element

To illustrate the concept of three nodded elements using the trigonometric functions, the element with three coordinates of nodes, x1, x2, and x3, in the global coordinates is shown in Fig. 6. Again the element is considered within a circle of unit radius and the third node is selected at the centre of the circle.

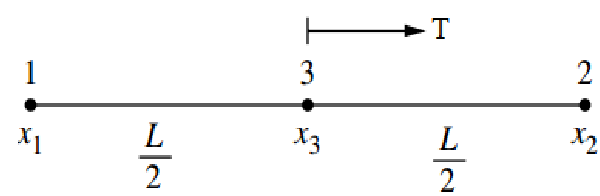

Figure 6 : Three nodded bar element in global coordinate system X

The interpolation model of the field variable (displacement model inside the element) in terms of nodal degrees of freedom is given by trigonometric function as

$$U(T) = a_1 + a_2 \sin\left(\frac{\pi}{2}T\right) + a_3(\sin(\frac{\pi}{2}\mathrm{T}))^2 \quad \text{Where} \quad \begin{cases} \mathrm{T} = -1 & at\ node\ one \\ \mathrm{T} = 1 & at\ node\ two \\ \mathrm{T} = 0 & at\ node\ three \end{cases} \tag{38}$$

Using the displacement field given in Eq. (38), the shape functions are given as

$$\begin{cases} N_1 = \dfrac{(\sin(\frac{\pi}{2}\mathrm{T}))^2 - sin(\frac{\pi}{2}T)}{2} \\ N_2 = \dfrac{(\sin(\frac{\pi}{2}\mathrm{T}))^2 + sin(\frac{\pi}{2}T)}{2} \\ N3 = 1 - (\sin(\frac{\pi}{2}\mathrm{T}))^2 \end{cases} \tag{39}$$

The variation of the resulting shape functions are shown in Fig. 7. The essential properties of shape functions are also satisfied as following

$$\begin{cases} At\ node\ 1\ where\ T=T_1=-1 \\ N_1=1 \\ N_2=0 \\ N_3=0 \end{cases} \begin{cases} At\ node\ 2\ where\ T=T_2=1 \\ N_1=0 \\ N_2=1 \\ N_3=0 \end{cases} \begin{cases} At\ node\ 3\ where\ T=T_3=0 \\ N_1=0 \\ N_2=0 \\ N_3=1 \end{cases}$$

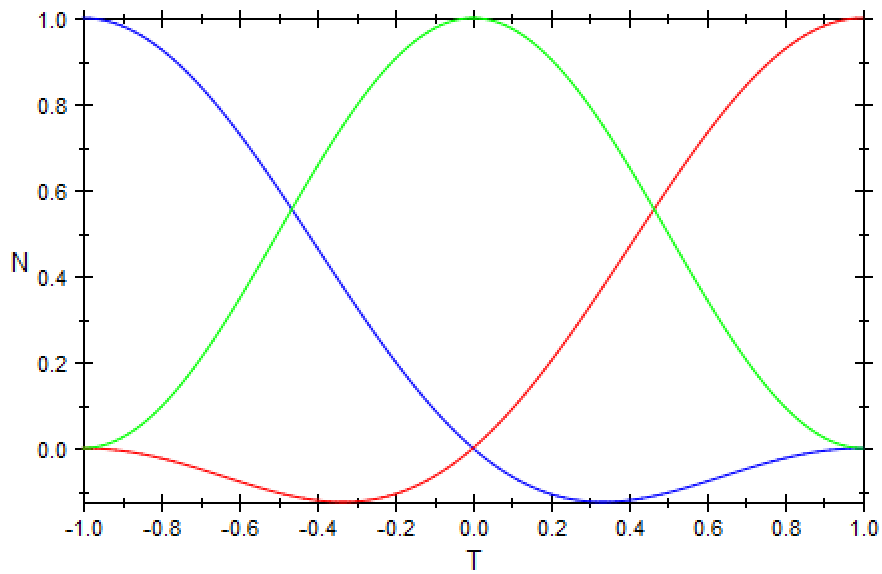

Figure 7 : Variation of shape functions for three nodded bar element

To have the C^0 continuity for three nodded bar element here again $\sum N_i = 1$ and $\sum \frac{\partial N_i}{\partial T} = 0$. As there are three nodal unknowns U_1, U_2 and U_3 for node 1, 2 and node 3 respectively, therefore in the natural coordinate system it can be written as

