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Relationship of Cash Conversion Cycle with Firm Size, Working Capital Approaches and Firm's Profitability: A Case of Pakistani Industries

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Abstract

This study is aims to analyze the comparative performance management of different industrial groups at single time scale from multiple perspectives. The study investigates the relationship between the length of Cash Conversion Cycle CCC, firm size, firm profitability and aggressive/conservative Working Capital policies of 12 industrial groups. Descriptive analysis, Pearson correlation and Analysis of Variance (ANOVA) with post-hoc test (Least Significant Differences) have been used for empirical investigation. The data was collected from the financial statements of the 157 public limited companies listed in the Karachi Stock Exchange (KSE) for the year 2009. It was found that significant differences lie among the mean values of CCC across the Industries and more specifically, Oil and Gas industry is significantly different from all the other industries in term of its length of CCC. Findings of the study show that there is a significant and positive relationship between firms' aggressive investing policies and conservative financing policies. It is concluded that length of CCC has negative relationship with sales revenue, return on equity (ROE) and financing policies of the firms and has positive

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relationship with total assets, return on assets (ROA) and investing policies of firms. The practical implications of this study are for the management of the firms to consider the importance of the length of CCC in formulating their policies because the length of CCC is closely related to aggressive/conservative Working Capital approaches of firms. This is the first study of its nature conducted in Pakistan so far which has taken into account all these variables simultaneously and tried to investigate their relationship with each other.

Keywords: CCC, Working Capital approaches, Firm size and profitability, Pakistan

1. INTRODUCTION

The working capital management was traditionally a less focused topic in financial management literature. The focus of research is particularly on examining investments, capital structure, dividends or company valuation decisions, risk and return, among other topics. However, current assets and liabilities are important components of total assets and play a crucial role in success of a firm. Working Capital Management, also referred as liquidity management demands a careful attention since it plays a three dimensional role in firms profitability, risk, and its value (Smith, 1980). In a typical manufacturing company currents assets accounts for over half of its total assets, and accounts for even more in a distribution company. An excessive level of current assets leads to idle funds, non-profitable for business, poor ROI, and Credit worthiness suffers on one hand and due to low rate of return on investments, the market value of shares may fall on other hand. However, firms having fewer current assets may have to find external financing to pay of its short term debts, and may find difficulties in maintaining smooth operations.

There are two basic ways to assess the working capital management of firms, one is by following balance sheet concept and studying current assets and current liabilities; the other is to approach the concept of working capital management from point of view of Cash Conversion Cycle (CCC). The CCC measures the number of days between actual cash expenditures on purchase of raw materials and actual cash receipts from the sale of products or services (Eljelly, 2004). The traditional balance sheet measures of liquidity as Current Ratio and quick ratio are useful to analyze liquidity but CCC in a dynamic measure of ongoing liquidity management that uses both balance sheet as well as income statement data combined with time dimension (Jose et al., 1996). The length of CCC differs from one firm to another and from one industry to another. To measure the performance of CCC and to assess improvement opportunities firms not only analyze its own CCC but also consider the industry benchmarks (Hutchison et al., 2007).

A firm may use aggressive working capital financing policy with a high level of current liabilities as percentage of total liabilities and owner's equity; moreover, an aggressive working capital management policy may also be used by employing a low level of current assets as a percentage of total assets. Current assets are considered an important and crucial component of total assets of a firm. Investment in fixed assets is reduced by leasing or renting plant, buildings, transportation equipment, and machinery but this type of policy cannot work to finance working capital.

The impact of length of CCC and working capital policies is highly important; however, less empirical research has been carried out to examine the relationship between Length of CCC and working capital policies and their relationship with profitability and size of firm in Pakistan. This study contributes to better understanding of the length of the CCC of Pakistani manufacturing and merchandising companies listed on Karachi Stock Exchange (KSE). Also, the study provides an empirical evaluation of the relationship among aggressive and conservative working capital investment and financing polices and there relation with CCC, firm size, and profitability. Following are the main objectives of the present study:

- To investigate whether there is significant difference across industries with respect to length of CCC, and working capital policies.
- To analyze the relationship of between working capital policies among firms and see whether an aggressive policy go together with aggressive financing policy.
- To analyze the relationship of working capital policies with length of CCC.
- To analyze the relationship of working capital policies and length of CCC with firms profitability and size.

2. LITERATURE REVIEW

Management of Working capital is crucial for all businesses, no matter what the size of the firm is and the industry in which it operates. Because, it means managing the assets and liabilities in such a way so that a firm has no difficulty in paying off its short term debts. So, if a firm fails to manage its working capital properly it would need additional funds to pay off its short term liabilities and those additional funds must have some cost associated with them. Therefore it can be concluded from above discussion that liquidity management is as important as profitability for an ongoing concern.

In finance literature the researchers approaches Working Capital management from two distinct aspects: static or dynamic views (Moss and Stine, 1993; Lancaster *et al.*, 1999; and Farris and Hutchison, 2002). The static view of Liquidity analysis measures liquidity at a given point in time, on the contrary ongoing liquidity of firm's operations is measured by dynamic view. As a dynamic measure of liquidity Cash Conversion Cycle is used that measure cash outflow and cash inflow in days for a given period of time. Using static view researchers used traditional ratios calculated from balance sheet e.g. current and quick ratio and analyzed the working capital management and financing policies. In a study on retail firms, Moss and Stine (1993) showed that the firm size has a significant negative relationship with CCC i.e. larger the size of the firm shorter is the CC and vice versa. They also found a significant positive relation between length of the CCC and current and quick ratios. In another study conducted on non-financial firms of Istanbul Stock Exchange (ISE) Uyar A. (2009) found a significant negative relationship between the length of CCC and firm size and its profitability.

A significant negative relationship between the profitability and length of CCC was found in empirical studies conducted to examine the liquidity profitability tradeoff (Jose *et al.* 1996; Eljelly, 2004; Sen and Oruc, 2009). In another study of two thousand public limited firms by Hutchison *et al.* (2007) showed a positive relation between shorter CCC and higher profitability. In study conducted by Khan, Hijazi, and Kamal (2006) on Pakistani listed companies found that firm's profitability is negatively related to day's inventory outstanding, days' payable outstanding and CCC. Shah and Sana (2006) found a significant negative relation between CCC and gross profit margin in their study on the impact of working capital on profitability in Pakistani Oil & Gas sector.

The other issue examined in the present study is the relative aggressiveness in the policies of working capital management. Weinraub and Visscher (1998) studied 10 different industrial groups over a 10 year period to examine the relative relationship between aggressive and conservative working capital practices. Results show that there is a significant difference among industries with respect to aggressiveness of working capital management policies. The interesting finding of the study is that there is a significant negative correlation among current asset investment and financing policies. Relatively aggressive current assets financing policy is balanced with a relatively conservative working capital financial policy. The conservative working capital policies are found to be associated with lower levels of risk and return and vice versa (Carpenter and Johnson 1983, Gardner et al. 1986, Weinraub and Visscher 1998, Afza and Nazir 2008).

In their study on seventeen industrial groups of Karachi Stock Exchange Afza and Nazir (2007) found that working capital investment and financing policies are significantly different across different industries and an aggressive investment policy is associated with aggressive financing policy. They also found a negative relation between degree of aggressiveness of investment and financing policies with firm's profitability.

In the light of the above discussion, the present study expects negative relationship between length of CCC and profitability and a positive relationship between the degree of aggressiveness and the profitability of the firms. The main hypotheses to be tested in this study are as follows:

H_1 = There are no differences among the length of cash conversion cycle of firms across different industries

H_2 = There are no differences among the working capital investment policies of firms across different industries

H_3 = There are no differences among the working capital financing policies of firms across different industries

H_4 = An aggressive investment working capital policy is not accompanied by a aggressive financing policy

H_5 = There is no relationship between CCC and firms profitability

H_6 = There is no relationship between CCC and firm size.

3. DATA AND METHODOLOGY

The current study is based on the secondary data collected from the financial statements of 157 non-financial companies comprising of 12 industrial groups listed on the Karachi Stock Exchange, Pakistan for the year 2009. The firms with negative equity and profitability were excluded from the study. The study investigates the relationship between the length of CCC, firm size, firm profitability and aggressive/conservative Working Capital policies of 12 industrial groups. The hypotheses are formulated to test the relationship of CCC with working capital policies, firm size and profitability. Descriptive analysis, Pearson correlation and Analysis of Variance (ANOVA) with post-hoc test (Least Significant Differences) have been used for empirical investigation. Among these variables, sale and total assets are used as a measure of firm size, account receivable days, inventory days, and account payable days are the measures of firm's cash conversion cycle and return on equity and return on asset are used as a measure of firm's profitability. On the other hand current asset ratio shows the liquidity position of the firms. The working capital policies of the firm are classified as working capital investing policy and working capital financing policy.

Working capital investing policy:

The firm's working capital investing policy may be aggressive or conservative. The working capital investing policy of the firm is the ratio of the total current asset to its total assets. The degree of aggressiveness depends on the strength of the ratio. If this ratio is lower, it means firm has adopted aggressive investment policy and utilizes less proportion of liquid assets or keeps low amount of cash in hand and if the ratio of current asset to total asset is higher, it will indicate the conservative investment policy of the firm.

$$INV = \frac{\text{Total Current Assets}}{\text{Total Assets}}$$

Where INV means working capital investment policy of the firm

Working capital financing policy:

On the other hand the working capital financing policy of the firm is the ratio of firm's current liabilities to its total assets. If the ratio of total current liabilities to total assets high, it means that the firm is following an aggressive financing policy and vice versa. In aggressive financing policy, the firm uses more portions of current liabilities and fewer portions of long term debts.

$$FIN = \frac{\text{Total Current Liabilities}}{\text{Total Assets}}$$

Where FIN means working capital financing policy of the firm

The working capital management policy of the firms has been analyzed on the single time scale for the year 2009. Correlation matrix has also been developed to see the strength of relationship among the working capital management policies, ROA and ROE (measures of profitability), firms' size and CCC of the firms. The significance level of Pearson's correlation coefficients was analyzed at 0.05 and 0.01.

5. EMPIRICAL ANALYSIS

a) Descriptive Analysis

Table-1 shows the descriptive analysis of different industries of Pakistan analyzed in this study. The results of the descriptive analysis include mean values of Total Assets, Sales Revenue, Account Receivable Days (ARD), Inventory Days (IND), Account Payable Days (APD), Cash

Conversion Cycle (CCC), Investing Policy (INV), Financing Policy (FIN), Return on Assets (ROA), Return on Equity (ROE) and Current Asset Ratios (CAR) of 12 industries of Pakistan. The mean values of assets and sales (in PKR) of 12 industries are 13,693,364 and 16,866,730 respectively. The mean value of CCC is 65.525 days for all the industries and from these mean values inventory turnover is greater than the mean values of sales outstanding and account payable days. By analyzing the mean values of CCC in all the industries individually, it was found that Oil & Gas have negative CCC which means that the industry is very much efficient by collecting its receivables from customers before paying to suppliers but this policy of strict collection and relax payments is not always sustainable. The CCC of Electricity is almost 29 and is the second shortest CCC among the list of twelve industries considered in this study. These shortest mean values of Oil & Gas and electricity are followed by cement, Industrial Engineering, automobile, Chemical, Food, Cotton Yarn, Spinning, Textile, household goods and personal goods. The CCC mean value of Personal Goods is 145.821 which is the highest among all the industries.

The greater mean value of CCC shows that companies producing household goods fail to shorten their CCC. This highest CCC shows that these companies store their inventory for longer time period with an average of 161.044 days and take more time in the collection of payments from their customers with an average of 37.807 days. But in this case the average collection days of personal goods industry are higher than their average payment days to suppliers. The resultant of highest CCC of this industry is only due to the high inventory days. This analysis indicates that personal goods industry has difficult time in Pakistan and need to revise its business policies.

The mean values of the firms' investment policies and financing policies indicate that on an average firms follow an aggressive investment policies and conservative financing policies. As the average ratio of total current assets to total assets of these 12 industrial groups is below 0.5 which shows that firms follow an aggressive investment policies while the ratio of total current liabilities to total assets which is also below 0.5 shows that firms are following conservative financing policies. The mean values of ROA and ROE indicate that on average industries have very low 0.005 returns on assets and negative growth rate. The average ROE of 12 industrial groups is -0.044 which means firms are facing serious growth problems and have very low returns on investment.

b) ANOVA Results

The results of analysis of variance will help to test the hypotheses which are used to explain the relationship CCC with working capital management policies, firm size and profitability.

Hypothesis 1:

There are no differences among the length of cash conversion cycle of firms across different industries

In order to test the first hypothesis and to investigate whether the industries significantly differ from each other in terms of size of CCC, one-way ANOVA analysis with test of Least Significant Differences (LSD) from Post-Hoc tests was conducted. On the basis of results of one-way ANOVA with resulting value of F-test 2.327 that is significant at 5% level as shown in the Table-2. The hypothesis is rejected and it is concluded that significant differences exist among industries in terms of their Length of CCC. To find out where these differences exist the post hoc test of Least Significant differences is conducted that shows that oil and gas industry differs significantly from all other industries. Furthermore, the results also indicate that significant differences lie among the personal goods, cement, electricity and industrial engineering.

Hypothesis 2:

There are no differences among the working capital investment policies of firms across different industries

One-way ANOVA has also been applied to test our second hypothesis. To test the relative degree of degree of aggressive/conservative investment policies among industries one-way ANOVA with post hoc test of Least Significant Differences (LSD) is conducted and results are presented in table 3. The resulting value of F-test in table-3 is 4.624 Significant at 5% shows that significant differences exist among industries in terms of their working capital Investment policies. To find out where these differences exist, a post hoc Least Significant Difference (LSD) test has also been applied to compare the industry mean values of investment policies on a paired sample basis. Out of 66 pairs 26 differs from each other at 5% level of significance. So, on the basis of above results the hypothesis is rejected and it is concluded that there are significant differences among industries in terms of their working capital investment policies.

Hypothesis 3:

There are no differences among the working capital financing policies of firms across different industries

Again to test the relative degree of aggressive/conservative financing policies among industries and our third hypothesis, one-way ANOVA with post hoc test of Least Significant Differences (LSD) was conducted and results are presented in table-4. The resulting value of F-test is 1.241 which is Significant at 5% shows that significant differences exist among industries in terms of their working capital financing policies. To find out where these differences exist a post hoc Least Significant Difference (LSD) test was also applied to compare the industry mean values of financing policies on a paired sample basis. Out of 66 pairs 5 differs from each other at 5% level of significance. Therefore on the basis of above results this hypothesis is also rejected and it is concluded that again significant differences exist among industries in terms of their working capital financing policies.

c) Correlation Results

Correlation matrix was constructed to investigate the relationship between Cash Conversion Cycle, Profitability measures, Current Asset Ratio, total assets, sales revenue and industries investing and financing policies and to test our hypothesis from 4 to 6.

