

Flexible Work Arrangements Availability and their Relationship with Work- Family- Conflict: The Moderating Effect of Employment Nature and Job Status

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Abstract

The present study has explored the moderating effects of employment nature and job status on the relation between Flexible Work Arrangements (FWAs) and Work-Family-Conflict (WFC). Cross-sectional survey research design has been used and a structured self-administered survey questionnaire used to collect data from 330 employees working on private and public organizations in Bangladesh. Different statistical measures such as descriptive statistics, zero order correlation, Ordinary Least Square (OLS) multiple regression analysis, interaction regression and F-test for model fit were used to explore research observations and statistical verification of findings. The findings of this research is FWA is negatively related with WFC { $B = -0.408$, $t(2.311) = -5.07$, $p < .000$ } and also cause to reduce WFC ($\beta = -0.283$). On the other hand, employment nature and job status have moderating effect on FWAs and WFC. The most consistent finding in this regard suggests that FWAs is a more powerful mechanism for private organization employees with greater job responsibilities than employees (with less responsibility at work) in government organizations.

Keywords: Employment Nature, Flexible Work Arrangements, Flexible Policies, Job Status and Work-Family-Conflict.

1. Introduction

Work-Family-Conflict (WFC) has turn into an imperative issue in modern organizations. An employee has both work and family lives which have started to overlap and hence, disturbing each other due to one's heavy commitments at work. Organizational structures/ policies/ practices regarding employee's time, efforts, priorities and attractions etc. to be competitive in this ever changing world. Officially, employees in Bangladesh are usually required to work six to eight hours in a working day, but excessive workload and career pressure force them to stay for extra time in office or take away the official work to home. So, there might be a disparity between work life and family life which is the cause of WFC. Over the time, researchers suggest different measures to minimize such disparity and conflict. Today, organizations are increasingly researching and adopting different work-family programs, such as Flexible Work Arrangements (FWA), management and supervisory supports as a reaction to socio-demographic changes take place (Davis & Polonko, 2001; Golden, 2006; Goodstein, 1994). According to Allen, Johnson, Kiburz & Shockle (2013), FWAs are the important measures that help to mitigate this disparity between job and family roles. Further, Allen et al. (2013) observed that among various organizational policies and FWAs in particular have been touted as key to help employees' manage work and non-work responsibilities. In connection to this research, WFC is defined as a form of inter-role conflict in which role pressures from the work and family domains are mutually mismatched in some respects (Greenhaus & Beutell, 1985, p. 77). On the other hand, Dunham, Pierce & Castaneda (1987); Hill, Miller, Weiner & Colihan, (1998) have explored in their empirical investigations that FWAs initiatives have little or no influence on employees' nature and personal attitudes. Though, there are many different moderators of these relationships (Jacob, Allen, Hill, & Mead, 2008). In this study, the researchers tested different forms of FWAs (e.g., availability and use) and their relationships with directionality of WFC to mitigate the disparity between work life and family life considering employment nature and job status. However, the specific objectives of this research are

First, the researchers explore the relationship of different forms of FWAs to directionality of WFC.

Second, the researchers look at the moderating effect of four level of job status (e.g., managers, officers, academicians and professionals) and two level of employment nature (private and public) on WFC, considering FWAs.