$$U = N_1\vec{U}_1^e + N_2\vec{U}_2^e + +N_3\vec{U}_3^e \tag{40}$$

$$\begin{cases} N_1+N_2+N_3=1 \\ \frac{(\sin(\frac{\pi}{2}T))^2 - \sin(\frac{\pi}{2}T)}{2} + \frac{(\sin(\frac{\pi}{2}T))^2 + \sin(\frac{\pi}{2}T)}{2} + 1 - (\sin(\frac{\pi}{2}T))^2 = 1 \end{cases}$$

And

$$\begin{cases} \frac{\partial N_i}{\partial T} = \frac{\partial N_1}{\partial T} + \frac{\partial N_2}{\partial T} + \frac{\partial N_3}{\partial T} = 0 \\ \frac{\partial N_i}{\partial T} = \frac{\pi}{2}\cos\left(\frac{\pi}{2}T\right)\sin\left(\frac{\pi}{2}T\right) - \frac{\pi}{4}\cos\left(\frac{\pi}{2}T\right) + \frac{\pi}{2}\cos\left(\frac{\pi}{2}T\right)\sin\left(\frac{\pi}{2}T\right) + \frac{\pi}{4}\cos\left(\frac{\pi}{2}T\right) - \pi\cos\left(\frac{\pi}{2}T\right)\sin\left(\frac{\pi}{2}T\right) = 0 \end{cases}$$

It can be seen that the two essential requirements of the C^0 continuity element are satisfied.

a) Strain – displacement and stress - strain relationship

From our basic definition of axial strain we have

$$\{\epsilon\} = \frac{du}{dx} = \frac{\frac{du}{dT}}{\frac{dx}{dT}} = [B]\begin{Bmatrix} U_1 \\ U_2 \\ U_3 \end{Bmatrix}^{(e)} \tag{41}$$

It has previously proven that $\frac{dx}{dT} = \frac{L\pi}{4}\cos(\frac{\pi}{2}T)$, this relationship holds for the three nodded one-dimensional elements as well as for the two-nodded constant strain bar element. Using this relationship and $\frac{\partial U}{\partial T}$ in Eq. (41), we obtain

$$\frac{du}{dx}=\left[\frac{4}{L\pi cos\left(\frac{\pi}{2}T\right)}\left(\left[\frac{\pi}{2}cos\left(\frac{\pi}{2}T\right)sin\left(\frac{\pi}{2}T\right)-\frac{\pi}{4}cos\left(\frac{\pi}{2}T\right),\quad \frac{\pi}{2}cos\left(\frac{\pi}{2}T\right)sin\left(\frac{\pi}{2}T\right)+\frac{\pi}{4}cos\left(\frac{\pi}{2}T\right),\right.\right.\right.$$
$$\left.\left.\left.-\pi cos\left(\frac{\pi}{2}T\right)sin\left(\frac{\pi}{2}T\right)\right]\right)\right]\begin{Bmatrix}U_1\\U_2\\U_3\end{Bmatrix}^{(e)}$$

Therefore

$$\frac{du}{dx}=\frac{1}{L}\left[2sin\left(\frac{\pi}{2}T\right)-1,\quad 2sin\left(\frac{\pi}{2}T\right)+1,\quad -4sin\left(\frac{\pi}{2}T\right)\right]\begin{Bmatrix}U_1\\U_2\\U_3\end{Bmatrix}^{(e)} \tag{42}$$

By comparing the expression given for the strain in Eq. (41) with Eq. (19), the strain-displacement matrix [B] for the three nodded bar is

$$[B]=\frac{1}{L}\left[2sin\left(\frac{\pi}{2}T\right)-1,\quad 2sin\left(\frac{\pi}{2}T\right)+1,\quad -4sin\left(\frac{\pi}{2}T\right)\right] \tag{43}$$