Hypothesis 4:

An aggressive investment working capital policy is not accompanied by a aggressive financing policy

The results of correlation matrix in table-5 show that there is a significant positive relationship between the ratio of TCA/TA (INV) and TCL/TA (FIN) at 1% level of significance, which means higher current asset to total assets ratio is accompanied with higher Current liabilities to total assets ratio. So, this hypothesis cannot be rejected because on the basis of correlation results lower the INV ratios (means aggressive working capital investment policy) lower the FIN ratio (Means conservative working capital financing policy). This result contradicts with the finding of Afza and Nazir (2008) in which they concluded that an aggressive WCM investment policy is accompanied with an aggressive WCM financing Policy.

Hypothesis 5:

There is no relationship between firms' CCC and profitability

It is obvious from table-6 the regression results that ROA is one the determinants of CCC at 1% significant level. ROA and CCC are positively related with each other. Therefore on the basis of regression results we can conclude that profitability is one of the determinants of CCC, hence hypothesis 5 is rejected. This result is in accordance with the findings of Uyar A. (2009), who also found a significant but negative relationship between the length of CCC and Firms' profitability (ROA). So it can be concluded that firms having more profitable operations tend to have shorter longer CCC to maintain their profit levels.

Hypothesis 6:

There is no relationship between CCC and firm size.

From the regression results presented in table-6, it is obvious that firm size measured by natural log of sales has no significant relationship with CCC. This result contradicts with that of Uyar A. (2009), who found a significant negative relationship between the length of CCC and Firms' Size.

Apart from this it is obvious from the regression results that both working capital investment and financing policies have significant relationship with CCC. Working capital investment policy has a significant positive relationship with CCC at 1% level, which means firms having an aggressive working capital investment policy tends to have shorter CCC and vice versa. Working capital investment policy has a significant negative relationship with CCC at 1% level of significant. Which means firms have an aggressive working capital investment policy also tend to have shorter CCC and vice versa.

6. CONCLUSION

The present study, conducted on listed companies of Karachi Stock Exchange (KSE), presents the average values of CCC, the TCA/TA ratio, and TCL/TA ratios. It is concluded that there exist a significant difference among the industries with respect CCC, INV policy and FIN policy. The results of the study show that oil and gas industry have shortest CCC and it differs significantly from all other industries. Other important finding with respect to CCC is that the Personal Goods sector has the longest CCC. The present study also investigates the relative relationship between the working capital investment and financing policies for twelve different industrial sectors and found that industries differ significantly with respect to their working capital investment and financing policies. The positive and significant correlation between the investment and financing policies for industries indicate that industries which pursue aggressive investment working capital policies tend to follow conservative working capital financing policies. These results are consistent with that of findings of Weinraub and Visscher (1998) that showed a negative correlation between the asset management policies and financing policies.

Moreover, it is found that there exist a significant negative relationship between the firm size (measured by Total Assets) and the length of CCC. Hence it is concluded that large firms have shorter CCC and vice versa. This finding is consistent with that of Moss and Stine (1993) and Uyar A. (2009). Finally, another important finding of this study is that there is a significant negative relationship between the length of CCC and firm size. This means that firms with longer CCC have earned less profits and vice versa. This result is also consistent with that of Uyar A. (2009) who also found a negative relationship between the length of CCC and firm Size.

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Table: 1. Descriptive Analysis of Twelve Industrial Groups in Terms of Their CCC, Size, WCM Policies and Profitability

Industry	Total assets	Sales	ARD	IND	APD	CCC	INV	FIN	ROA	ROE
Automobile	4125998	6319557	67.153	101.718	104.451	64.420	0.659	0.485	-0.012	0.022
Cement	19570577	9492166	13.311	117.146	93.512	36.945	0.200	0.293	0.034	0.056
Chemical	2059906	1935423	67.453	90.501	83.600	74.353	0.548	0.406	0.043	0.045
Textile	3409958	3003359	39.804	103.590	55.453	87.941	0.404	0.479	-0.044	-0.146
Personal Goods	6634314	6029609	37.807	161.044	53.029	145.821	0.522	0.413	0.045	0.070
Cotton Yarn	2113948	2241775	20.757	104.198	48.627	76.328	0.377	0.473	-0.183	-0.163
Spinning	3010584	2846079	26.634	104.595	47.902	83.327	0.442	0.516	-0.034	-1.445
Electricity	43628012	31184299	112.178	45.304	128.483	28.999	0.369	0.363	0.018	0.448
Food	1454134	1842495	28.467	90.095	43.752	74.810	0.543	0.317	0.049	0.193
Industrial Engineering	2497337	2648669	50.334	154.919	157.858	47.395	0.580	0.505	-0.016	-0.033
Oil & Gas	70906881	131013240	90.467	63.248	205.081	-51.367	0.639	0.562	0.014	0.029
Household Goods	4908721	3844094	67.392	113.813	63.870	117.335	0.547	0.389	0.147	0.400
Average	**13693364**	**16866730**	**51.813**	**104.181**	**90.468**	**65.525**	**0.486**	**0.433**	**0.005**	**-0.044**

Table: 2. Result of ANOVA (F-Test) and Test of Least Significant Differences (LSD) for Cash Conversion Cycle (CCC)

F-Statistics = 2.327

Industries	Automobile	cement	chemical	textile	personal goods	cotton yarn	spinning	electricity	food	industrial engineering	oil & gas
cement	0.564										
chemical	0.825	0.37									
textile	0.536	0.136	0.653								
personal goods	0.123	0.03*	0.132	0.156							
cotton yarn	0.791	0.345	0.959	0.701	0.143						
spinning	0.659	0.24	0.804	0.864	0.168	0.846					
electricity	0.469	0.863	0.294	0.102	0.023*	0.273	0.186				
food	0.823	0.384	0.991	0.687	0.147	0.97	0.823	0.308			
industrial engineering	0.715	0.81	0.505	0.214	0.045*	0.475	0.346	0.682	0.517		
oil & gas	0.016*	0.049*	0.003*	0*	0*	0.003*	0.001*	0.082	0.004*	0.024*	
household goods	0.34	0.129	0.393	0.506	0.619	0.415	0.483	0.103	0.412	0.178	0.002*

*. The mean difference is significant at the 0.05 level

Table: 3. Result of ANOVA (F-Test) and Test of Least Significant Differences (LSD) for Investment Policy of the Industries

F-Statistics = 4.620

Industries	Automobile	cement	chemical	textile	personal goods	cotton yarn	spinning	electricity	food	industrial engineering	oil & gas
cement	.45894*										
chemical	0.1111	-.34785*									
textile	.25507*	-.20387*	.14397*								
personal goods	0.13683	-.32211*	0.02573	-0.11824							
cotton yarn	.28256*	-.17638*	.17146*	0.02749	0.14573						
spinning	.21704*	-.24190*	0.10594	-0.03803	0.08021	-0.06552					
electricity	.29075*	-0.1682	.17965*	0.03568	0.15392	0.00819	0.07371				
food	0.11606	-.34288*	0.00496	-.13901*	-0.02077	-.16650*	-0.10098	-0.17468			
industrial engineering	0.07924	-.37971*	-0.03186	-.17583*	-0.05759	-.20332*	-0.13781	-.21151*	-0.03683		
oil & gas	0.02015	-.43880*	-0.09095	-.23492*	-0.11668	-.26241*	-.19690*	-.27060*	-0.09592	-0.05909	
household goods	0.11254	-.34640*	0.00144	-0.14253	-0.02429	-0.17002	-0.1045	-0.17821	-0.00352	0.0333	0.09239

*. The mean difference is significant at the 0.05 level.

Table: 4. Result of ANOVA (F-Test) and Test of Least Significant Differences (LSD) for Financing Policy of the Industries

F-Statistics = 1.241

Industries	Automobile	cement	chemical	textile	personal goods	cotton yarn	spinning	electricity	food	Indus. engineering	oil & gas
cement	0.19177										
chemical	0.07846	-0.1133									
textile	0.00598	-.18579*	-0.07248								
personal goods	0.07203	-0.1197	-0.00643	0.06605							
cotton yarn	0.01194	-0.1798	-0.06652	0.00596	-0.06009						
spinning	-0.03158	-.22335*	-0.11004	-0.03756	-0.10361	-0.04352					
electricity	0.12205	-0.0697	0.04359	0.11608	0.05002	0.11011	0.15363				
food	0.16774	-0.024	0.08928	0.16176	0.09571	0.1558	.19932*	0.04569			
Indus. engineering	-0.02006	-0.2118	-0.09852	-0.02603	-0.09209	-0.03199	0.01153	-0.14211	-0.1878		
oil & gas	-0.07737	-.26914*	-0.15583	-0.08334	-0.1494	-0.08931	-0.04579	-0.19942	-.24511*	-0.05731	
household goods	0.09606	-0.0957	0.0176	0.09008	0.02403	0.08412	0.12764	-0.026	-0.07168	0.11611	0.17342

*. The mean difference is significant at the 0.05 level.

Table: 5. Correlation Matrix of CCC, Firm Size, WCM Policies and Profitability Measures

		CCC	Sales	Total Assets	ROE	ROA	CAR	INV	FIN
CCC	Pearson Correlation	1	-.106	-.173*	-.143	.141	.081	.088	-.103
	Sig. (2-tailed)		.187	.030	.074	.077	.311	.274	.198
	N	157	157	157	157	157	157	157	157
Sales	Pearson Correlation	-.106	1	.728**	.011	.036	-.009	.227**	.142
	Sig. (2-tailed)	.187		.000	.896	.656	.913	.004	.075
	N	157	157	157	157	157	157	157	157
Total Assets	Pearson Correlation	-.173*	.728**	1	.053	.121	.007	.086	.009
	Sig. (2-tailed)	.030	.000		.513	.131	.931	.282	.907
	N	157	157	157	157	157	157	157	157
ROE	Pearson Correlation	-.143	.011	.053	1	.010	.031	-.270**	-.266**
	Sig. (2-tailed)	.074	.896	.513		.899	.701	.001	.001
	N	157	157	157	157	157	157	157	157
ROA	Pearson Correlation	.141	.036	.121	.010	1	.368**	.097	-.518**
	Sig. (2-tailed)	.077	.656	.131	.899		.000	.228	.000
	N	157	157	157	157	157	157	157	157
CAR	Pearson Correlation	.081	-.009	.007	.031	.368**	1	.192*	-.448**
	Sig. (2-tailed)	.311	.913	.931	.701	.000		.016	.000
	N	157	157	157	157	157	157	157	157
INV	Pearson Correlation	.088	.227**	.086	-.270**	.097	.192*	1	.480**
	Sig. (2-tailed)	.274	.004	.282	.001	.228	.016		.000
	N	157	157	157	157	157	157	157	157
FIN	Pearson Correlation	-.103	.142	.009	-.266**	-.518**	-.448**	.480**	1
	Sig. (2-tailed)	.198	.075	.907	.001	.000	.000	.000	
	N	157	157	157	157	157	157	157	157

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Table: 6. **Regression Analysis of CCC, Firm Size, WCM Policies and Profitability Measures**

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	-45.657	47.092		-.970	.334
	INV	.451	.113	.238	3.994	.000*
	FIN	-.690	.073	.567	9.509	.000*
	ROA	106.869	33.613	.192	3.179	.002*
	Size	1.985	3.131	.038	.634	.527

Adjusted R-square = .436, F-statistics = 32.333, Significance F = .0000

*Significant at 1% level

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Software Quality Assurance
A Study Based on Pakistan's Software Industry

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ABSTRACT

This paper investigates the role of quality management practices in software industry of Pakistan. We present a comparison between the more-experienced and less-experienced firms with respect to the critical factors of quality management. The critical factors of quality management practices in the software industry were first identified from literature surveys and validated through an empirical study. The study attempts to examine the influence of "age of quality" and "use of software" over software quality management practices and programs. The results of the study shows that the 'age of quality" and "use of software" have partial influence over the software quality management.

Keywords:

Software quality, Capability Maturity Model (CMM), Software Quality Assurance (SQA), International Standard Organization (ISO) 9000 series

1. INTRODUCTION

Software development has been one of the fastest growing business over the last two decades. The global competition has become even more severe as the number of software development firms increased at a much faster pace. To survive in this intense competitive environment, software vendors need to differentiate their products in ways that are meaningful to their customers. Quality is a proven way to achieve this differentiation. Quality in software industry is derived from three important sources namely people, technology and management (Owe and Yaacob, 1996). Wikipedia add link defines quality assurance as "a planned and systematic

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pattern of all actions necessary to provide adequate confidence that the item or product conforms to established technical requirements". Software Quality Assurance (SQA) provides means for monitoring the software engineering processes and procedures used to ensure quality. Software firms pay less attention to quality assurance as it is frequently the first area that is cut back when deadlines are missed (Miller, 2007). Software firms develop quality programs which include reviews, inspections and audits detecting faults/defects at early stages of the software development process and therefore, prevent wastage of project resources and diversion from user requirements. Companies also use automated tools for software quality assurance that helps the quality assurance professionals to perform their activities (Sneed and Merey, 1985). The most commonly used quality assurance standards are ISO 9000 series, Capability Maturity Model (CMM) and Capability Maturity Model Integration (CMMI). ISO 9001 is a well established quality framework, currently being used by organizations in almost 170 countries worldwide (Yoo et. al., 2004).

Coleman (2005) has evaluated The Chaos Report of 1994 published by the Standish Group International Inc. The report found that 31% of software projects ended in cancellation and more than 76% of remaining projects experience significant delays or significant cost overages or significantly reduced functionality or some combination of the three. There is a lack of published information on software development in South Asia, which is fast becoming an IT outsourcing hub (Sison et. al., 2006).

The current study examines a software industry to evaluate the SQA trends and to investigate the influence of "age of quality" and "use of software" over SQA with respect to the critical factors of quality. In section 2, literature review is given. Research Methodology is explained in section 3. In section 4 and section 5, results and discussion are given respectively. Finally, conclusion is given in section 6.

This paper aims to address three primary questions,

1. Are software companies in Pakistan aware of the quality management requirements?
2. Are more-experienced and less-experienced companies equally conscious of quality when it comes to software development?

3. Do software companies believe in the fact that investment in SQA will improve the quality of their product and performance?

2. LITERATURE SURVEY

A number of studies have been carried out in different countries including India, Malaysia, Philippines and Singapore to find out SQA trends. There are very few research studies carried out in Pakistan to find the SQA investment trends. Following literature has been reviewed:

Sneed and Merey (1985) studied a family of tools which not only supports software development but also assures the quality of each software product from the requirement definition to integrated system. Further Owe and Yaacob (1996) extended the previous study and conducted a survey in Malaysian software industry to encompass the trends of SQA investments, quality assurance problems encountered, the tools being used in SQA and their weaknesses and people involved in SQA activities.