2. Literature Review

In recent years, FWAs policies have received a great deal of attention from both the practitioners and researchers as a tool to helping individuals manage work and family responsibilities (Hill & Civian, 2008; Hammer, Neal, Newsom, Brockwood, & Colton, 2005). The study of FWAs and their effects in employees' work and personal life have been well recognized (Hayman, 2009). Researchers and practitioners, over the period have found difference positive and in some cases controversial relationships between FWAs and WFC. For instance, previous research (Kossek, Lautsch & Eaton, 2006; Saltzstein, Ting & Saltzstein, 2001) examined the impact of FWAs on employee behavior and observed that FWAs positively influence the work and non-work employee attitudes, such as, work life balance and job satisfaction; and negatively influence the ones that are associated with WFC. FWAs and WFC are burning researchable issue but most of the studies on FWAs and WFC have been conducted based on western samples (individualistic orientation) assuming the homogeneity in terms of legal and cultural characteristics (Poelmans & Sahibzada, 2004, p. 413). The research conducted by western perspective has considered flexibility in when (schedule flexibility, flextime, compacted work weeks, and so forth) and where employees take part in business related assignments, for example, flex-place, working from home, virtual office and portability, and so on, crosswise over nations in predicting WFC (Allen et al., 2013; Hill, Erickson, Holmes & Ferris, 2010). In this exploration, the sample is taken from Bangladeshi personnel (collectivism orientation or cooperation introduction) viewed flexibility as when and where to work. According to Robbins, Judge, & Vohra (2014) Bangladesh is a collectivistic country with masculinity dominance. Further, western researches have not explored how these types of flexibility interact with employment nature and job status to predict the direction specific WFC together. Here, the researchers find a research gap and decide to conduct this study.

2.1. Research hypothesis

2.1.1. Flexible Work Arrangement and Direction of Work- Family –Conflict

FWAs help individuals to manage work and family responsibilities (Edwards & Rothbard, 2000) and consequently reduce WFCs. Researchers have investigated the relationship between FWA and WFC (Allen & Shockley, 2006; Allen & Shockley, 2009), whereas others have found no relationship between WFAs and WFC (e.g., Anderson, Coffey, & Byerly, 2002). The relationship between FWAs and the two directions of WFC are likely to differ (Allen et al., 2013; Frone, Russell & Cooper, 1992; Frone, Yardley & Markel, 1997). From the previous literatures, the researchers pose the following hypotheses:

H₁: Flexible Work Arrangements (FWAs) and Work-Family-Conflict (WFC) are negatively related.

H₂: Flexible Work Arrangements (FWAs) are cause to reduce Work-Family-Conflict (WFC).

2.1.2. Demographic Moderators (Employment Nature and Job Status)

Bangladesh is a collectivism oriented developing country (Robbins et al., 2014) having strong social supports and cultural bonding which are totally different from western developed countries (individualistic orientation). In Bangladesh, there is a huge gap in employees of public and private organizations in terms of job security, time stress, duty stress, role overload and bringing office work at home. Employee's responsibility at government organization is much more flexible in compare to working at private ownership business organization. Regarding job status, it is generally assumed the managerial job is more stressful than any other positions, like, officer, academician and professional. Thus, we expect these two independent variables employment nature and job status likely to moderate the relationship of FWAs and WFC. Based on the above discussion, we put forward the following hypothesis:

H₃: Employment nature (private and public) moderates the relationship between Flexible Work Arrangements (FWAs) and Work-Family-Conflict (WFC).

H₄: Job status (managers, officers, academician and professionals) moderates the relationship between FWAs and WFC.

3. Method

This research is an exploratory and empirical in nature, based on both primary and secondary data sources. Different published articles, Human Resource Management (HRM) books, and web addresses have used to construct review of literatures and questionnaire. Primary data, on the other hand was collected through a structured close ended questionnaire packages consisting of respondent's demographic information and research specific information. Questionnaires were developed in both English and Bengali language. Here, FWAs variables are taken as independent variables and WFC as dependent variables. A convenience sampling method was used in this study. The questionnaire, at first time was administered to 20 employees of private and public organizations as a pilot study to pretest the validity of all questions. Results have showed good consistency except minor change. On the basis of pilot study's feedback, the final questionnaire was modified and finalized to collect primary data. 400 survey questionnaires were distributed, 345 were returned representing an effective response rate of 86.25 %. However, 15 filled questionnaires were discarded because the respondents served either inconsistent information or missing data. This study was based on 330 full time employees. The independent and dependent variables related questions were rated by Five-Point "Likert Type" Scale. Data analysis are carried out with the use of SPSS 17.5 version software. Statistical methods like demographic analysis, descriptive statistics, Zero Order Pearson Correlation, Ordinary least square (OLS) multiple regression, and ANOVA have been used in this research. In addition to the univariate checks on the data, residual plots were used to assess the assumptions of normality, linearity, and homoscedacity. There was no evidence in the plots that the assumptions were violated. An assessment of collinearity also indicated no multicollinearity (VIF less than 2 in all cases) or singularity.