Substituting the expression for [B] into Eq. (27), the stiffness matrix is obtained as

$$[K]=\int_{-1}^{1}\frac{EA}{L^2}\begin{bmatrix}2sin\left(\frac{\pi}{2}T\right)-1\\2sin\left(\frac{\pi}{2}T\right)+1\\-4sin\left(\frac{\pi}{2}T\right)\end{bmatrix}\left[2sin\left(\frac{\pi}{2}T\right)-1,\quad 2sin\left(\frac{\pi}{2}T\right)+1,\quad -4sin\left(\frac{\pi}{2}T\right)\right]\frac{L\pi}{4}\cos\left(\frac{\pi}{2}T\right)dT$$

$$=\frac{EA}{L}\int_{-1}^{1}\begin{bmatrix}2sin\left(\frac{\pi}{2}T\right)-1\\2sin\left(\frac{\pi}{2}T\right)+1\\-4sin\left(\frac{\pi}{2}T\right)\end{bmatrix}\left[2sin\left(\frac{\pi}{2}T\right)-1,\quad 2sin\left(\frac{\pi}{2}T\right)+1,\quad -4sin\left(\frac{\pi}{2}T\right)\right]\frac{\pi}{4}\cos\left(\frac{\pi}{2}T\right)dT$$

$$=\frac{EA}{L}\int_{-1}^{1}\begin{bmatrix}\left(2sin\left(\frac{\pi}{2}T\right)-1\right)^2 & \left(2sin\left(\frac{\pi}{2}T\right)\right)^2-1 & -8\left(sin\left(\frac{\pi}{2}T\right)\right)^2+4sin\left(\frac{\pi}{2}T\right)\\ \left(2sin\left(\frac{\pi}{2}T\right)\right)^2-1 & \left(2sin\left(\frac{\pi}{2}T\right)+1\right)^2 & -8\left(sin\left(\frac{\pi}{2}T\right)\right)^2-4sin\left(\frac{\pi}{2}T\right)\\ -8\left(sin\left(\frac{\pi}{2}T\right)\right)^2+4sin\left(\frac{\pi}{2}T\right) & -8\left(sin\left(\frac{\pi}{2}T\right)\right)^2-4sin\left(\frac{\pi}{2}T\right) & \left(4sin\left(\frac{\pi}{2}T\right)\right)^2\end{bmatrix}\frac{\pi}{4}\cos\left(\frac{\pi}{2}T\right)dT$$

Integrating the matrix the stiffness matrix for three nodded bar element becomes

$$[K]=\frac{EA}{L}\begin{bmatrix}2.333333 & 0.333333 & -2.666667\\0.333333 & 2.333333 & -2.666667\\-2.666667 & -2.666667 & 5.333333\end{bmatrix} \tag{44}$$

The stiffness matrix given in Eq. (27) is the same as that of given for the three nodded bar elements evaluated using polynomial functions.

Example 1. Analysis of bar of uniform cross section (A), Young's modulus of the material (E) due to self-weight (unit weight,ρ) when held as shown in Fig. 8. Self-weight acting in T direction.

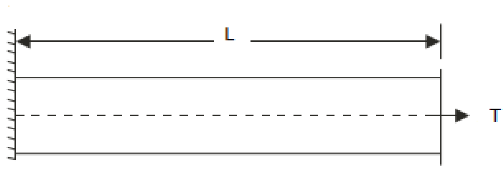

Figure 8 : Bar of constant cross section

By substituting the $\begin{Bmatrix}F_1\\F_2\end{Bmatrix}^{(e)}=\frac{\rho AL}{2}\begin{Bmatrix}1\\1\end{Bmatrix}^{(e)}$ obtained from Eq. (32), and boundary values of $\begin{Bmatrix}0\\U_2\end{Bmatrix}^{(e)}$ in Eq. (33), the extension of the bar evaluated is.

$$U_2=\frac{\rho L^2}{2E} \tag{45}$$

The Eq. (44) is the exact solution [22]. The strain may be evaluated using the Eq. (18) and stress also is found using the Eq. (22) as

$$\varepsilon = \frac{\rho L}{2E} \quad (46)$$

$$\sigma = \frac{\rho L}{2} \quad (47)$$

Equations (45) and (46) are the exact solutions for a bar having constant cross –section due to its own self weight.