Ahire (1996) investigated the effect of Total Quality Management (TQM), Age on Quality in case of a manufacturing industry and concluded that manufacturing firms can observe the effects of their TQM implementation efforts within few years.

Issac. et. al. (2004) used Comparative Fit Index (CFI), Bentler-Bonett Normated Fit Index (BFI) and ANOVA to establish relationship between age of quality and operational performance in Software Industry in India.

Yoo et. al. (2004) presented an integrated model of ISO 9001:2000 and CMMI to resolve the problems that exist in these models. Further Miller (2007) studied the empirical results of CMMI and Team Software Process (TSP) and assessed these software improvement approaches on the basis of Cost, Schedule, Productivity, Quality, Satisfaction and Return on Investment.

Coleman (2005) used grounded theory to investigate what processes software companies are using and examined why these companies are rejecting best practices. Further Sison et. al. (2006) extended the previous study and conducted a survey to study the software practices in five

ASEAN countries (Malaysia, Philippines, Singapore, Thailand and Vietnam) and provided direction for further research in these countries.

3. RESEARCH METHODOLOGY

Personal interviews and mailed questionnaires are the two main methods of survey. Critical factors of quality management identified from a thorough survey of literature are percentage investment of research and development (R&D) on SQA, number of employees working in quality control department, use of automated testing tools, training given to quality control engineers and ownership of quality certification (Owe and Yaacob, 1996). Ahire (1996) reported that in order to implement a quality management system, on the average, a software firm requires a three-year period of time. Therefore, a three-year time period has been adopted in this research to distinguish between the "more-experienced" firms and "less-experienced" firm. Owe and Yacoob (1996) found a significant difference between the firm that develop software for internal use and firms that develop software for commercial use and reported that "use of software" has an influence over SQA investment decisions.

The survey questionnaire is based on the critical factors of quality management identified from the reviewed literature. Sample of this survey is based on non-probability convenience sampling due to the fact that most of the companies were reluctant to share their investment data. A random sample of 100 software firms in Karachi were selected and questionnaires were sent to each firm. A response rate of 70% was noted. The questionnaires were filled by Quality Control Engineers/Managers and Project Managers. The questionnaire contained 25 different questions based on the factors of quality management identified from the reviewed literature as given in Appendix A.

Following hypotheses were developed to test the relationships:

Research Question 1:

It has been observed that experienced firms are more aware of adapting quality practices in software industry. As this assumption plays an important role in this global scenario we have developed the following hypothesis. To investigate, whether there is a significant difference between "more experienced" firms and "less experienced" firms with respect to the critical factors of quality.

As the time progresses, there is a continuous improvement in company's operations and quality. Age of quality means number of years since SQA department was established and SQA practices followed by the companies (Issac et. al, 2004). This hypothesis will simply test whether the companies in Pakistan are improving their quality with the passage of time or not.

H_{01}: There is no significant difference between "more-experienced" firms and "less-experienced" firms with respect to the critical factors of quality. (Ref. Q4, Q9, Q13, Q15, Q16 and Q20)

H_{02}: There is significant difference between "more-experienced" firms and "less-experienced" firms with respect to the critical factors of quality.

Research Question 2:

Companies develop software for different purpose. Some companies develop software to support their internal operations; others develop software commercially for clients. Some companies develop software internally as well as commercially (Owe and Yaacob, 1996). It is a perception that companies which develop software commercially invest more on software quality assurance than the companies that develop software for internal use. The reason is that commercial users pay for the software and hence they are more quality conscious than the internal users. So, companies that develop software commercially pay more attention to quality assurance.

To investigate whether there is a significant difference between the firms that develop software for internal and external purpose with respect to the critical factors of quality, following hypothesis is developed

H_{02}: There is no significant difference between firms that develop software for internal and firms that develop software for external purpose with respect to the critical factors of quality. (Ref. Q4, Q7 and Q8)

H_{12}: There is a significant difference between firms that develop software for internal and firms that develop software for external purpose with respect to the critical factors of quality

4. RESULTS

Prior to formal analysis, questionnaires were carefully checked for completeness, accuracy and conformity. Later, data errors and ambiguities were removed. A confirmatory factor analysis was performed to test the validity and reliability of the instrument as shown in Table1. The value of CFI greater than or equal to 0.9 indicates that there is a strong evidence of uni-dimensionality in the data. Data coding was performed in an excel sheet and the coded data were imported into SPSS 17.0 and AMOS 5.0 for analysis.

Table 1: Baseline Comparisons

Model	NFI Delta 1	RFI Rho 1	IFI Delta 2	TLI Rho 2	CFI
Default Model	0.711	0.423	0.942	0.827	0.914

Out of 70 respondents, 45 were classified as "more-experienced" firms. Out of the "more-experienced" firms, 15 develop software for internal use and 30 for commercial use. Similarly, among 25 "less-experienced" firms, 7 develop software for internal use and 18 for commercial use.

In order to test null hypotheses (H_{01} and H_{02}), ANOVA test was performed; the results are given in Table 2 and 3 respectively.

Table 2: More experienced Vs. Less Experienced Firms: Difference with respect to the Critical Factors of Quality

Critical Factor	More Experienced		Less Experienced		F-value	Significance
	Mean	S.D	Mean	S.D		
% Investment on SQA	17.14	0.9520	9.0	0.1872	2.24	0.195
Quality Certification	4.24	4.0	3.2	2.25	2.82	0.235
Strength of SQA staff	10.15	4.598	9.71	7.521	0.027	0.872
SQA Training	1.33	0.577	4.5	3.54	12.0	0.179
QA Automated Tools	2.0	1.41	4.5	2.12	0.24	0.676

Table 3: Internal use vs. External use: Differences with respect to the Critical Factors of Quality

Critical Factor	Internal use		Commercial use		F-value	Significance
	Mean	S.D	Mean	S.D		
% Investment on SQA	10.40	3.050	4.56	3.504	4.839	0.264
Quality Certification	1.00	0.00	0.5	0.33	8.058	0.002
Strength of SQA staff	10.40	2.881	8	5.612	1.367	0.276
SQA Training	0.447	0.22	0.49	0.31	2.778	0.084
QA Automated Tools	0.60	- 0.548	0.56	0.527	0.306	0.739

Table 2 shows the comparison between the more-experienced firms and the less-experienced firms with respect to the critical factors of quality. ANOVA does not indicate any significant difference between the more-experienced firms and less- experienced firms with respect to Quality Certification (QC) and Automated Tools (AT), indicating that "age of quality" has no influence over these two critical factors of quality. There is no significant difference between the more-experienced firms and less-experienced firms with respect to Percentage Investment on SQA (PI), Strength of SQA Staff (SS) and SQA Training (ST). Analysis of the mean values shows that the more-experienced and less-experienced firms are same with respect to all the critical factors of quality i.e. PI, QC, SS, ST and AT.

Table 3 shows the difference between the firms that develop software for internal use and firms that develop software for commercial use with respect to the critical factors of quality. The results show no significant difference between the firms that develop software for internal use and firms that develop software for commercial use with respect to Investment on SQA(PI), Strength of SQA Staff (SS), SQA Training (ST) and Automated Tools (AT).

However, a significant difference can be observed between the firms that develop software for internal use and the firms that develop software for commercial use with respect Quality Certification (QC). The mean values show that the firms that develop software for internal use are better than the firms that develop software for commercial use with respect to the quality certification (QC).

5. DISCUSSION

Refer to Table 2, Percentage Investment on SQA (PI) was found insignificant ($\alpha > 0.05$). According to the questionnaires filled by the practitioners, all companies invest between 5-10 percent of the total research and development (R&D) budget on SQA activities irrespective of the "age of quality". Similarly, the rational of the insignificance of Strength of SQA Staff (SS) is that, according to the survey, on the average 10-12 people are working in SQA department whether it's a "more-experienced" firm or "less-experienced" firm. SQA Training (ST) was also found insignificant because neither the "more-experienced" firms, nor the "less-experienced" firms in Pakistan software industry pay attention to the SQA training programs.

Refer to Table3; the same factors have been focused with respect to the internal and external use, only Quality Certification (QC) is found statistically significant.

6. CONCLUSION

The survey investigated the trends of software quality assurance in Pakistan software industry. The critical factors of quality have been identified through a thorough survey of literature. The firms that participated in the research were classified into different groups based on the criteria namely "age of quality" and "use of software". The results of the analyses performed in this study indicate that "age of quality" in Pakistan software industry has a very limited influence over Software Quality Assurance. Only 2 out of 6 factors i.e. Quality Certification (QC) and Automated Tools (AT) were found significant between "more-experienced" firms and "less-experienced" firms indicating that there is not much difference between "more-experienced" and "less-experienced" firms with respect to critical factors of quality. Similarly, use of software is playing a partial role in the improvement of quality management practices. Software firms in Pakistan need to make improvements in their quality management programs so that they can differentiate their products from others in terms of quality.

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Marine Ecological Assessment for LNG Terminal at Port Qasim

Shahid Amjad* and Moin uddin Ali Khan**

ABSTRACT

Multinational companies intend to develop a Liquefied Natural Gas (LNG) terminal with floating storage and regasification arrangement (FSRA) in the jurisdiction of Port Qasim. Approximately 500 MMSCFD or 3.5 million tons per annum of LNG would be transferred through a mooring arrangement, which would require marine works/structures such as a berth for docking and mooring of LNG Carriers and Floating Ship Regasification Arrangement (FSRA) i.e., unloading, storage and vapor recovery and return unit and pipelines to the delivery point for transport to off-takers. The FSRA will deliver the re-gasified liquefied natural gas (RLNG) via jetty and onshore associated facilities to the gas network operated by the in-country transmission pipeline providers SSGCL and SNGPL. The approach channel of Port Qasim is associated with Gharo Phitti Creek System consists of three creeks: Gharo Creek, Kadiro Creek and Phitti Creek has tidal creeks and are with associated mangrove and mudflats ecosystems that are linked with a network of creeks in the Indus Delta. Dredging will be required to create the berthing and the turning basin of diameter 400 to 700 m with a depth of -13.5 m below chart datum (CD). Approximate dredged material would be upto 5.5 Million cubic meters. The dredged material will be utilized for the reclamation and to construct shore protection structure. Land Area of 75-100 acres with water front of 1000 m has been allocated in the PQA for this project. This would be the first time that LNG terminals are being set up in PQA.

1. INTRODUCTION

The approach channel of Port Qasim is associated with that consists of three creeks: Gharo Creek, Kadiro Creek and Phitti Creek. These are tidal creeks with associated mangrove and mudflats ecosystems. The Gharo Phitti Creek System is linked with a network of creeks in the Indus Delta. The environmental ecological assessment study was conducted in the Port Muhammad Bin Qasim area during 2010 South West Monsoon period. The overall objective of the study was to establish an environmental baseline, at the proposed port sites designated for construction and operation of LNG terminal, which would include, docking and mooring of LNG

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Carriers, Floating Ship Regasification Arrangement (FSRA) i.e., unloading, storage, vapor recovery and delivery point for transport to off-takers. The FSRA will deliver the re-gasified liquefied natural gas (RLNG) via jetty and onshore associated facilities to the gas network operated by SSGCL and SNGPL. A baseline ecological impact assessment has been conducted to assess impacts on mangrove plantation, marine benthic invertebrates, and fisheries was carried out within an area in close proximity to the proposed LNG site in PQA. The proposed sites at Port Qasim in the Gharo - Phitti creek system are dedicated areas for Oil and Gas development that promote local energy supply system. This is the first time that LNG projects are being set up in the PQA area. LNG operations includes constructing and operating a Liquefied Natural Gas (LNG) terminal in Port Qasim, inclusive of ship berthing and import facilities, floating storage tanks and regasification equipment.

The environmental baseline programme focuses on mangrove ecosystem marine organisms, their habitats, water quality, productivity, The baseline also takes into consideration the probability of the ecosystem being affected by port development, and evaluates unique ecosystems, key linkages, habitat loss for any endangered organisms found in the Mangrove Ecosystem, marine flora and fauna of the Mudflats that may require special management during LNG jetty development and accidental spillage of LNG during regassification and unloading operation. The purpose of this paper is to assess marine ecological impact of setting up of LNG terminal in the Port Qasim area.

2. PHYSIOGRAPHY OF MAJOR CREEKS IN PQA

The present delta covers an area of about 600,000 hectares and is characterized by 16 major creeks and innumerable minor creeks, (figure 1), dominated by mud flats, and fringing mangroves. The coastal morphology is characterized by a network of tidal creeks and a number of small islands with sparse mangrove vegetation, mud banks, swamps, and lagoons formed because of changes in river courses. The Gharo Phitti Creek System consists of three creeks: Gharo Creek, Kadiro Creek and Phitti Creek. All three are connected in a series starting from Gharo Creek at the north-eastern end to the Phitti Creek at the south-western end and located at 22.3 km from Karachi. This creek system is about 28 km long and its width ranges from 250 to 2,500 m. The Korangi Creek, and Kadiro Creeks are connected with it at the north-eastern end while it acts as main waterway connected with the open sea at the south-western end. The main channel of Port Bin Qasim lies in this creek system, which has been dredged to maintain a navigable depth of -11.3 metres.

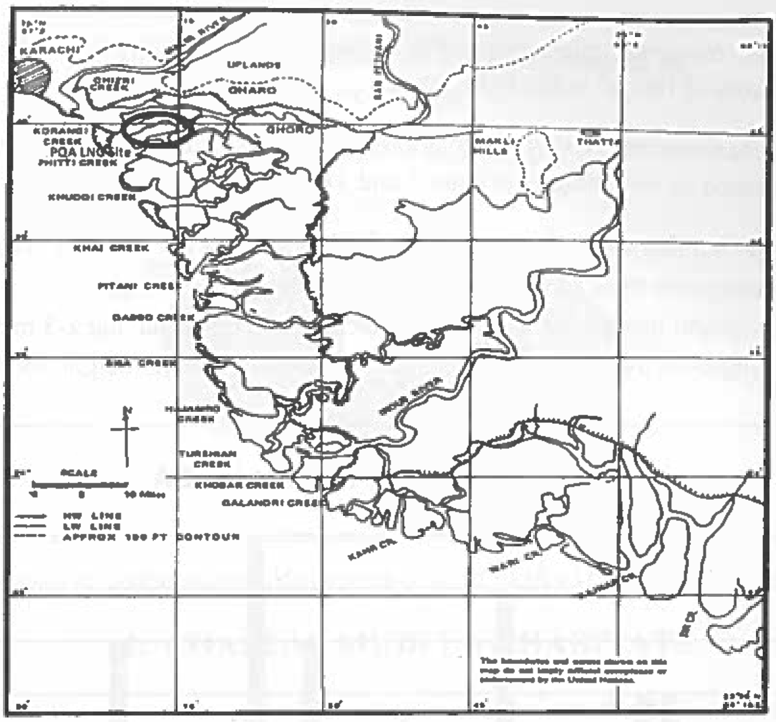

Figure 1. The Indus Delta and the numerous creeks in the deltaic region. Encircled area is PQA LNG site

The inner section of the creek is sheltered from the onslaught of high energy waves during the south west monsoons (June, July and August). Strong tidal currents have been observed during spring and neap tides. Seawater flows in the creek with velocities as high as 2-3 m/sec during the flood and ebb tides. The sediments are subjected to coastal dynamic processes, such as, tides, winds, waves, and currents. This leads to accretion and erosion of the Indus deltaic coast. The daily ebb and flow of water entering and leaving the creek have an erosional effect on the sediment movement in the creek.