4. Result and Discussion

4.1. Demographic Statistics

A demographic statistics was performed to know the general socio-demographic characteristics of the respondent's gender, age distribution, marital status, education level, position and working experience. The sample was 70% males and 30% females with an average age

(40 years), experience (14 years) and income Tk. 46,950 respectively for males and; average age (36 years), experience (10 years) and income Tk. 28,650 for females. The maximum year of age was 77 for males and 62 for females. Maximum respondents have either one or two children. In the sample, 60% respondents live with extended family i.e., having aged dependent care and 40% live as nuclear family; 45% working at government organizations and 55% working at private organizations. In addition, 14% work as managers, 49% as officers, 20 % as professionals and remaining 17% employed as academicians.

4.2. Inferential Statistics

A series of statistical techniques like Zero Order Pearson Correlation, Ordinary Least Square (OLS) multiple regression, and ANOVA table were used to analyze the data and to make prediction. Ordinary Least Square (OLS) regression analysis was conducted to determine impact of FWAs on WFC. Reliability analysis via Cronbach’s alpha were used to measure constructs with multiple indicator variables as well as the internal consistency of variables because Cronbach's Alpha α value (≤ 0.5).

Table 1: Descriptive Statistics and Correlations among all Study Variables

	Mean	SD	1	2	3	4	5	6
1. Time Based WFC	3.35	.950	1					
2. Strain Based WFC	2.25	.847	.186**	1				
3. Flexible Work Arrangements	2.85	.656	-.260**	.209**	1			
4. Flextime Availability	3.10	.757	-.213**	.157**	.664**	1		
5. Flex-place Availability	2.60	.977	-.202**	.155**	.813**	.103	1	
6. Family Flex Arrangements	3.36	.636	.066	-.063	.121*	.257**	-.039	1

The descriptive statistics and correlations of all studied variables are visualized in Table 1. Employees in Bangladesh have faced time based WFC (mean 3.35) and other forms of conflicts have not significantly appeared. Since time based WFC is common, employees tried to get flextime availability (3.10) than Flex-place availability (2.60). Further, on an average Bangladeshi employees perceived more enjoyment of Family Flexible Arrangements (FWA) (3.36) over work FWA (2.85). This is because of collectivistic cultural orientation. According to zero order correlation, time based WFC is negatively correlated with all forms of flexibility arrangements and strain based WFC is only negatively correlated with FFA although it was insignificant. Further, FWA is positively associated with flexible flexi time availability and flexi place availability.

Table 2: Regression effect of FWAs on WFC

Model: OLS Multiple Regression	Coefficients		W-F-C	
	B	Beta	t	Sig.
Flexible Work Arrangement	-.408	-.283	-5.08	.000**

R²= .084; Adj.R²= .077 F= 13.58 (.000**)
 * Effect size is significant at .05% level; ** Effect size is significant at .01% level
 a. Predictors: (Constant),Flexible Work Arrangements
 b. Dependent Variable: Time Based WFC

4.3. Flexibility Arrangements and Work family Conflict

Table 2 reports results of the regressions testing hypothesis 1 and hypothesis 2 The entire model predicted time-based WFC, F (2. 311) = 13.58 (.000**), R²= .084. The results of regression showed effect sizes and all criterion variables are significant predictors to WFC. FWA is negatively related with WFC {B= -0.408, t (2.311) =-5.07, p<.000}. Thus, **H₁** is accepted that means Flexible Work Arrangements (FWAs) and Work-Family-Conflict (WFC) are negatively related. Again, FWAs are related to reduce WFC ($\beta = - 0.283$). Thus, **H₂** is accepted that means Flexible Work Arrangements (FWAs) are cause to reduce Work-Family-Conflict (WFC).