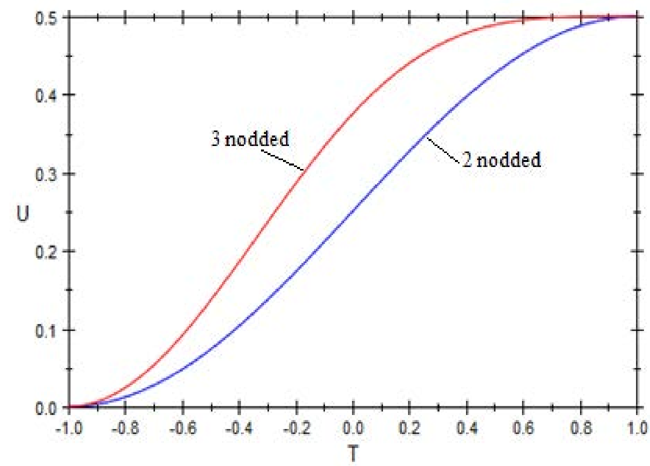

Figure 9 : Displacement of bar due to its self weigh using 2 and 3 nodded element with $-1 \leq T \leq 1$

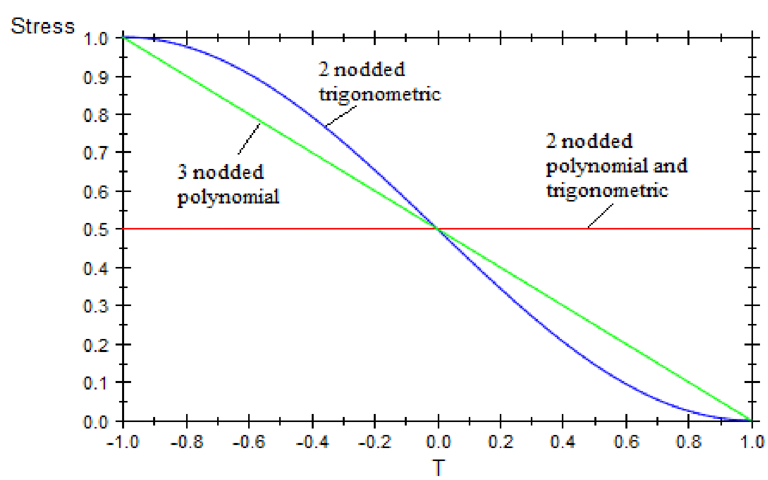

Figure 10 : Stress in the bar due to its self weigh using 2 and 3nodded element with $-1 \leq T \leq 1$

V. Conclusion

Using the trigonometric interpolation model, new family of C^0- continuity elements are introduced. To obtain the constant stress and strain state in 2 nodded elements, trigonometric function is used instead of the polynomial Jacobian determinant to relate the natural and global coordinate system. The bar of uniform cross section is analyzed and results are compared with those of obtained using the polynomial functions.

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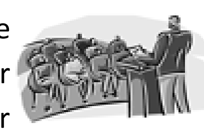

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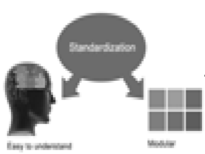

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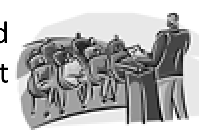

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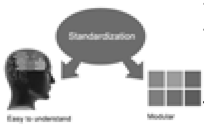

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- One should start brainstorming lists of possible keywords before even begin searching. Think about the most important concepts related to research work. Ask, "What words would a source have to include to be truly valuable in research paper?" Then consider synonyms for the important words.
- It may take the discovery of only one relevant paper to let steer in the right keyword direction because in most databases, the keywords under which a research paper is abstracted are listed with the paper.
- One should avoid outdated words.

Keywords are the key that opens a door to research work sources. Keyword searching is an art in which researcher's skills are bound to improve with experience and time.