3. THE MANGROVE ECOSYSTEM

In the Indus Delta mangrove ecosystem, there are eight species of mangroves. The dominant mangrove species are *Avicenia marina*. The other mangrove species in the deltaic region such as the *Ceriops tagal* occur in localized patches and there are a few plants of *Rhizophora mucronata*. All other species are rare and have disappeared from most part of the Delta due to adverse environmental conditions.

The Gharo Phitti Creek System and its environs support a large mangrove ecosystem in the PQA coastal environments. The mangrove trees grow within the 200-300 m breath of PQA coastal belt of the creeks that are flushed by seawater in the land ward direction show an overall decline in the height of the mangrove plantations. The density of mangrove vegetation was randomly evaluated in an area of 100 m^2 in the PQA creeks.

The trees were characterized (visual observations) according to the arbitrary height of the plants and results expressed as percentages. (Figure 2 and 3)

- Mangrove sapling were characterized as having a height between 0.5 -1.0 m (5%)
- Short mangroves trees were characterized as having 1-2 m height.
- Medium height mangroves trees had were characterized as having 2-3 m height. (30)
- High mangroves trees had were characterized as having >3 m height. (60%)

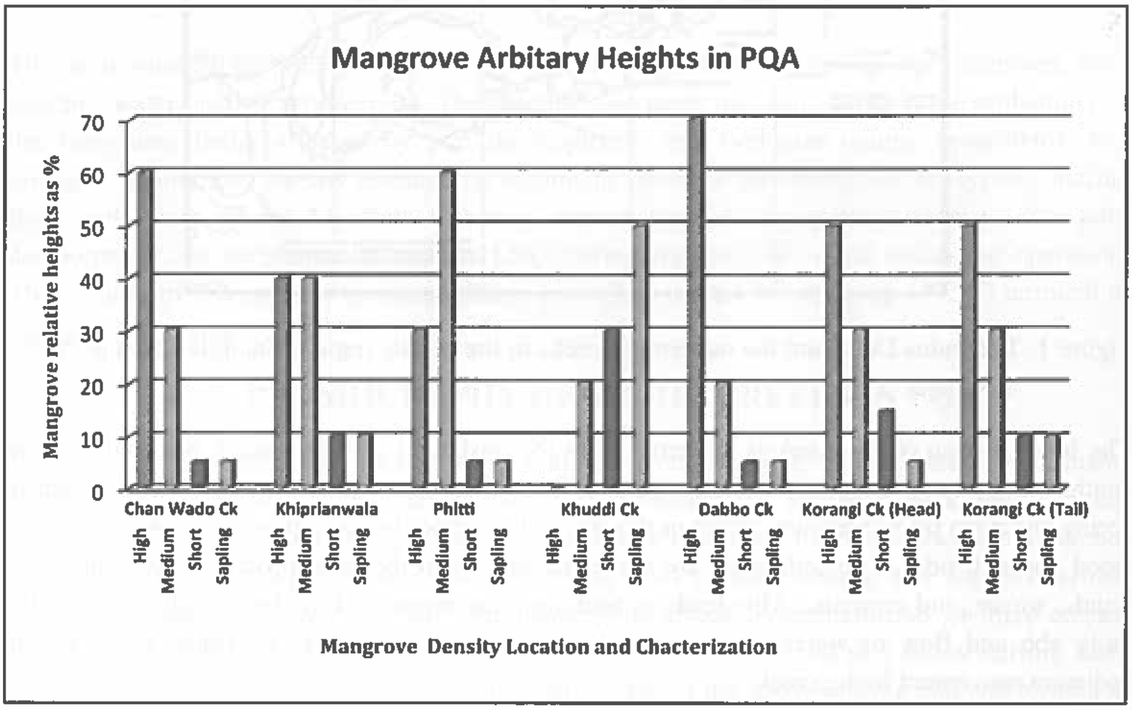

Figure 2. Arbitrary mangrove heights (high/medium/short/sapling) at different locations in PQA

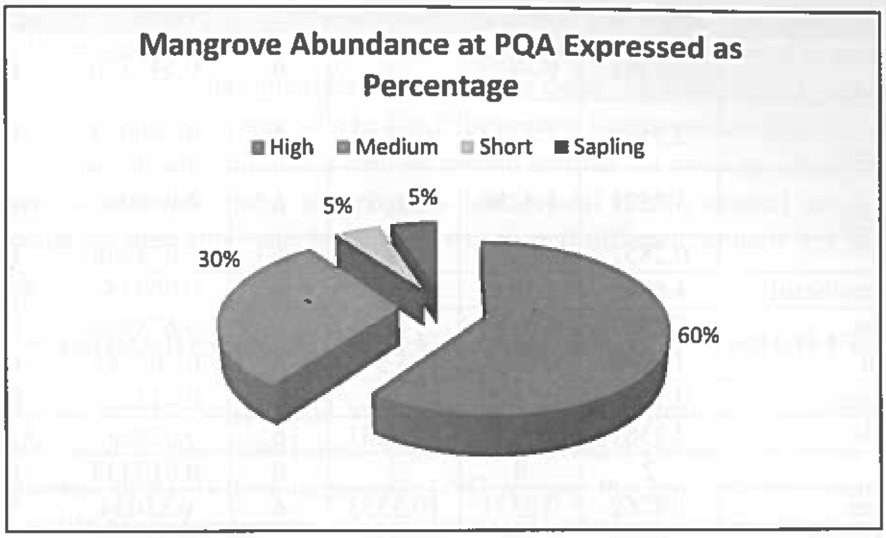

Figure 3. Accumulative abundance of mangroves tress in PQA expressed as percentages

4. COASTAL MUDFLAT HABITATS.

Coastal areas and the intertidal region is a complex area where the division between land and sea is unclear. Coastal intertidal areas have a diverse range of communities including sandy shores, mudflats, and mangrove forests. the Gharo Phitti Creek System has faunal communities characteristic of very fine sediments from muddy to clayey. The communicaties included in the mud flats were dominated by faunal assembleges representing the soft sediments having a high percentage of silt and clay. The sediment substrate were generally found to be high in organic content and with black mud just below the substrate (anerobic sediments with H_2S). Most of the area surveyed constitutes of mangrove and the fauna associated with mangrove communities.

5. BENTHIC SPECIES DISTRIBUTION PATTERN

The Marine Benthic Invertebrates (MBI) plays an important role in mixing the organically enriched bottom sediments. The MBI are a key linkage in transferring the energy from lower trophic level to the next higher trophic level in the food chain. The species distribution pattern of benthic invertebrates in the PQA area of interest are randomly distributed, while a few species aggregate. (Table 1) The distribution of invertebrates is dependent on the surface current that redistributes the planktonic larval form to locations away from where they were spawned they are hence random in their population densities. Aggregation is also a function of reproduction, where the benthic organisms tend to colonies together. The substrate sediment samples taken from the creeks, Nemetodes, Annelid Polychaete worms, bivalve mollusk, Pinnotherid crabs, and species of Tanaidacean were by far the most dominant benthic species in the benthic sediment samples collected from the PQA region.

Invertebrate Species	Variance	Mean	Chi-sq	d.f.	Probability	Aggregation
Brittle star (Amphiurid)	0.2381	0.2857	5	6	0.545356	Random
Annelida (Polychaeta)	2.9524	2.5714	6.8889	6	0.330937	Random
Mollusca (Gastropods)	3.9524	1.4286	16.6	6	0.010985	Aggregated
Ostracods	0.2857	0.4286	4	6	0.678836	Random
Crabs (pinnotherid)	4.8095	1.1429	25.25	6	0.000355	Aggregated
False Crabs	0.2857	0.4286	4	6	0.678836	Random
Hydrozoan	0.619	0.5714	6.5	6	0.369585	Random
Sea anemone	0.1429	0.1429	6	6	0.423695	Random
Amphipods	9.2381	3.7143	14.9231	6	0.020851	Aggregated
Nematoda	2	4	3	6	0.810439	Random
Tanaidacean	1.4762	0.8571	10.3333	6	0.11034	Random
Shrimp (Alpheus)	3.9048	1.2857	18.2222	6	0.005848	Aggregated

Table 1. Specie wise distribution of Marine Benthic Invertebrates and their distribution pattern in PQA benthic samples collected in Gharo - Phitti creek system

6. PELAGIC FISH AND BENTHIC FISH COMMUNITY

Pelagic fish community includes Juveniles of powerful swimmers, which are exclusively carnivore in nature like predaceous fishes, croakers, carangids, breams, and shrimps, and cephalopods. In the mangrove ecosystem the predaceous forms are often small in size and easily wander among the mangroves at high tide. A 15-20 minutes fish trawl was conducted at selected station in the major creeks of PQA viz -a- viz Korangi, Kadrio, Phitti and Chhan Waddo creeks. The pelagic fish generally show a random distribution pattern. With the exception of shrimps with showed to aggregate, the fish and crustaceans species showed random distribution (table 2).

Fish /Crustaceans Species	Variance	Mean	Chi-sq	d.f.	Probability	Aggregation
Mullets (Mugils)	1.5833	1.25	3.8	3	0.283189	Random
Sole fish (Cynoglossus sp)	1.3333	1	4	3	0.260453	Random
Carangoids	0.9167	1.75	1.5714	3	0.670141	Random
Pony fishes (Leiognathus sp)	2.9167	1.75	5	3	0.169987	Random
Shrimps (Metapenaeus sp)	8	2	12	3	0.007541	Aggregated
Swimming Crabs (Portunids)	1.5833	1.25	3.8	3	0.283189	Random

Table 2. Pelagic fish distribution pattern in major creeks of PQA

Benthic fish community includes detritus feeders, small and large herbivores, and small and large carnivores. In the mangrove ecosystem, the benthic community of the adjacent shallow water is a subject of interest. Here, the microbes decompose the plant litter into organic detritus-a fundamental commodity of system energy. This detritus matter is picked up by the detritus feeders over the bottom, such as fishes, shrimps and shellfish, and then carried to the littoral zone by wave action, shared by the intertidal fauna such as crabs, shrimps, mudskippers, and other invertebrates. Grey mullets, gizzard shads, flat fishes, many skates and rays are some of the fish which prefer to live on soft bottom and feed on bottom detritus. At low tide, when a large part of muddy bottom is exposed, crabs, mudskippers and coastal birds (waders) are seen in large numbers picking up their food which includes worms and different animals left behind by the receding tide.

7. COMPARISON OF LNG HAZARDS WITH OTHER FUELS.

Risk of LNG hazards due to spill and leakages into the environment are considered to be less hazardous compared to other fossil fuels. LNG is considered a simple asphyxiant, but has low toxicity to humans (table 3). In a large-scale LNG release, the cryogenically cooled (-160^0 C) liquid LNG would begin to vaporize upon accidental release from the breach of an LNG cargo tank. If the vaporizing LNG does not ignite, the potential exists that the LNG vapor concentrations in the air might be high enough to present an asphyxiation hazard to the ship crew, pilot boat crews, emergency response personnel, or others that might be exposed to an expanding LNG vaporization plume. Although oxygen deficiency from vaporization of an LNG spill should be considered in evaluating potential consequences, this should not be a major issue because flammability limits and fire concerns will probably be the dominant effects in most locations.

Hazard	**LNG**	**LPG**	**CNG**	**Petrol**	**Diesel**
Behavior, if spilled	Evaporates, forming visible vapor cloud that disperses quickly	Evaporates, forming flammable vapor cloud that tends to accumulate	Evaporates, forming a visible vapor cloud that disperses quickly	Forms a flammable pool and flammable vapor cloud, environmental cleanup required	Forms a flammable vapor cloud, environmental clean up required
Toxic	No	No	No	yes	Yes
Carcinogenic	No	No	No	Yes	Yes
Asphyxiant	Yes in confined spaces	Yes same as LNG, but higher density encourages accumulation	Yes same as LNG	No	No
Stored Pressure	Ambient, except in small containers	Pressurized	Pressurized	Ambient	Ambient

Autoignition Temperature ^0C	540	455	540	257	315
Other Health Hazards	Low Temperature during transport (-160°C), Cryogenic Burns	May cause Nausea	May cause minor nasal irritation	Can cause Nausea, eye irritant, narcosis	Forms a flammable pool and flammable cloud vapor. Cleanup required.

Table 3, LNG Hazards Compared of to other fossil fuels Source: Based on Lewis, William W., James P. Lewis and Patricia Outtrim, PTL, "LNG Facilities – The Real Risk," American Institute of Chemical Engineers, New Orleans, April 2003,

8. POTENTIAL IMPACTS OF DREDGING ON PRODUCTIVITY

Continuous dredging in the creeks for safe operations of LNG would increase the sediment load, the suspended sediment load in the water column, may deteriorate the marine water quality and transparency for phytoplankton production, and it adversely affects fish and fish habitat. The overall Productivity of the mangrove areas has been reported to be high (365-780gC/M^2/year), compared to coastal waters (50-200 gC/M^2/Year),

High concentrations of resuspended sediment in the water during NE monsoon in side the shallow creek ranges between 25 to 178 ppm. Higher turbidity concentrations are detrimental to benthic organisms, (interstitial fauna) that include macro and meiofauna, fish ova and larval survival and productive capacity of a habitat. During the SW Monsoon period the suspended load levels are approximately 300 ppm. The Benthic fauna (Interstitial macro, meio and microfauna) although ubiquitous are restricted within the top 15-20 cms of the subsoil. The benthic fauna in silt/clay sediments below 20 cm of subsoil in the PQA channel is restricted to anaerobic micro organisms. The distribution of interstitial benthic fauna is restricted vertically due to compact silt clay nature of the sediments and low oxygen content within the sediments of PQA channel. Gray J.S and M. Elliott, (2009) have shown that benthic organisms have a well defined animal/sediment relationship. The benthic fauna has a short regeneration time. They quickly recolonize within 3-4 weeks of the disturbed sediment surface due to their reproductive potential. Phytoplankton and primary productivity will return to its original natural concentration of approximately 10 cells ul^{-1} . Hence any disturbance of sediment suspension in the water column and within the microenvironment of PQA channel due to dredging activity would be temporary. Benthic organisms at the sediment disposal site may be buried and may not be able to migrate through the dumped sediment material. If the substrate is changed from what was previously present at the sediment dumping site, the organisms which recolonize the site may be different from those present prior to disposal. Increased suspended sediments may also interfere with production of macroinvertebrates and other aquatic fish food organisms.