Table 3: Moderating effects of Employment Type on the relation between FWA and WFC

Model Summary: R ² = .073; Adj.R ² = .064; F= 7.874, (.000***)					
	Work Family Conflict (WFC)				
	B	Std. Error	Beta	t	Sig.
(Constant)	3.330	.831		4.009	.000
Flexible Work Arrangement	-.448	.100	-.310	-4.470	.000**
Employment Nature	.686	.486	.358	1.412	.159
FWA*Employment Nature	-.175	.166	-.326	-1.056	.022*

Effect size is- *significant at .05% level; ** significant at .01% level
 Predictors: (Constant), FWA*Employment Nature, Flexible Work Arrangement (FWA), Employment Nature.
 Dependent Variable: Time Based WFC

4.4. Moderating Effects of Employment Nature

Table 3 explains the moderating effects of FWAs on WFC. The moderated multiple regression analysis examines the moderating effects of FWAs on the relationship between WFC and employment nature. The results showed that interaction between FWAs and types employment is significant, {B= -0.175, t(3.310)= -1.056, p<.022} in predicting WFC. The direction of interaction slope or coefficient is negative indicating FWAs to reduce WFC but it varies depending on the types of employment nature (government employment and private employment).

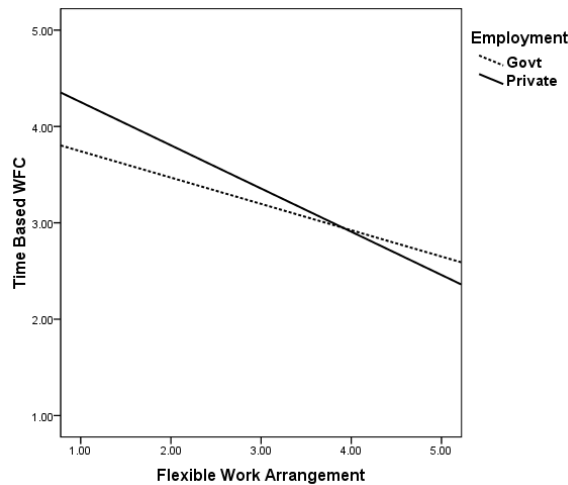


Fig. 1: Moderating Effects of Employment

The figure shows WFC is decreasing with the raise of FWAs. The effect of FWAs for government employee and private employee is not same. Having no or little flexibility, the experiences of the employees of private organizations are more reflections of WFC than the employees of government organizations. With the increase of flexibility, WFC is reduced for both types of employments. The moderating figure also reveals that FWAs reduced WFC more for private employment than government. Thus, flexibility arrangement policy is more effective for people working at private organizations than the people working at government organizations. Thus, H_3 is accepted that means employment nature (private and public) moderates the relationship between Flexible Work Arrangements (FWAs) and Work-Family-Conflict (WFC).

Table 4: Moderating effects of Job Status on the relationship between WFC

Model: OLS Multiple Regression (WFC on FWA)	Coefficients		W-F-C	
	B	Beta	T	Sig.
FWA	.151	.101	1.778	.076*
Job Status	-.014	-.016	-.279	.780
FWA*Job Status	-.093	-.260	-4.488	.000**

R2= .073; Adj.R2= .064, F= 7.874, (.000***)
 Effect size is- *significant at .05% level; ** significant at .01% level
 a. Dependent Variable: Time Based Work Family Conflict; Strain based Family Work conflict

4.5. Moderation Effects of Job Status

The moderating effects presented in Table 4 are significant to WFC, B= -0.039, t (3,310) = -4.488, p<.000, and insignificant to FWC. Since interaction effect is significant, as per principle of marginality, there is no need to explain main effect(s). The interaction effect explains that employees’ job titles moderate the relationships of FWAs and WFC.