Numerical Methods: Numerical methods used should be clear and, where appropriate, supported by references.

Acknowledgements: Please make these as concise as possible.

References

References follow the Harvard scheme of referencing. References in the text should cite the authors' names followed by the time of their publication, unless there are three or more authors when simply the first author's name is quoted followed by et al. unpublished work has to only be cited where necessary, and only in the text. Copies of references in press in other journals have to be supplied with submitted typescripts. It is necessary that all citations and references be carefully checked before submission, as mistakes or omissions will cause delays.

References to information on the World Wide Web can be given, but only if the information is available without charge to readers on an official site. Wikipedia and Similar websites are not allowed where anyone can change the information. Authors will be asked to make available electronic copies of the cited information for inclusion on the Global Journals Inc. (US) homepage at the judgment of the Editorial Board.

The Editorial Board and Global Journals Inc. (US) recommend that, citation of online-published papers and other material should be done via a DOI (digital object identifier). If an author cites anything, which does not have a DOI, they run the risk of the cited material not being noticeable.

The Editorial Board and Global Journals Inc. (US) recommend the use of a tool such as Reference Manager for reference management and formatting.

Tables, Figures and Figure Legends

Tables: Tables should be few in number, cautiously designed, uncrowned, and include only essential data. Each must have an Arabic number, e.g. Table 4, a self-explanatory caption and be on a separate sheet. Vertical lines should not be used.

Figures: Figures are supposed to be submitted as separate files. Always take in a citation in the text for each figure using Arabic numbers, e.g. Fig. 4. Artwork must be submitted online in electronic form by e-mailing them.

Preparation of Electronic Figures for Publication

Even though low quality images are sufficient for review purposes, print publication requires high quality images to prevent the final product being blurred or fuzzy. Submit (or e-mail) EPS (line art) or TIFF (halftone/photographs) files only. MS PowerPoint and Word Graphics are unsuitable for printed pictures. Do not use pixel-oriented software. Scans (TIFF only) should have a resolution of at least 350 dpi (halftone) or 700 to 1100 dpi (line drawings) in relation to the imitation size. Please give the data for figures in black and white or submit a Color Work Agreement Form. EPS files must be saved with fonts embedded (and with a TIFF preview, if possible).

For scanned images, the scanning resolution (at final image size) ought to be as follows to ensure good reproduction: line art: >650 dpi; halftones (including gel photographs) : >350 dpi; figures containing both halftone and line images: >650 dpi.

Figure Legends: Self-explanatory legends of all figures should be incorporated separately under the heading 'Legends to Figures'. In the full-text online edition of the journal, figure legends may possibly be truncated in abbreviated links to the full screen version. Therefore, the first 100 characters of any legend should notify the reader, about the key aspects of the figure.

6. AFTER ACCEPTANCE

Upon approval of a paper for publication, the manuscript will be forwarded to the dean, who is responsible for the publication of the Global Journals Inc. (US).

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Acrobat Reader will be required in order to read this file. This software can be downloaded

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Before start writing a good quality Computer Science Research Paper, let us first understand what is Computer Science Research Paper? So, Computer Science Research Paper is the paper which is written by professionals or scientists who are associated to Computer Science and Information Technology, or doing research study in these areas. If you are novel to this field then you can consult about this field from your supervisor or guide.

TECHNIQUES FOR WRITING A GOOD QUALITY RESEARCH PAPER:

1. Choosing the topic: In most cases, the topic is searched by the interest of author but it can be also suggested by the guides. You can have several topics and then you can judge that in which topic or subject you are finding yourself most comfortable. This can be done by asking several questions to yourself, like Will I be able to carry our search in this area? Will I find all necessary recourses to accomplish the search? Will I be able to find all information in this field area? If the answer of these types of questions will be "Yes" then you can choose that topic. In most of the cases, you may have to conduct the surveys and have to visit several places because this field is related to Computer Science and Information Technology. Also, you may have to do a lot of work to find all rise and falls regarding the various data of that subject. Sometimes, detailed information plays a vital role, instead of short information.