9. IMPACT ON MANGROVE ECOSYSTEM.

Port development activity can have a major destabilization impact on Mangrove growth density and diversity if no mangrove rehabilitation management is made. However, the degradation of mangroves in the Indus Delta can be attributed to the progressive reduction in fresh water discharge over a period of many years. Historical records indicate that the distribution of mangroves in the Indus Delta has significantly changed during the past several hundred years with the shifting pattern of the river (Snedaker, 1984). Until recently the Indus River had a largely river-dominated estuary but increased utilization of the river for agriculture etc. has resulted in discharge to the Arabian Sea only during the summer southwest monsoon. During remaining nine to ten months the Indus River has no estuary due to elimination of the river discharge (Schubel, 1984). As a result, the mangrove ecosystem has been adversely affected. Some decades ago the area of mangrove cover in the active Indus Delta has been estimated at about 250,000 ha (Khan, 1966,). The mangroves are degrading rapidly caused by a number of factors such as cutting, browsing and by reduced silt laden river water. These forests which covered 263,000 ha in 1977 have recessed to about 160,000 ha in 1990 (Qureshi, 2005). This is probably the most serious problem focusing mangroves of Indus Delta; therefore the salinity value of 40 ppt or more is common in mangrove areas. Although there exist no previous records of salinity values in the area for past some decades, but it was appreciably lower since rice was once cultivated in Keti Bunder in the vicinity of mangrove stands (Saifullah, 1982). Due to hyper salinity and nutrient impoverishment decline in mangrove is now visible everywhere. Early dense and extensive forest has changed to stunted growth of trees and reduction in forest area.

10. IMPACTS OF DREDGING ON BENTHIC COMMUNITIES.

The potential (negative) impacts of (conventional) dredging activities can impact benthic habitat and species. Recolonisation or recovery of disturbed areas may be possible; Alteration of sediment composition, i.e. of substrate characteristics in the surrounding of the dredging site, resulting in a change of the nature and diversity of benthic communities, e.g. decline of individual density, species abundances or biomass. Dredging generally causes to some extent an increase of turbidity that may be regarded as indicator for potential ecological impacts, as resuspension of sediments may give rise to various adverse effects on the environment. These include, spread of sediments and associated contaminants in the surroundings of the dredging site, leading to clogging of gills in fish, and smothering of benthic invertebrate community. Impact on pelagic and benthic organisms (e.g. decrease of primary production due to reduced transparency of the water column, smothering of benthic organisms may occur, but is less important at the dredging site than at the disposal site. Release of nutrients, would increase eutrophication; leading to decreased amount of dissolved oxygen in water column. turbidity plumes and resuspension may change the physical/chemical equilibria, with a potential to release contaminants into the water phase (remobilisation), especially in suspensions of anoxic silty sediments, to enhance the bioavailability and ecotoxicological risk of the already present (background) contaminants (e.g. heavy metals), and to chemical or biochemical changes of contaminants and bioaccumulation of contaminants in tissues of benthic organisms, crabs and demersal fish. There is also a possibility of invasive species or the introduction of new species into the system through release of ballast water by LNG cargo tankers.

11. PROPOSED MITIGATION MEASURES

The following mitigatative measures will address the potential effects on the marine environment and marine organisms from increased suspended sediments. Vessels during the construction phase of the jetty should operate outside of biologically sensitive areas (close proximity to mangrove vegetation) and outside of periods of critical fish, shrimps life stages i.e. SW Monsoon season (June, July and August). The construction of the jetty should ideally be during the winter monsoonal months (NE Monsoon. i.e. November, December, January) timing. This period is best suited as it lies outside of biologically sensitive temperature ranges for fish gonadal maturation. Implement acoustic restrictions during construction phase, in biologically sensitive areas during breeding and spawning periods and critical fish life stages. Timing of dredging to avoid key biological processes (migration, spawning, etc.), and minimize sediment transport and mixing. Uprooted and dislocated of mangrove trees during the construction phase must be replanted in location best suited for their growth. This should be done under the aegis of independent environmental monitoring organisation. Minimize use of lights during night. During Project operation, LNG carrier vessels may risk introduction of exotic species through bilge and ballast discharges into the marine environment. Arrival of international marine vessels in the PQA Channel potentially exposes native marine organisms to exotic/invasive species through ballast water exchange, hull fouling and direct transport. There is a possibility of invasive species or the introduction of new species into the system through release of ballast water by LNG cargo tankers. There is therefore a need to Implement ballast control measures, preferably away from the internal water; (beyond 200 m depth contour). Green House Gasses (GHS) levels in the PQA are within the permissible limits. The GHS (No_x, So_x) during the construction phase would not be an Issue. Levels of atmospheric CO_2 levels may increase slightly during the construction activity mainly due to use of fossil fuels by construction machinery. These temporary increases in the CO_2 level will not endanger the PQA environment. There is a need to develop a preparedness, prevention and hazardous materials spills protocol. An Environmental Protection Plan and an Emergency Response Plan for oil and LNG spill.

Treatment of the dredged material may be considered if this would facilitate beneficial use of the material. A variety of treatment processes are available to reduce contamination of the toxic components in the dredged material solids or slurries. Low-cost treatment alternatives include bioremediation. Bioremediation (use of bacteria, fungi, or enzymes to break down organic contaminants), chemical treatment (e.g., oxidation, reduction, chelation, hydrolysis, detoxification, thermal (e.g., incineration) can use utilized.

12. UTILISATION OF DREDGED MATERIAL

Use of dredged material as the substrate for habitat development is one of the most common and most important beneficial use. The use of dredged material for habitat development offers a disposal technique that is an attractive and feasible alternative to more conventional disposal options. Within various habitats, several distinct biological communities may occur. For example, the development of a dredged material, creation of an island or nourishment sediment to eroded creeks banks may initiate a wide variety of wetland, upland, island, and aquatic habitats. Potential developments include such communities as tidal flats, oyster beds, clam flats, fishing reefs, and aquatic plant and plantation of mangroves. The excavated dredged material can be used as the substrate for mangrove habitat development. Within various habitats, several distinct biological communities may occur. For example, the development of a dredged material can reinforce eroded banks by providing coastal nourishment. The sediments can be used for reclamation of Bundal Island can also be developed after initiating necessary coastal hydraulic studies. Potential developments could include encouraging faunal communities as tidal flats, oyster beds, clam flats, fishing reefs, and aquatic plant and replantation of mangroves

13. CONCLUSION

To conclude extensive environmental surveys must be conducted on regular basis to have a better understanding of marine ecological impacts during construction and operational phases of LNG terminal at PQA. This should be a mandatory component of Environmental Monitoring Program (EMP). Ecological baseline information on PQA mangrove ecosystem in the Gharo-Phitti Creek System have been evaluated, that include mangroves, the mud flat fauna, Marine Benthic Invertebrates (MEI) habitats, pelagic and benthic fisheries along with the impacts of dredging and mitigation options have been taken onto consideration. PQA Gharo-Phitti creek ecosystem has key linkages, habitats and organisms associated within the mangrove ecosystem. Marine flora and fauna of PQA along with the mangroves and the mudflats may require special management during development of LNG jetties, dredging and LNG operation. A well formulated Environmental Management Plan (EMP) must be in place to effectively monitor the impact as per the national environmental quality standards (NEQS) and international environmental guidelines on a regular basis through independent environmental monitoring organizations. Any deviation from the basic ecological study must be highlighted followed by mitigation/remedial measures. Biological resources are renewable and can even increase with proper management.

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PJETS

Use of Technology Acceptance Model for Turnitin®

Abu Turab Alam*

ABSTRACT

A useful Information System is difficult to conceive and develop. Research on technology has revealed that end-user likes or dislikes may matter towards the success or failure of information system (IS). A highly complicated system in which developers have put lots of development efforts may fail if the end-user dislikes it after its initial installation. In software engineering literature it is claimed that system rejection is mostly caused by not meeting the non-functional requirements. In this paper, a study is being done on 'turnitin®' as technology and its acceptance to a group of students in order to find out confirmation of result as claimed by TAM while it is a post implementation research activity for technology acceptance.

1. INTRODUCTION

Davis (1989) mentioned that there is a short supply of valid measurement scale for predicting user acceptance of technology. He proposed two specific features: (i) perceived usefulness (PU/U) and (ii) perceived ease of use (PEOU/EOU). He hypothesized that these are fundamental determinants of user acceptance. The model can be visualized as shown in figure 1.

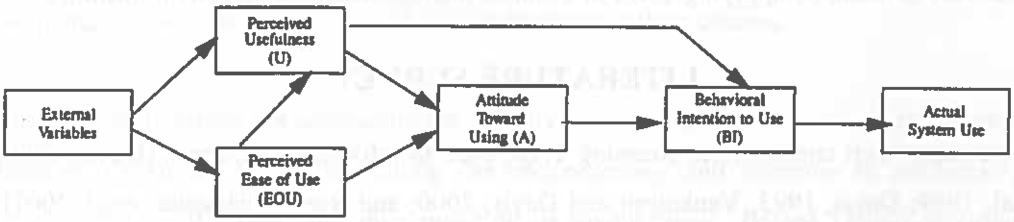

Figure 1: Basic Technology Acceptance Model (TAM)

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Perceive usefulness is the degree of believe of a person that a particular system would enhance his or her capability in job performance. While the perceived ease of use is the degree of believe that a particular system would be effortless in its usage. Over the past few years, after the publication of TAM, researchers have used this model extensively for checking technology acceptance. This paper highlights nine technological areas in which TAM was used. Table 1 summarizes the number of articles using TAM in different fields:

Table 1: Areas of research and the number of papers found in the sample

S.No.	Areas (field of study)	No of Papers
1	IS/IT	36
2	E-Commerce	28
3	E-Learning	21
4	Telecommunication	9
5	Online Banking	2
6	Health Information System	7
7	Personal Computing	3
8	Social Sciences	2
9	Software Development Methods	4
Total		112

2. RESEARCH OBJECTIVES

Since TAM is a popular model to study technology in various study areas, this article first discusses TAM itself, with two main objectives: (1) discuss the TAM model within the domain area in which TAM is used heavily; (2) to bring out the added value of TAM in explaining a system use. This is found by applying TAM to a course management system called 'turnitin®.'

3. LITERATURE SURVEY

Davis wrote many well cited articles stressing TAM used in information systems (Davis, 1989; Davis et al, 1989; Davis, 1993; Venkatesh and Davis, 2000; and Riemenschneider et al, 2002). The popularity of the article could be observed by the citations they received, for example, Davis, 1989, has 8208 citations; Davis et al, 1989, received 4865 citation and Venkatesh and Davis, 2002, has been cited for 2655 times. Criticizing TAM applications as scientific theory, Silva (2007) argues that "our discipline (IS/IT) is not the application of rigorous statistical techniques but the proposition of theories that explain intriguing phenomena in bold ways". Moreover, reflecting on TAM from the point of view of the post positivist philosophy of science, Saliva (2007) has further stated that "progress in our field will be achieved neither by attempting to confirm theories nor by accommodating already known facts. Progress will be achieved when we are able to propose theories that solve phenomena that neither practitioners nor researchers have been able to fully explain; in other words when we establish progressive research programs."

In the subsequent discussion, we show how TAM is supported by many statistical analyses to prove acceptance of technology. For this purpose, we selected a sample technology called 'turnitin®' used generally to prevent internet plagiarism in assignments submitted by students. In author views, semester work marks can be easily managed by the use of this web based software/technology.

4. THE TECHNOLOGY 'TURNITIN®'

Turnitin is currently a very popular technology that prevents plagiarism. It engages students heavily into course work and deliver rich feedback on student work and checks for potential plagiarism. Students can check their own composition for improperly used content, inadvertent plagiarism, or quotation errors before final submission to course instructor. 'turnitin®' is the global leader in originality checking and internet plagiarism prevention. In Pakistan, many users are actively involved in submitting their assignments through an initiative of Higher Education Commission (HEC). Fortunately, this technology has been given to the author's institute, as well, and teachers have started using this technology in their classes.

Multiple publications are addressing the effectiveness of 'turnitin®' services in education which reduces plagiarism and in improving the understanding and attention to academic integrity. (Badge and Scott, 2009) and thus resulting in saving time. Batane (2010) reported a 4.3% decrease in plagiarism after introducing the use of the tool. Batane's survey shows that 65% of students likes the idea of using 'turnitin®.

5. TAM FOR 'TURNITIN®'

The user acceptance of TAM was taken as a research study. The users in this case could be researchers, instructors/teachers of a course or students using Turnitin. Not by those who want to get benefitted of other work. Second category, who like 'turnitin®,' are those students who themselves are hard workers but are not social. They do not share their work with others and sometime get less mark than those who do violate academic integrity. It is also generally seen that male students want to give their assignments to female students in order to get their attentions. In such cases, female students who get less attention in class are found happy with the introduction of 'turnitin®.' Obviously, except for difficult assignments, students who violate academic integrity are always less than those who do not violate academic integrity in a normal class.

6. RESEARCH METHODOLOGY

Data for this study was collected by a survey conducted in a local teaching institute situated in Karachi. A total of 262 students were contacted through kwiksurverys® mail server who have used turnitin®. Out of which 97 responded within 7 days response time. This resulted in a sample that was moderately well distributed in terms of range of information (See table 2). The survey (Appendix-A) consisted of 27 questions that were related to usage of the software, possible affecting acceptance of 'turnitin®' and use of its services. Likert five point scales ranging from "strongly agree" to strongly disagree" was used. This scale has been used in previous TAM related research (Igbaria et al., 1995; Teo et al., 1999).

Table 2: Survey Statistics

Male	63
Female	34
Age Range	20–24

The usefulness of software, like 'turnitin®', is quite obvious for stopping plagiarism. The question is whether the technology is easy enough to be used by both the students and teachers.

The average age of respondents was 22 years. Overall, according to software itself, around 2205 students were actively involved with 'turnitin®' in Pakistan (at the time of writing). Its standing world over is shown below (http://www.turnitin.com).

- **135+** million archived student papers
- **90,000+** journals, periodicals & books
- **823,414** active instructors
- **13.5+** billion web pages crawled
- **9,500** educational institutions
- **19** million licensed students
- **126** countries

7. FACTOR ANALYSIS

The idea was "to uncover" the latent structure (dimensions) of a set of variables. Out of 25 we left three items as dependent variables: V1, V9, and V19 (Variables/items are listed in Appendix-A in details). The factor analysis was conducted using principal axis factoring with varimax rotation as an extraction method (see for details, Nummenmaa et al., 1996; Aczel, 1999; Hair et al., 1998). The Bartlett's test of sphericity confirmed that the variables within factors are correlated. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy indicated a practical level of common variance (KMO=0.876) See Table 3.Thereby, the factor analysis was appropriate.