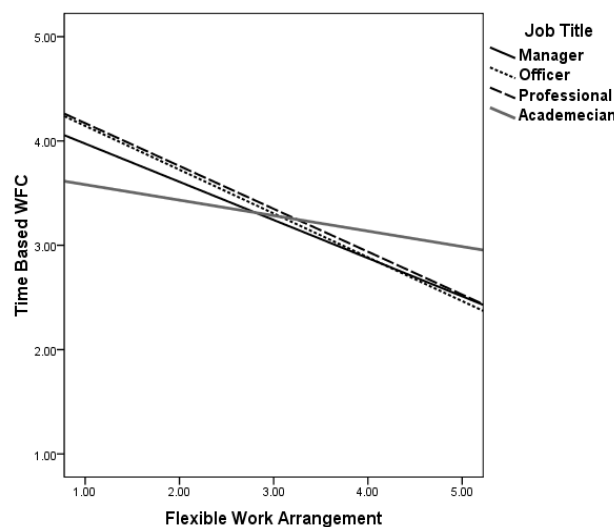


Fig. 2: FWA and WFC Moderated by Job Status

The interaction patterns and Hypothesis 4(b) can be clearly explained with the help of interaction chart presents in figure no. 2. FWA reduces WFC but the effects are dependent on different job status. The experience of reducing WFC of academician is different from manager, officer and professional with the increase of FWA. And there are no apparent differences among managers, officers and professionals in reducing work family conflict against FWAs. Thus H_4 is partially accepted means Job status (managers, officers, academician and professionals) moderates the relationship between FWAs and WFC and FWAs policy is no more significant for managers in mitigat-

ing WFC with the increase of FWAs. Academicians, on the other hand, have showed little change of WFC against FWAs, but people with other job status have shown visible decrease.

5. Contribution to Practitioners and Policy Makers

This paper is an empirical study to explore the moderating effects of employment nature and job status on the relation between Flexible Work Arrangements (FWAs) and Work-Family-Conflict (WFC). Depending on the findings of our research, private employees' and managers would be benefited more from FWAs as a resource than those who assume less job responsibility, such as, government employees and any professional other than the managers and FWAs are more powerful mechanisms for private organization employees with greater job responsibilities and they may stand to benefit more from FWAs than people (with less responsibility at work) in government organizations. Jobs status does not make a sensible effect in taking advantage more from FWAs among managers, officers and professionals, yet these individuals get more benefit by FWA in contrast with academicians. In future, if any private or public organization want to arrange FWAs policy for their employees they can use the findings of this research. Apart from, practitioners and policy makers can use any findings while preparing FWAs which will help to reduce WFC.

6. Limitations and Suggestions for Future Research

The researchers acknowledge some limitations associated with our research study. One limitation is the nature of picking up respondents as sample because the study did not include blue color employees, though majority of employees usually come from this section. It would be better to include both white color and blue color people to assess the flexibility requirements and effects of WFC. In this study, we have used cross-sectional design procedures which limit the ability to make causal assertions regarding the nature of relationships observed. As a result the directions of the relationship between FWAs (use v/s availability) and domain specific WFC in particular is uncertain to the effect that individuals who use FWAs may be those who begin with greater WFC. So we may suggest little regarding the strength of the implementation of these practices and their causal relationships. Future researches may be called to use longitudinal study and focus on the dynamic nature of relationships between FWA and WFC. Previous longitudinal studies investigating FWAs use over time have found that the benefits from flexible work arrangements diminish over time (Baltes et al., 1999). A well-planned longitudinal research can better address the issue of causality. Finally, the study fails to show spillover effects of FWA on WFC and its different outcomes. Future research will focus on the issue. In spite of the limitations of this study, our findings pertain to relationship of FWAs. Not only that, this study also shows the moderating effects of employment nature and job status on the relation between Flexible Work Arrangements (FWAs) and Work-Family-Conflict (WFC).