2. Evaluators are human: First thing to remember that evaluators are also human being. They are not only meant for rejecting a paper. They are here to evaluate your paper. So, present your Best.

3. Think Like Evaluators: If you are in a confusion or getting demotivated that your paper will be accepted by evaluators or not, then think and try to evaluate your paper like an Evaluator. Try to understand that what an evaluator wants in your research paper and automatically you will have your answer.

4. Make blueprints of paper: The outline is the plan or framework that will help you to arrange your thoughts. It will make your paper logical. But remember that all points of your outline must be related to the topic you have chosen.

5. Ask your Guides: If you are having any difficulty in your research, then do not hesitate to share your difficulty to your guide (if you have any). They will surely help you out and resolve your doubts. If you can't clarify what exactly you require for your work then ask the supervisor to help you with the alternative. He might also provide you the list of essential readings.

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8. Use the Internet for help: An excellent start for your paper can be by using the Google. It is an excellent search engine, where you can have your doubts resolved. You may also read some answers for the frequent question how to write my research paper or find model research paper. From the internet library you can download books. If you have all required books make important reading selecting and analyzing the specified information. Then put together research paper sketch out.

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10. Bookmarks are useful: When you read any book or magazine, you generally use bookmarks, right! It is a good habit, which helps to not to lose your continuity. You should always use bookmarks while searching on Internet also, which will make your search easier.

11. Revise what you wrote: When you write anything, always read it, summarize it and then finalize it.

12. Make all efforts: Make all efforts to mention what you are going to write in your paper. That means always have a good start. Try to mention everything in introduction, that what is the need of a particular research paper. Polish your work by good skill of writing and always give an evaluator, what he wants.

13. Have backups: When you are going to do any important thing like making research paper, you should always have backup copies of it either in your computer or in paper. This will help you to not to lose any of your important.

14. Produce good diagrams of your own: Always try to include good charts or diagrams in your paper to improve quality. Using several and unnecessary diagrams will degrade the quality of your paper by creating "hotchpotch." So always, try to make and include those diagrams, which are made by your own to improve readability and understandability of your paper.

15. Use of direct quotes: When you do research relevant to literature, history or current affairs then use of quotes become essential but if study is relevant to science then use of quotes is not preferable.

16. Use proper verb tense: Use proper verb tenses in your paper. Use past tense, to present those events that happened. Use present tense to indicate events that are going on. Use future tense to indicate future happening events. Use of improper and wrong tenses will confuse the evaluator. Avoid the sentences that are incomplete.

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18. Pick a good study spot: To do your research studies always try to pick a spot, which is quiet. Every spot is not for studies. Spot that suits you choose it and proceed further.

19. Know what you know: Always try to know, what you know by making objectives. Else, you will be confused and cannot achieve your target.

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21. Arrangement of information: Each section of the main body should start with an opening sentence and there should be a changeover at the end of the section. Give only valid and powerful arguments to your topic. You may also maintain your arguments with records.

22. Never start in last minute: Always start at right time and give enough time to research work. Leaving everything to the last minute will degrade your paper and spoil your work.

23. Multitasking in research is not good: Doing several things at the same time proves bad habit in case of research activity. Research is an area, where everything has a particular time slot. Divide your research work in parts and do particular part in particular time slot.

24. Never copy others' work: Never copy others' work and give it your name because if evaluator has seen it anywhere you will be in trouble.

25. Take proper rest and food: No matter how many hours you spend for your research activity, if you are not taking care of your health then all your efforts will be in vain. For a quality research, study is must, and this can be done by taking proper rest and food.

26. Go for seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.

27. Refresh your mind after intervals: Try to give rest to your mind by listening to soft music or by sleeping in intervals. This will also improve your memory.

28. Make colleagues: Always try to make colleagues. No matter how sharper or intelligent you are, if you make colleagues you can have several ideas, which will be helpful for your research.

29. Think technically: Always think technically. If anything happens, then search its reasons, its benefits, and demerits.

30. Think and then print: When you will go to print your paper, notice that tables are not be split, headings are not detached from their descriptions, and page sequence is maintained.