Table 3: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.876
Bartlett's Test of Sphericity	Approx. Chi-Square	2092.405
	Df	231
	Sig.	.000

In our case of finding popularity of 'turnitin@' usage among students, it was observed that 22 components (factors) would be needed to cover 100% of the variance of data. We have used the normal criterion of stopping when initial eigenvalue drops below 1.0, only 5 of the 22 factors were, actually, extracted for this analysis. These five factors cover 65% of the variance in the data.

Table 4: Rotated Component Matrix[a]

		Component				
		1	2	3	4	5
V2	The screens provided by the software are easy to understand		.744			
V3	I can undo a mistake before a final submission.					.738
V4	Knowing your similarity index before final submission is helpful.		.510			
V5	The timing constraints bring efficiency into my work.					
V6	Including pictures and graphs in answers help me to produce answers efficiently.					.712
V7	Producing an answer of your own is quicker than to search and copy.				.778	
V8	My concentration increases while doing an assignment on turnitin.	.620				
V10	when using the software, the competition is more in the class for a good assignment	.752				
V11	My attendance improves in the class which uses turnitin.	.542				
V12	Disallowing late submission of assignments help good students to be more attentive.				.535	

V13	My class assignments will be better judged in this system.	.729				
V14	My home assignments will be better judged in this system.	.716				
V15	When using turnitin, I am able to check my academic status anytime.					
V16	The inclusion of Discussion Board is helpful for assignment discussion.			.673		
V17	The turnitin is a globally recognized tool to stop plagiarism.	.560				
V18	When turnitin is used in a class, I have a solid reason not to provide my assignments to others		.616			
V20	A learning outcome is high in classes that are using turnitin.	.771				
V21	The required transparency is exercised by the instructor when a tool like turnitin is used in the class.	.728				
V22	My work will be better judged in this system.	.792				
V23	I can mail my instructor if my assignment is not checked using turnitin in due time.			.714		
V24	If my grades are not coming up to my expectation I can talk to my instructor before semester end.			.655		
V25	I can focus on learning content of the course rather than learning what teacher likes.				.506	

Factor analysis determined as given in table 4 and 5, it was found that only three of five factors were significant with our dependent variable/item V9. The details are given in table:

Table 5: Regression Model Summary

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.584	.215		-2.720	.007
	F1	.888	.095	.585	9.345	.000
	F2	.213	.106	.118	2.016	.046
	F4	.296	.073	.226	4.059	.000

a. Dependent Variable: V9

These factors (components, F1, F2, F4) are based on the following items. However, the dependent item in this case was V9: I like the course more with turnitin than without.

F1: Globally Recognized Standard (GRS)

V10. When using the software, the competition is more in the class for a good assignment.

V11. My attendance improves in the class which uses turnitin.

V17. The turnitin is a globally recognized tool to stop plagiarism.

V20. A learning outcome is high in classes that are using turnitin.

V22. My work will be better judged in this system.

(Note: Add 2 in variable numbers to coincide with Appendix-A Questionnaire)

F2: Ease of Use (EU)

V2. The screens provided by the software are easy to understand.

V4. Knowing your similarity index before final submission is helpful.

V18. When turnitin is used in a class, I have a solid reason not to provide my assignments to others.

F4: Perceive Usefulness (PU)

V7. Producing an answer of your own is quicker than to search and copy.

V12. Disallowing a late submission help good students to be more attentive.

PU and EU have obviously been positive on the use of 'turnitin®.' The recognition of turnitin as standard was somewhat surprising to the researcher with respect to how much the students were aware of globalization. There were two factors that were not statistically significant, i.e., F3, and F5. Probable reasons may be that in F3, feature like 'discussion board' was asked and many of the students unaware of its use. The responses, therefore, were not found consistent for statistical use. Similarly, in F5, items were discussed like resubmission facility that helps in keeping similarity index low. Fewer students were aware of this facility so the responses received were statistically insignificant.

8. SUMMARY AND CONCLUSIONS

The primary objective of this paper was to study students acceptance of 'turnitin®' in Pakistan in the light of the technology acceptance model (TAM). Initially, we have tried to use factor analysis for confirmatory factor analysis, using the TAM factors (i.e., PU, PEOU, etc.) into our consideration. Later it becomes an exploratory factor analysis, when we found that a new factor may be significant for technological acceptance which we call "Global Recognized Standards (GRE)." In technology such as turnitin, students are highly committed to compile their assignments efficiently. It is hard to make them like this technology unless they are forced by the global competitions. In response to the question "The turnitin is a globally recognized tool to stop plagiarism" 70% students were in agreement to this statement.

From a theoretical standpoint, the results contributed towards existing knowledge in a number of ways. First, the information provided in the article contributes towards internet plagiarism by providing insights on the factors that seem to affect 'turnitin®' acceptance. Both the teachers and students can benefit by the arguments posed as factors. The results hint that global information about 'turnitin®' functions and its benefits are critical factor influencing the acceptance of this technology.

Secondly, the study confirmed, as in the technology acceptance literature, that ease of use EU as well as perceived usefulness (PU) was found to have some effect on technology acceptance (cf.

Davis, 1989; Davis & Ann., 1989; Teo et al., 1999). Furthermore, we found that PU was more influential than PEOU in explaining technology acceptance.

9. CONCLUSION

The results of the study provide some information about the planning of 'turnitin®' Web sites and guide service selection. In the planning and development of 'turnitin®' services, software developers should pay attention to informative content that is above all perceived useful and with relevant information and services. In institution processes of 'turnitin®' services, instructors should accentuate the benefits of adoption of technology. Institutes should now concentrate in their advertising more to informative issues rather than in building only brands with less informative advertisements.

10.LIMITATIONS AND FURTHER RESEARCH

Although the results can be considered statistically significant in most parts, the study has several limitations that affect the reliability and validity of the findings of few factors (F3 and F5). First of all, the regression model developed had relatively low coefficient. The second limitation concerns the sample. Although the sample size was quite large compared to sample sizes of other TAM studies, it consisted of finish consumers only. This has an effect on the generalization of the findings. The other limitation of this work concerns the measures for user acceptance. TAM studies have found that PU and EU are not the only predictors of technology acceptance. Legris et al., 2003, found that many TAM studies are not consistent or clear and lack many factors that influence adaptation.

Students' acceptance of 'turnitin®' are consistent and many new significant factors surfaced to support its adoption. Partly on this basis, the original TAM has been extended for example by Venkatesh and Davis, 2000, who introduced the second version of TAM, labeled TAM2 to explain how subjective norms and cognitive instrumental processes affect perceived usefulness and intentions (see also Venkatesh and Morris, 2000. On this basis, our model might also suffer from the fact that for example subjective norms and other possible factors influencing the acceptance of 'turnitin®' were not included in the model. These limitations pave the way for future studies.

11.ACKNOWLEDGEMENT

I acknowledge Dr. Ejaz Ahmed and Mr. Rizwan Ahmed for making me understand 'nitty-gritty'of 'factor analysis.'

Appendix-A

This survey is done to find out that "turnitin" is an acceptable technology for students or NOT.

Please indicate your Gender

○ Male ○ Female

In which class you were enrolled while experiencing turnitin?

○ BBA ○ MBA

Variables	Questions	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
V1	The software is easy for me to use.	○	○	○	○	○
V2	The screens provided by the software are easy to understand	○	○	○	○	○
V3	I can undo a mistake before a final submission.	○	○	○	○	○
V4	Knowing your similarity index before final submission is helpful.	○	○	○	○	○
V5	The timing constraints bring efficiency into my work.	○	○	○	○	○
V6	Including pictures and graphs in answers help me to produce answers efficiently.	○	○	○	○	○
V7	Producing an answer of your own is quicker than to search and copy.	○	○	○	○	○
V8	My concentration increases while doing an assignment on turnitin.	○	○	○	○	○
V9	I like the course more with turnitin than without.	○	○	○	○	○

V10	when using the software, the competition is more in the class for a good assignment	○	○	○	○	○
V11	My attendance improves in the class which uses turnitin.	○	○	○	○	○
V12	Disallowing late submission of assignments help good students to be more attentive.	○	○	○	○	○
V13	My class assignments will be better judged in this system.	○	○	○	○	○
V14	My home assignments will be better judged in this system.	○	○	○	○	○
V15	When using turnitin, I am able to check my academic status anytime.	○	○	○	○	○
V16	The inclusion of Discussion Board is helpful for assignment discussion.	○	○	○	○	○
V17	The turnitin is a globally recognized tool to stop plagiarism.	○	○	○	○	○
V18	When turnitin is used in a class, I have a solid reason not to provide my assignments to others.	○	○	○	○	○
V19	If my assignment similarity index is high, a low grading will not give me a pain.	○	○	○	○	○
V20	A learningout come is high in classes that are using turnitin.	○	○	○	○	○
V21	The required transparency is exercised by the instructor when a tool like turnitin is used in the class.	○	○	○	○	○
V22	My work will be better judged in this system.	○	○	○	○	○

V23	I can mail my instructor if my assignment is not checked using turnitin in due time.	○	○	○	○	○
V24	If my grades are not coming up to my expectation I can talk to my instructor before semester end.	○	○	○	○	○
V25	I can focus on learning content of the course rather than learning what teacher likes.	○	○	○	○	○

Appendix-B

Results for survey: Survey for Turnitin

Survey Invitations

Invitations Sent:	262
Invitations Accepted:	51
Untracked Responses:	46
Total Completed Surveys Received:	94
Total Incomplete Surveys Received:	3
Total Responses Received:	97

This survey is done to find out that "turnitin" is an acceptable technology for students or NOT.

Q1. Please indicate your Gender

Male	63	64.95%
Female	34	35.05%

Q2.In which class you were enrolled while experiencing turnitin?

BBA	8	8.25%
MBA	89	91.75%

Q3. The software is easy for me to use

Strongly Agree	40	41.24%
Agree	50	51.55%
Neutral	7	7.22%
Disagree	0	0.00%
Strongly Disagree	0	0.00%

Q4.The screens provided by the software are easy to understand

Strongly Agree	29	29.90%
Agree	61	62.89%
Neutral	6	6.19%
Disagree	1	1.03%
Strongly Disagree	0	0.00%

Q5.I can undo a mistake before a final submission.

Strongly Agree	24	24.74%
Agree	49	50.52%
Neutral	20	20.62%
Disagree	1	1.03%

Q6. Knowing your similarity index before final submission is helpful.

Strongly Agree	11	11.34%
Agree	52	53.61%
Neutral	24	24.74%
Disagree	7	7.22%

Strongly Disagree	3	3.09%	Strongly Disagree	3	3.09%

Q7. The timing constraints bring efficiency into my work.			**Q8. Including pictures and graphs in answers help me to produce answers efficiently.**		
Strongly Agree	25	25.77%	Strongly Agree	20	20.62%
Agree	43	44.33%	Agree	55	56.70%
Neutral	17	17.53%	Neutral	19	19.59%
Disagree	9	9.28%	Disagree	3	3.09%
Strongly Disagree	3	3.09%	Strongly Disagree	0	0.00%
Q9. Producing an answer of your own is quicker than to search and copy.			**Q10.My concentration increases while doing an assignment on turnitin.**		
Strongly Agree	14	14.43%	Strongly Agree	16	16.49%
Agree	43	44.33%	Agree	56	57.73%
Neutral	20	20.62%	Neutral	15	15.46%
Disagree	16	16.49%	Disagree	8	8.25%
Strongly Disagree	4	4.12%	Strongly Disagree	2	2.06%
Q11. I like the course more with turnitin than without.			**Q12. When using the software, the competition is more in the class for a good assignment**		
Strongly Agree	16	16.49%	Strongly Agree	25	25.77%
Agree	43	44.33%	Agree	52	53.61%
Neutral	22	22.68%	Neutral	9	9.28%
Disagree	11	11.34%	Disagree	9	9.28%
Strongly Disagree	5	5.15%	Strongly Disagree	2	2.06%
Q13. My attendance improves in the class which uses turnitin.			**Q14. Disallowing a late submission help good students to be more attentive.**		
Strongly Agree	22	22.68%	Strongly Agree	32	32.99%
Agree	47	48.45%	Agree	48	49.48%

Neutral	19	19.59%	Neutral	9	9.28%
Disagree	7	7.22%	Disagree	7	7.22%
Strongly Disagree	2	2.06%	Strongly Disagree	1	1.03%
Q15. My class assignments will be better judged in this system.			**Q16. My home assignments will be better judged in this system.**		
Strongly Agree	19	19.59%	Strongly Agree	20	20.62%
Agree	48	49.48%	Agree	47	48.45%
Neutral	14	14.43%	Neutral	16	16.49%
Disagree	13	13.40%	Disagree	11	11.34%
Strongly Disagree	3	3.09%	Strongly Disagree	3	3.09%

Q17. When using turnitin, I am able to check my academic status anytime.			**Q18. The inclusion of Discussion Board is helpful for assignment discussion.**		
Strongly Agree	35	36.08%	Strongly Agree	9	9.28%
Agree	51	52.58%	Agree	45	46.39%
Neutral	9	9.28%	Neutral	36	37.11%
Disagree	2	2.06%	Disagree	7	7.22%
Strongly Disagree	0	0.00%	Strongly Disagree	0	0.00%
Q19. The turnitin is a globally recognized tool to stop plagiarism.			**Q20. When turnitin is used in a class, I have a solid reason not to provide my assignments to others.**		
Strongly Agree	17	17.53%	Strongly Agree	34	35.05%
Agree	52	53.61%	Agree	48	49.48%
Neutral	24	24.74%	Neutral	9	9.28%
Disagree	4	4.12%	Disagree	5	5.15%
Strongly Disagree	0	0.00%	Strongly Disagree	1	1.03%
Q21. If my assignment similarity index is high, a low grading will not give me a pain.			**Q22. A learningout come is high in classes that are using turnitin.**		
Strongly Agree	12	12.37%	Strongly Agree	16	16.49%

Agree	38	39.18%
Neutral	21	21.65%
Disagree	19	19.59%
Strongly Disagree	7	7.22%

Agree	48	49.48%
Neutral	22	22.68%
Disagree	8	8.25%
Strongly Disagree	3	3.09%

Q23. The required transparency is exercised by the instructor when a tool like turnitin is used in the class.

Strongly Agree	20	20.62%
Agree	56	57.73%
Neutral	14	14.43%
Disagree	4	4.12%
Strongly Disagree	3	3.09%

Q24. My work will be better judged in this system.

Strongly Agree	16	16.49%
Agree	55	56.70%
Neutral	13	13.40%
Disagree	8	8.25%
Strongly Disagree	5	5.15%

Q25. I can mail my instructor if my assignment is not checked using turnitin in due time.

Strongly Agree	24	24.74%
Agree	42	43.30%
Neutral	22	22.68%
Disagree	6	6.19%
Strongly Disagree	3	3.09%

Q26. If my grades are not coming up to my expectation I can talk to my instructor before semester end.