7. Conclusion

The pressure from both work domain and family domain are incompatible and consequently turn out WFC and FWC. All forms of conflicts are dysfunctional for productivity, good organizational citizenship, personal life and family life. A number of mechanisms have been being adopted to reduce work interference to family and family interference to work. Among those policies, FWAs are being continuously tested over several decades as mitigating factors of WFC. Advancing our understanding of the relationship between WFC and FWAs, this study has important implications on both theory and practice. Our study demonstrated the significant relationships between flexible work arrangement and WFC, though the magnitudes were smaller than assumed. This study also examines how employment nature and job status moderate the relationships. FWAs are helpful to reduce WFC. Flexibility availability is more prevalence to WFC than flexibility use. FWAs are more effective to private employment in comparison to government employment. FWAs mechanisms assist manager, officer and professional more to control WFC and less effective for academicians.

References

- [1] Allen, T. D., & Shockley, K. (2006). Flexible work arrangements: Help or hype? Paper presented at the Families and Health Conference, Provo, Utah.
- [2] Allen, T.D., & Shockley, K.M. (2009). Flexible work arrangements: Help or hype? In D.R. Crane & E. J. Hill (Eds.), *Handbook of Families and Work: Interdisciplinary Perspectives*, Lanham, MD: University Press of America, 265–284.
- [3] Allen, T. D., Johnson, R. C., Kiburz, K. M., & Shockley, K. M. (2013). Work–family conflict and flexible work arrangements: Deconstructing flexibility, the study of people at work. *Personnel Psychology*, 66, 345-376. doi: 10.1111/peps.12012
- [4] Anderson, S. E., Coffey, B. S., & Byerly, R. T. (2002). Formal organizational initiatives and informal workplace practice: Links to work–family conflict and job-related outcomes. *Journal of Management*, 173, 1–24.
- [5] Coakes, S.J., & Steed, L.G. (2001). *SPSS: Analysis without anguish*. Sydney, Australia: John Wiley & Sons.
- [6] Davis, D.D., & Polonko, K.A. (2001). *Telework in the United States: Telework America Survey 2001*. <http://www.workingfromanywhere.org/telework/twa2001.htm>.
- [7] Dunham, R.B., Pierce, J.L., & Castaneda, M.B. (1987). Alternative work schedules: Two field quasi-experiments. *Personnel Psychology*, 40, 215–242.
- [8] Edwards, J.R., & Rothbard, N.P. (2000). Mechanisms linking work and family: Clarifying the relationship between work and family constructs. *Academy of Management Review*, 25(1), 179–199.
- [9] Frone, M.R., Russell, M., & Cooper, M.L. (1992). Prevalence of work-family conflict: Are work and family boundaries asymmetrically permeable? *Journal of Organizational Behavior*, 13(7), 723–729.
- [10] Frone, M.R., Yardley, J.K., & Markel, K.S. (1997). Developing and testing an integrative model of the work-family interface. *Journal of Vocational Behavior*, 50(2), 145–167.
- [11] Golden, T.D., (2006). Avoiding depletion in virtual work: Teleworking and the intervening impact of work exhaustion on commitment and turnover intentions. *Journal of Vocational Behavior*, 69, 176–187.
- [12] Goodstein, J.D., (1994). Institutional pressures and strategic responsiveness: Employer involvement in work–family issues. *Academy of Management Journal*, 37, 350–382.