31. Adding unnecessary information: Do not add unnecessary information, like, I have used MS Excel to draw graph. Do not add irrelevant and inappropriate material. These all will create superfluous. Foreign terminology and phrases are not apropos. One should NEVER take a broad view. Analogy in script is like feathers on a snake. Not at all use a large word when a very small one would be sufficient. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Amplification is a billion times of inferior quality than sarcasm.

32. Never oversimplify everything: To add material in your research paper, never go for oversimplification. This will definitely irritate the evaluator. Be more or less specific. Also too, by no means, ever use rhythmic redundancies. Contractions aren't essential and shouldn't be there used. Comparisons are as terrible as clichés. Give up ampersands and abbreviations, and so on. Remove commas, that are, not necessary. Parenthetical words however should be together with this in commas. Understatement is all the time the complete best way to put onward earth-shaking thoughts. Give a detailed literary review.

33. Report concluded results: Use concluded results. From raw data, filter the results and then conclude your studies based on measurements and observations taken. Significant figures and appropriate number of decimal places should be used. Parenthetical remarks are prohibitive. Proofread carefully at final stage. In the end give outline to your arguments. Spot out perspectives of further study of this subject. Justify your conclusion by at the bottom of them with sufficient justifications and examples.

34. After conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print to the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects in your research.

Informal Guidelines of Research Paper Writing

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form, which is presented in the guidelines using the template.
- Please note the criterion for grading the final paper by peer-reviewers.

Final Points:

A purpose of organizing a research paper is to let people to interpret your effort selectively. The journal requires the following sections, submitted in the order listed, each section to start on a new page.

The introduction will be compiled from reference matter and will reflect the design processes or outline of basis that direct you to make study. As you will carry out the process of study, the method and process section will be constructed as like that. The result segment will show related statistics in nearly sequential order and will direct the reviewers next to the similar intellectual paths throughout the data that you took to carry out your study. The discussion section will provide understanding of the data and projections as to the implication of the results. The use of good quality references all through the paper will give the effort trustworthiness by representing an alertness of prior workings.

Writing a research paper is not an easy job no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record keeping are the only means to make straightforward the progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear

· Adhere to recommended page limits

Mistakes to evade

- Insertion a title at the foot of a page with the subsequent text on the next page
- Separating a table/chart or figure - impound each figure/table to a single page
- Submitting a manuscript with pages out of sequence

In every sections of your document

· Use standard writing style including articles ("a", "the," etc.)

· Keep on paying attention on the research topic of the paper

· Use paragraphs to split each significant point (excluding for the abstract)

· Align the primary line of each section

· Present your points in sound order

· Use present tense to report well accepted

· Use past tense to describe specific results

· Shun familiar wording, don't address the reviewer directly, and don't use slang, slang language, or superlatives

· Shun use of extra pictures - include only those figures essential to presenting results

Title Page:

Choose a revealing title. It should be short. It should not have non-standard acronyms or abbreviations. It should not exceed two printed lines. It should include the name(s) and address (es) of all authors.

Abstract:

The summary should be two hundred words or less. It should briefly and clearly explain the key findings reported in the manuscript--must have precise statistics. It should not have abnormal acronyms or abbreviations. It should be logical in itself. Shun citing references at this point.

An abstract is a brief distinct paragraph summary of finished work or work in development. In a minute or less a reviewer can be taught the foundation behind the study, common approach to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Yet, use comprehensive sentences and do not let go readability for briefness. You can maintain it succinct by phrasing sentences so that they provide more than lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study, with the subsequent elements in any summary. Try to maintain the initial two items to no more than one ruling each.