Strongly Agree	14	14.43%
Agree	58	59.79%
Neutral	16	16.49%
Disagree	7	7.22%
Strongly Disagree	2	2.06%

Q27. I can focus on learning content of the course rather than learning what teacher likes.

Strongly Agree	14	14.43%
Agree	49	50.52%
Neutral	22	22.68%
Disagree	10	10.31%
Strongly Disagree	2	2.06%

Inserted from <http://www.kwiksurveys.com/results-overview.php?survey_ID=NLLOIN_348ca54>

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PJETS

A Novel Text Steganography Technique to Arabic Language Using Reverse Fatha (الفتحة)

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ABSTRACT

This paper presents a new technique for information hiding in Arabic language. The technique uses text steganography to hide the information. Considering the existence of Harakat (Fatha, Kasra and Damma) in the languages a new approach of reversing the Fatha has been developed for message hiding. The technique has also been evaluated to ensure its quality. This technique can be applied on other languages like Persian, Sindhi and other Regional languages.

KEYWORDS: Steganography, Arabic Text, Text Steganography, Information Security, Fatha, Reverse Fatha and Harakat.

1. INTRODUCTION

The security of information has gained special significance due to heavy penetration of information exchange devices like computers, mobile phones in our daily routine. One of the major concerns of information security is to securely exchange information between the communicators. For this purpose various techniques like cryptography, steganography, coding and digital watermarking (Cox I. J., et al. 2008) are being used. Steganography is derived from two Greek words "*Steganos*" and "*Graphia*" (Cox I. J., et al. 2008) means "covered" or "hidden" and "written" respectively. The main purpose of this technique is to hide data in a cover media so that data is undetectable by anyone else. The simple implementation method of this technique is to hide text data in cover image file. The cover media for a steganography technique can in a text (Shirali-Shahreza M. H. and Shirali-Shahreza M., 2006, Gutab A. and Fatani M. 2007, Bennett K., 2004), in audio (Gopalan K., 2003), image (Doerr G. and Dugelay J. L., 2003, Doerr G. and Dugelay J. L., 2004) or video

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(Chandramouli R. and Memon N., 2001, Shirali-Shahreza M., 2005). Mostly text steganography is not used, as it contributes in increasing the difficulty level for detection of hidden bits while text cover data offers smaller memory occupation and is simpler to communicate (Shirali-Shahreza M. H. and Shirali-Shahreza M., 2006). Steganography adds another layer of secrecy *undetectability* over cryptography's *confidentiality* (Bohme R. 2010). The individuals can not notice the existence of secret information if steganography is used while they can observe the encoded secret information if cryptography is used.

The prime objective of this research is to develop a new steganography technique for Arabic language. This work encompasses on applying steganography in such a way that although the language text remains accessible to everyone but only the concerned receiver is able to decipher and extract the crucial information. The next phase is to evaluate the quality of technique which is defined in (Bohme R. 2010) steganography as how difficult it is to detect the presence of hidden information or to break the technique.

2. METHODOLOGY

2.1. Proposed Technique

Languages like Arabic use Harakat or short vowel marks (Fatha, Kasra and Damma) for the correct pronunciation of a word. A single word in these languages has multiple meanings depending on the pronunciation handled by Harakat. Harakat can be used on a single alphabet of these languages. Few changes have been made in these Harakat to achieve steganography in this research like reversing the Fatha.

The technique reversal of Fatha; is used in this research to hide secret messages within the text. To achieve reversal of Fatha one needs to change the display manner of an original Fatha. Figure 1 and 2 shows this technique being implemented on a single alphabet "NOON" of Arabic language. The original display manner of a Fatha is a small line inclining from left to right as shown in Figure 1. Figure 2 shows the display manner of a Fatha that has been changed to a small line declining from left to right called as Reverse Fatha.

Figure 1 - NOON with Original Fatha

Figure 2 - NOON with Reverse Fatha

In this technique alphabets in a text are selected in a manner that hidden message can be extracted by simply placing them on side by side manner. Reverse Fatha is used on these selected alphabets instead of an original Fatha. These selected alphabets with reverse Fatha are treated as a secret alphabet within the text.

Figure 3 shows information has been hidden in cover text with original Fatha (as shown in figure 4) with the help of reverse Fatha technique. The information hidden in the cover text is shown in figure 5.

Figure 3 – Information hidden in cover text with Reverse Fatha

مُجْتَبٰى وَهُّوْ مَحَاضِر

Figure 4 – Cover text with original Fatha

توم حض

Figure 5 – Hidden information

The algorithm designed to hide the secret message in this technique is as follows

- Break each word of secret message into alphabets.
- Find the above alphabets having Fatha in the cover article.
- Reverse the Fatha of these alphabets with the help of new Font family created as mention earlier in a word processing software.

The algorithm designed to detect the secret message on receiving end involves the following steps

- Mark the alphabets in the article with reverse Fatha.
- Extract and simultaneously place the alphabets starting from the first letter of the article.
- Combine these extracted alphabets to achieve the secret word.

2.2. Implementation

The implementation process involves following phases

- Creation/Editing of font that is Reverse Fatha.
- Installation of the fonts in the Windows Fonts.
- Using the font in word processing softwares like MS Word 2007, WordPad to implement Reverse Fatha technique.

Software named Font Creator version 6.2 and predefined fonts for the Arabic language are used in this research. The process begins by editing a glyph Fatha in Arabic Transparent font family having Unicode $064E to glyph Reverse Fatha having same Unicode in the same font family. To achieve this just change the font style of Fatha with the help of software Font Creator version 6.2 by using following steps

- Initially open the font family (Arabic Transparent in this case) in Font Creator software.
- Open the desired glyph of font (Fatha in this case).
- Change the direction of Fatha by using the mirror button available in the drawing toolbar.
- Finally save the glyph further save the font family with a new name.

The next phase in the process is to install the font which can be done simply by copying newly made font file into Font folder of the Windows. The last phase involves usage of any word processing softwares (MS Word in this case) for hiding the secret message with the help of algorithm earlier mentioned. It should be insured that Arabic fonts should be installed before using the fonts.

3. EVALUATION

3.1. Method of Evaluation

The purpose to evaluate this technique was to observe how strong or efficient this technique is in the real world. This technique was developed to ensure securely hide the secret message but if someone would easily break the technique and view the secret message then there was no point to use the technique. Initially some secret message was hidden in an article of Arabic language using this technique, and then a questionnaire was developed to ask the readers if they were able to find the secret message. The article and questionnaire were distributed among different types of targeted audiences like some ordinary readers and some having familiarity with steganography or cryptography. It was obvious that negligible amount of ordinary readers would be suspicious about the article. Hence a hint for presence of secret message was given to the readers with the help of a question in the questionnaire. It was expected that this hint would be able to raise the level of doubt in the readers and correspondingly increase their focus level to detect the secret message.

3.2. Statistics of Evaluation

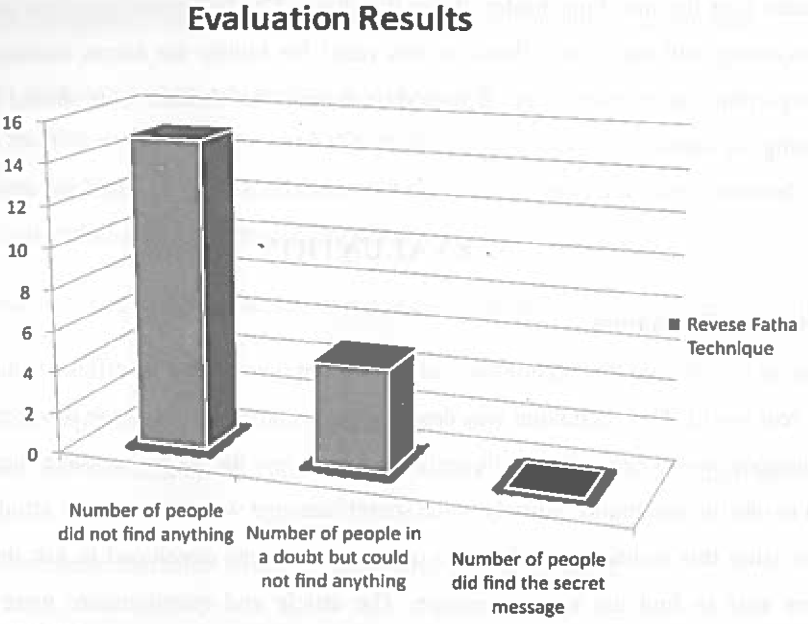

Figure 6 - Bar chart for results obtained in evaluation process

Figure 6 shows the statistics that have been calculated from the questionnaire asked in evaluation process. The article with questionnaire was distributed amongst 20 people, out of whom only 5 people were in a doubt while the rest could not find anything suspicious. These statistics show that even by giving the readers a hint for presence of secret message, about 75% of the readers were neither able to detect anything nor had any doubt. The remaining 25% of the readers had some kind of doubt about the presence of a secret message in the article but were unable to detect the secret message. It was observed that none of the readers were able to detect the secret message or the technique used for the steganography.

4. CONCLUSION

In this research a new approach for steganography of information in Arabic text was introduced. This technique is based on the existence of Harakat in majority of Arabic alphabets. The information was hidden in the text by placing the reverse Fatha. This technique can be used in hidden exchange of information through text documents and text watermarking. In addition to establishing secret communication, this technique can be used for preventing illegal duplication and distribution of text especially electronic text (Westfield A. and Pfitzmann A., 2000, Westfield A., 2001). This technique can be applied on hard copy documents, an OCR (Optical Character Recognition) and software is needed to detect the hidden information on receiver end. This technique can be used in languages like Persian, Urdu, Sindhi and other regional languages considering the similarity of these languages with Arabic. The number of hidden bits of information can be increased by combining reverse Fatha technique with size or width variation of other Harakat, and (or) with line shifting and word shifting techniques. A combination of different text steganography techniques with this technique can be applied in the same article.

5. RECOMMENDATION

Further work can be carried out for the following

- To design software that extracts the hidden alphabets from hard copy articles using this technique.
- To implement this technique for other languages like Persian, Urdu, Sindhi and other regional languages.
- To implement watermarking by using this technique. The original extra information is sent to attend and authenticate the fact that message is indeed sent from the particular source in watermarking.
- To increase the level of security by incorporating steganographic techniques with proposed information security techniques like cryptography, watermarking or both.
- To design techniques for Reverse Kasra expansion of Harakat.
- To design a technique to further increase the level of hidden bits by combining techniques like Reverse Fatha with Reverse Kasra, Line Shifting and Word Shifting techniques.

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Cost Effective Monitoring and Automation of Concrete Plant Using PLC

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ABSTRACT

A PLC is a digital computer used to automate electromechanical processes. This research is based on automation and real time monitoring of concrete plant by using Siemens PLC. Automatic plants can work continuously and can decrease the gap between demand and supply. For such plants there is no need of labor so there is no human error. Without human error the quality of product is better and the cost of production would definitely decrease. The main motivation factor of this research is cost effective automation and real time monitoring of plant.

Key terms: Programmable Logic Controller, concrete plant, automatic control.

PIC: Programmable Interface Controller

I/O: Input Output Devices

HMI: Human Machine Interface

Psi: Pound per square inch

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1. INTRODUCTION

A PLC or Programmable Logic Controller is a digital computer used for automation of electromechanical processes. It is used to convert the previously used "Relay Logic" or "Wired Logic" for automation of an industrial process into Ladder Logic as done in PLC-Based Monitoring Control System for Three-Phase Induction Motors in (Birbir.Y, Nogay, 2008) and Automation Control in Painting Line of Steel Plant (Hao.L, Ruilin.P, 2005). It is used to automate respective processes but in this research Siemens LOGO is used which is in the cheapest category or entry level of PLC. The reason of it being cheap is that it has limited number of input and output ports (I/O's). A concrete plant is taken into consideration for this research whose input and output devices matched LOGO's configuration. This plant comprises of three gates for ingredients of concrete, a conveyor belt to pour the ingredients into mixer and a water tank and storage for cement. Gates are controlled through pneumatic jacks that are operated by a compressor. Motors drive the conveyor belt and rotate the mixer.

2. PROBLEM

Concrete is the main part for construction. The existing plants work manually which takes a lot of time for production that results in a gap between demand and supply. Manual plants require a lot of labor that increases the cost of production. Labor works in shifts, which means more labor and time. Human intervention in any operation may cause human error. The existing plants are totally labor dependant which can create many errors during production thus affecting the product quality.

This research provides solution to the problems mentioned above by replacing wired logic with ladder logic. This research is based on PLC to automate the plant so that the gap between demand and supply could be reduced. Without human error the quality of product will be better and the cost of production will definitely decrease. The plant built for this research is a prototype, it was assumed prior its construction that the flow of sand and rocks would be smooth and there would be no resistance while opening and closing of the gates. There would be no blockage in flow. Timers would be used for the pouring cement so it was also assumed that the flow of cement would be according to the calculation. Another contention made was that a reed switch used for filling of water tank would be installed away from the influence of magnetic field; otherwise the reed switch would give false results.

3. DESIGN ISSUES

3.1 MECHANICAL DESIGN ISSUE

Concrete plant is a mechanical plant which is used to make concrete according to the requirements and formula specified. The concrete plant consists of conveyer belt, motors, pneumatic system, solenoid valves, load cells, limit switch etc. This prototype works on the formula specified for the concrete which is controlled by the PLC. The PLC has inputs and outputs that are used for getting information and sending the signals to the actuators. The actuators then perform the task for certain amount of time or when the sensor senses the limit (LOGO Manual and Bolton.W, 2006). While making this prototype a lot of mechanical problems were faced so while designing the mechanical structure we visited many plants to learn the process of the plant. During the designing and implementation phase of constructing the prototype structure, many problems were encountered. The major issue with the plant was that the plant was a prototype of a concrete plant and most of the parts available in market were for large scale plants so they had to be modified according to the requirements. Many of the mechanical processes were expensive, such as the transfer of cement from hopper to mixer. This process needs a screw system which was costly. It is expensive because it needs precision mechanical work to make a perfect screw. Then phasing the screw is also necessary, without phasing, the cement will not move. It is a well known fact that cement is a costly product therefore it needs to be isolation from air, water etc. These factors increase the cost of screw system. In this prototype making of a screw, the project cost exceeded allocated budget. To circumvent the problem a different idea for cement process was implemented. A hopper was introduced that directly dumped the cement in the mixture by using pneumatic system with a timer.. The flow of cement was tested at least 20 times to get the perfect relation with the weight and timing of cement.

In the prototype designed there was a problem with the gates of hoppers which had different kinds of material. While dropping the material there was a chance that materials including fine sand, fine stone and stone could jam the gates. This prompted the redesigning and changes to the gates on urgent basis. The previous design was of vertically control gates were not effective, the gates were frequently jammed by the material during the closing of the gates. But then it was decided to control the gates horizontally so that it could reduce the jamming of gates while closing. Another problem encountered was that in pneumatic system the jacks were controlling the gates at a much faster pace, opening them fully at very high speed. In this manner springs were placed in the jacks so it could reduce the opening speed of gates and the process would slow down. As a result the flow of material to the conveyer belt was not excessive.