- Greenhaus, J., & Beutell, N. (1985). Sources of conflict between work and family roles. *Academy of Management Review*, 10, 76 – 88.
- [13] Hammer LB, Neal MB, Newsom JT, Brockwood KJ, Colton CL. (2005). A longitudinal study of the effects of dual-earner couples' utilization of family-friendly workplace supports on work and family outcomes. *Journal of Applied Psychology*, 90(4), 799–810.
- [14] Hayman, J.R., (2009). Flexible work arrangements: exploring the linkages between perceived usability of flexible work schedules and work/life balance. *Community, Work & Family*, 12, (3), 327-338.
- [15] Hill, E. J., & Civian, J. T. (Eds.). (2008). Investigating workplace flexibility using a multi-organization database: A collaboration of academics and practitioners [Special issue]. *Community, Work, and Family*, 11, 1–242. doi:10.1080/13668800802172576.
- [16] Hill, E.J., Erickson, J.J., Holmes, E.K., & Ferris, M. (2010). Workplace Flexibility, Work Hours, and Work-Life Conflict: Finding an Extra Day or Two. *Journal of Family Psychology*, 24(3), 349358. doi: 10.1037/a0019282.
- [17] Hill, J.E., Miller, B.C., Weiner, S.P., & Colihan, J. (1998). Influences of the virtual office on aspects of work and work/life balance. *Personnel Psychology*, 51(3), 667-683.
- [18] Jacob, J., Allen, S. M., Hill, E. J., & Mead, N. L. (2008). Work interference with dinnertime as a mediator and moderator between work hours and work and family outcomes. *Family and Consumer Sciences Research Journal*, 36, 310 –327. doi:10.1177/1077727X08316025.
- [19] Kossek, E.E., Lautsch, B.A., & Eaton, S.C. (2006). Telecommuting, control, and boundary management: Correlates of policy use and practice, job control, and work family effectiveness. *Journal of Vocational Behaviour*, 68(2), 347-367.
- [20] Poelmans, S.A.Y., & Sahibzada, K. (2004). A multi-level model for studying the context and impact of work–family policies and culture in organizations. *Human Resource Management Review*, 14, 409–431.
- [21] Robbins, S. P., Judge, T.A., & Vohra, N. (2014). *Organizational Behavior*, 15th Edition, Pearson Education, Inc.
- [22] Saltzstein, A.L., Ting, Y., & Saltzstein, G. (2001). Work family balance and job satisfaction: The
- [23] impact of family-friendly policies on attitudes of government employees. *Public Administrative Review*, 61(4), 452-467.
- [24] Tabachnick, B.G., & Fidell, L.S. (2001). *Using multivariate statistics* (4). Needham Heights, MA: Allyn & Bacon. Chen. T. & Dai. L. (2013). Carbon nanomaterials for highperformance supercapacitors. *Materials Today*. Volume 16, Numbers 7/8
- [25] Conway, B.E. (1999). *Electrochemical Supercapacitor : Scientific Fundamentals and Technological Applications*. New York: Kluwer Academic-Plenum Publisher
- [26] Gedam, S.K., et al. (2013). *Development of Solid Proton Conductors Based On Doped Polyvinyl alcohol*. India: Department of Physics RTM Nagpur University
- [27] Kumar V. & Bhardwaj. N. (2013). Introduction to Supercapacitors and Supercapacitor Assisted Engine Starting System. *International Journal of Scientific & Engineering Research*, Volume 4, Issue 8
- [28] Pandolfo, A.G. & Hollenkamp, A.F. (2006). *Carbon Properties and Their Role In Supercapacitor*. Australia : CSIRO Division of Energy Technology
- [29] Senoz. E & Wool. RP. (2010). Microporous carbon-nitrogen fibers from keratin fibers by pyrolysis. *J Appl Polym Sci*. 118
- [30] Senoz. E. & Wool. RP. (2011). Hydrogen storage on pyrolyzed chicken feather fibers. *International Journal of Hydrogen energy*
- [31] Varade. V., et al. (2013). Probing disorder and transport properties in polypyrrole thin-film devices by impedance and Raman spectroscopy. *J. Phys. D: Appl. Phys.* 46
- [32] Williams, C.M., et al. (1991). Evaluation of a Bacterial Feather Fermentation Product, Feather Fermentation Product, Feather-Lysate, as a Feed Protein. *Poultry Sci.* 70:85-94
- [33] Xia et al. (2012). Hydrothermal synthesis of MnO₂/CNT nanocomposite with a CNT core/porous MnO₂ sheath hierarchy architecture for supercapacitors. *Nanoscale Research Letters*. 7:33.
- [34] Yin, Y. (2010). *An Experimental Study on PEO Polymer Electrolyte Based All-Solid-State Supercapacitor*. Open Access Dissertations. Paper 440
- [35] Yoo, J.J., et al. (2011). Ultrathin Planar Graphene Supercapacitors. *Nano Lett.* 11, 1423-1427