- Reason of the study - theory, overall issue, purpose
- Fundamental goal
- To the point depiction of the research
- Consequences, including definite statistics - if the consequences are quantitative in nature, account quantitative data; results of any numerical analysis should be reported
- Significant conclusions or questions that track from the research(es)

Approach:

- Single section, and succinct
- As a outline of job done, it is always written in past tense
- A conceptual should situate on its own, and not submit to any other part of the paper such as a form or table
- Center on shortening results - bound background information to a verdict or two, if completely necessary
- What you account in an conceptual must be regular with what you reported in the manuscript
- Exact spelling, clearness of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else

Introduction:

The **Introduction** should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable to comprehend and calculate the purpose of your study without having to submit to other works. The basis for the study should be offered. Give most important references but shun difficult to make a comprehensive appraisal of the topic. In the introduction, describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will have no attention in your result. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here. Following approach can create a valuable beginning:

- Explain the value (significance) of the study
- Shield the model - why did you employ this particular system or method? What is its compensation? You strength remark on its appropriateness from a abstract point of vision as well as point out sensible reasons for using it.
- Present a justification. Status your particular theory (es) or aim(s), and describe the logic that led you to choose them.
- Very for a short time explain the tentative propose and how it skilled the declared objectives.

Approach:

- Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done.
- Sort out your thoughts; manufacture one key point with every section. If you make the four points listed above, you will need a least of four paragraphs.

- Present surroundings information only as desirable in order hold up a situation. The reviewer does not desire to read the whole thing you know about a topic.
- Shape the theory/purpose specifically - do not take a broad view.
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This part is supposed to be the easiest to carve if you have good skills. A sound written Procedures segment allows a capable scientist to replacement your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt for the least amount of information that would permit another capable scientist to spare your outcome but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section. When a technique is used that has been well described in another object, mention the specific item describing a way but draw the basic principle while stating the situation. The purpose is to text all particular resources and broad procedures, so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step by step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

- Explain materials individually only if the study is so complex that it saves liberty this way.
- Embrace particular materials, and any tools or provisions that are not frequently found in laboratories.
- Do not take in frequently found.
- If use of a definite type of tools.
- Materials may be reported in a part section or else they may be recognized along with your measures.

Methods:

- Report the method (not particulars of each process that engaged the same methodology)
- Describe the method entirely
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures
- Simplify - details how procedures were completed not how they were exclusively performed on a particular day.
- If well known procedures were used, account the procedure by name, possibly with reference, and that's all.

Approach:

- It is embarrassed or not possible to use vigorous voice when documenting methods with no using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result when script up the methods most authors use third person passive voice.
- Use standard style in this and in every other part of the paper - avoid familiar lists, and use full sentences.

What to keep away from

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings - save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part a entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently.You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.

Content

- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
- In manuscript, explain each of your consequences, point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation an exacting study.
- Explain results of control experiments and comprise remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or in manuscript form.

What to stay away from

- Do not discuss or infer your outcome, report surroundings information, or try to explain anything.
- Not at all, take in raw data or intermediate calculations in a research manuscript.
- Do not present the similar data more than once.
- Manuscript should complement any figures or tables, not duplicate the identical information.
- Never confuse figures with tables - there is a difference.

Approach

- As forever, use past tense when you submit to your results, and put the whole thing in a reasonable order.
- Put figures and tables, appropriately numbered, in order at the end of the report
- If you desire, you may place your figures and tables properly within the text of your results part.

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- If you put figures and tables at the end of the details, make certain that they are visibly distinguished from any attach appendix materials, such as raw facts
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- In spite of position, each table must be titled, numbered one after the other and complete with heading
- All figure and table must be adequately complete that it could situate on its own, divide from text

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The Discussion is expected the trickiest segment to write and describe. A lot of papers submitted for journal are discarded based on problems with the Discussion. There is no head of state for how long a argument should be. Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implication of the study. The purpose here is to offer an understanding of your results and hold up for all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of result should be visibly described. Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved with prospect, and let it drop at that.

- Make a decision if each premise is supported, discarded, or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."
- Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work
- You may propose future guidelines, such as how the experiment might be personalized to accomplish a new idea.
- Give details all of your remarks as much as possible, focus on mechanisms.
- Make a decision if the tentative design sufficiently addressed the theory, and whether or not it was correctly restricted.
- Try to present substitute explanations if sensible alternatives be present.
- One research will not counter an overall question, so maintain the large picture in mind, where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

- When you refer to information, differentiate data generated by your own studies from available information
- Submit to work done by specific persons (including you) in past tense.
- Submit to generally acknowledged facts and main beliefs in present tense.

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Topics	Grades		
	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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