3.2 ELECTRONIC DESIGN ISSUES

Since the controlling of the concrete plant is based on PLC, not much electronic circuitry was involved. The only problem while designing was the conversion of parallel data into serial data which was a part of real time monitoring process of the plant. So for this purpose a microcontroller was used to transfer the data serially. This involved a circuitry which was designed according to the requirements.

4. METHODOLOGY

4.1 WORKING

Working of the concrete plant involved many dimensions (See Figure 4.2). The PLC was programmed on ladder logic. The working of the plant starts as gate 1 is opens and it drops the sand on to the conveyer belt. The load cells are attached to the conveyer belt. They sense the load and give output in a form of voltage. This voltage is an input in the analogue module of PLC. In the program of PLC, there is a threshold voltage set, when the load cell exceeds that voltage the PLC that gives a signal to the pneumatic system to close the gate instantaneously. The load cell was attached to input I5 of the PLC and gates 1, 2 and 3 were connected to outputs Q1,Q2 and Q3 of the PLC respectively (See Figure 4.4). Then according to the program PLC gives signal to the conveyer motor and it works for a certain time as specified by the program. The conveyer belt dumps the material which is sand in the mixture. As soon as the conveyer belt starts moving the mixture motor also starts at the same time. But the mixture motor does not stop working till the end. Same process repeats for the Gate2 and Gate3 which includes fine sand and rocks. After this the pump connected at port Q5 of PLC gets triggered to pour water in the tank. Inside the tank there is a water level sensor or upper limit sensor connected at port I1 which gets triggered when the water reaches its limit. The sensor will then give a signal to the PLC to stop the pump for filling the tank. The solenoid valve at port Q6 is triggered to pour all the water in the mixture (See Figure 4.3). After the complete flow of water in the mixture the PLC gives signal to the pneumatic solenoid of cement gate that starts dumping the cement for the required amount of time. When all the constituents are in the mixture, the mixture mixes them for certain amount of time as specified in the program and then the product is dispatched. In our prototype the dispatching was manual.

The pneumatic jacks used in the process operated at 10 psi. The motor installed in the mixture was an induction motor with gears. And the conveyer motor was a geared motor by which the conveyer belt moved with the load at a constant speed. The solenoid valve and the water pump operated at 220V. All these actuators are controlled by relays. The relays used were of 24V DC and the output of PLC was also 24V DC. The PLC would trigger the relay whenever the actuator has to be switch ON. The 220V AC was connected to relay that was connected to actuator. Whenever relays received a 24V DC from PLC the switch of the water level sensor would trigger the relay and then through relay the PLC will get the signal which will be of 24V DC. The PLC takes input of 24V DC. In this manner the whole process works in a closed loop system. (Henry.F, 1995; Majumdar.S.R, 1995; Goodman and Robbert.B, 1997; Muller.R, 1998; Jay.H, 2003; Austin.H, 2005)

Figure 4.1 The Prototype Plant

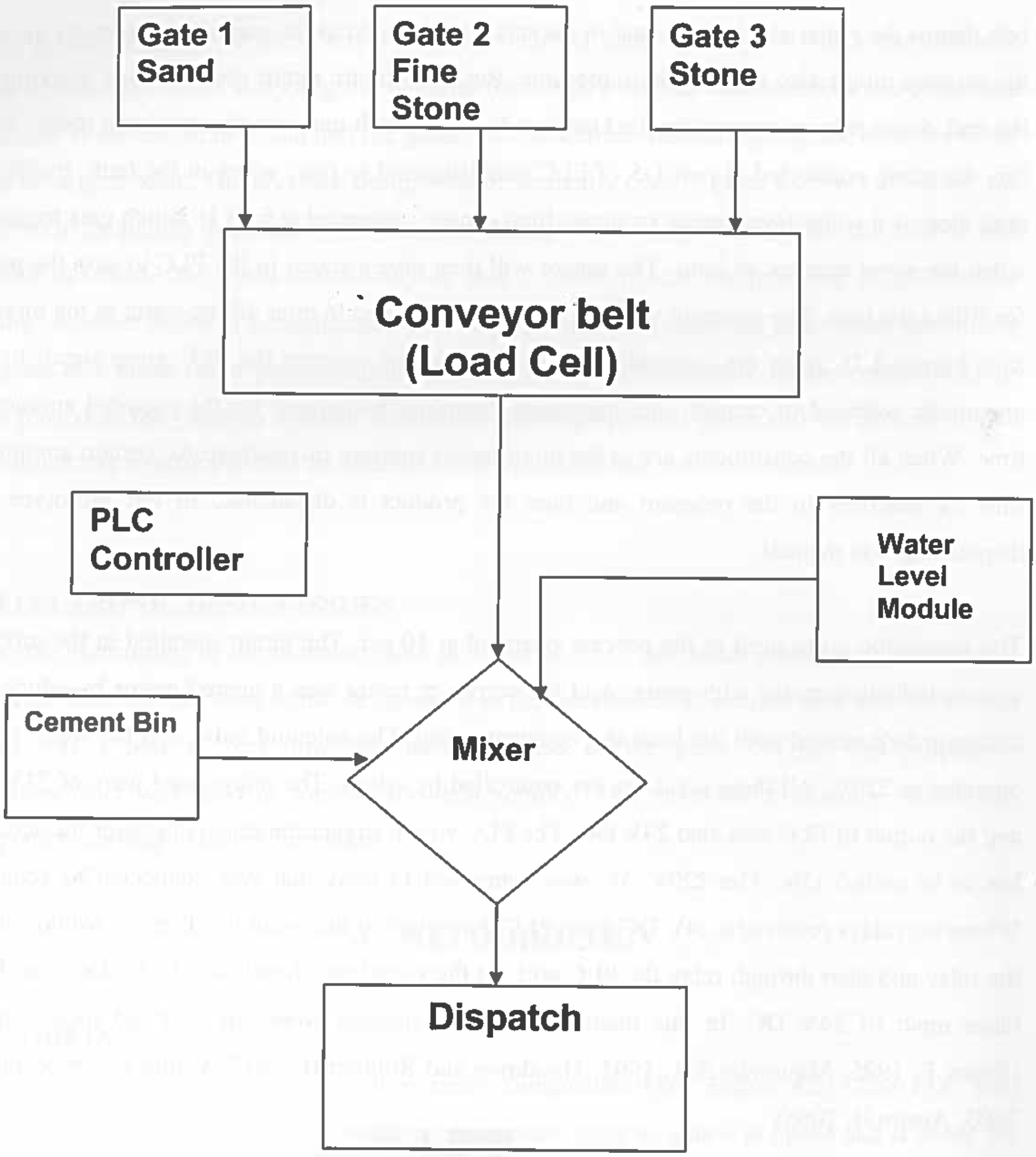

Figure 4.2 Plant Flow Chart

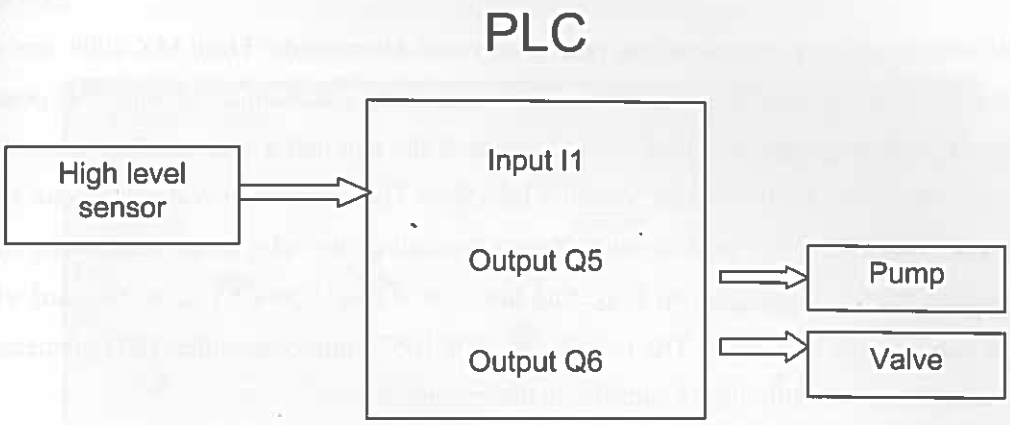

Figure 4.3 Water Level Module

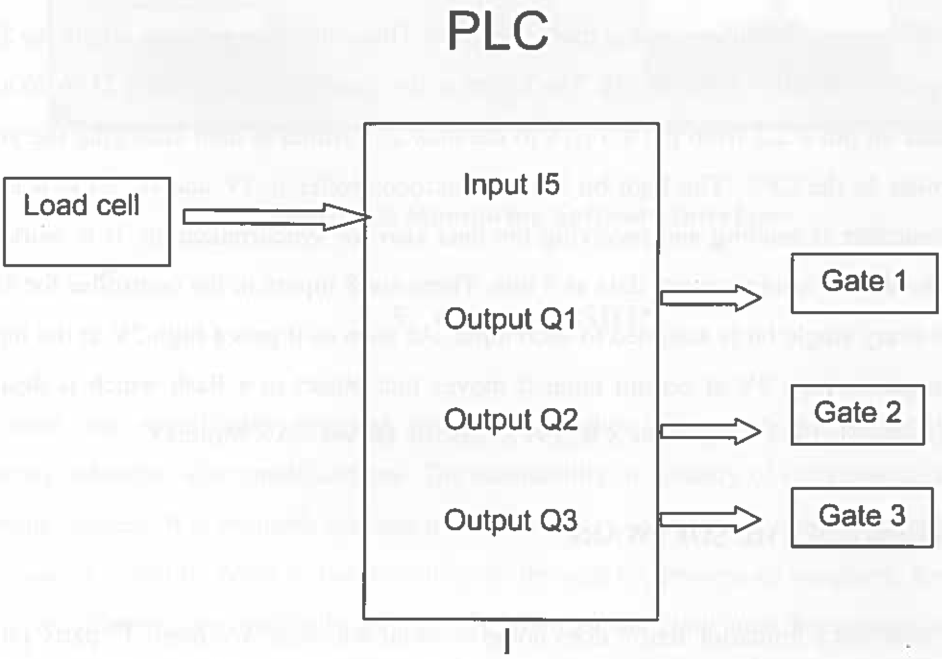

Figure 4.4 Weighing Module

4.2 REAL TIME MONITORING MODULE

For real time monitoring purpose of the plant a software Macromedia Flash MX 2004 was used instead of traditionally used Siemens Wincc which makes the communication with PLC possible by designing a microcontroller based circuit in spite of the fact that a Siemens PLC can only be interfaced with PC or HMI (Human Machine Interface) The Siemens provided software called Wincc is not cost effective. Every actuating device depends on the relay so the monitoring circuit was designed in such a way that on triggering the relay it would pass 5V dc to the card which converts parallel data into serial. The main IC is a PIC16876 microcontroller. DB9 connector is used to transfer data serially from controller to the computer.

4.2.1 WORKING OF THE HARDWARE

The PIC 16876 microcontroller was the main tool here. This controller gets vcc on pin no 20 and we can program it directly on pin 27, 28. The inputs to the controller are on pin # 21 to 26 and on pin 15,16 and on pin # 2,3 from pin # 17,18 to the max 232 which is then arranging the voltage from controller to the CPU. The high bit here at microcontroller is 5V and for CPU it is 15V. Here the controller is sending and receiving the data also for synchronization. It is working in active X. The data is sending serial data at 8 bits. There are 8 inputs in the controller for digital. This means every single bit is assigned to each input. As soon as it gets a high 5V at the input so whenever it gets a high 5V at certain input it moves that object in a flash which is design as specified. (James.H, 1993; Majumdar S.R.,1995, Electric Drives - AC Motors)

4.2.2 WORKING OF THE SOFTWARE

Flash MX 2004 has a limitation that it does not give serial interface. We used 3rd party plug-ins with Flash to serve this purpose .The plug-in work in a manner that it connects the serial data with the Flash and worked as a driver. It is important to note that it is a processor based monitoring and Flash is very good in graphics. The whole plant was designed on Flash as it made movements in every actuator in terms of animations whenever a high signal was received through the serial interface. The animations worked as long as the Flash was getting the signal from PIC.

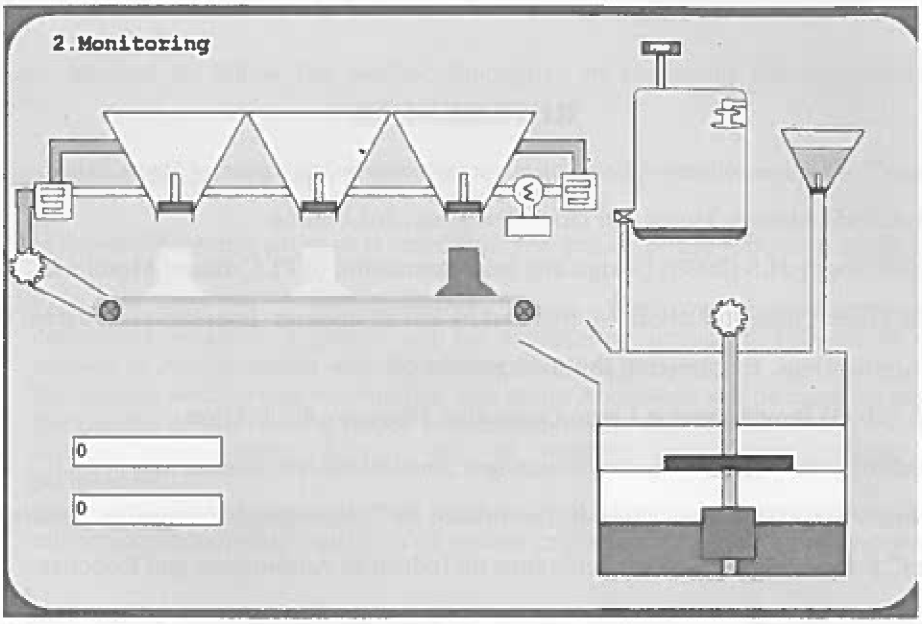

Figure 4.5 Monitoring Software Interface

5. CONCULSION

This plant was specifically designed for the production of concrete but it can be used in numerous industries after modifications. The adaptability in industry of our research is due to its automatic process. It is probable that our research work is accepted for industrial application due to the ease of usability. Most of the industries go through the process of weighing, level sensing, mixing of different raw materials and liquids whereas our plant uses Pneumatic system. Our design can work in multiple situations after required modifications. Our concrete plant can also produce concrete in bulk.

In today's world the industries can only grow by adapting making to advance and innovative technologies and by upgrading their machineries and plants. We have proposed an innovative idea of making an automatic concrete plant, which is normally manual in Pakistani industry.

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