

LEVERAGE OF OFFICE AUTOMATION IN A PUBLIC SECTOR ENGINEERING ORGANIZATION: PRE AND POST IMPLEMENTATION ANALYSIS

H. M. K. Ali, M. U. Farooq*, A. Wasim*, M. Jahanzaib* and S. Hussain*

Department of Mechatronics Engineering, *Department of Industrial Engineering
University of Engineering and Technology, Taxila, Pakistan
Corresponding Author Email: khuram.ali@uettaxila.edu.pk

ABSTRACT: The role of Information Technology (IT) solutions is becoming prominent in organizations to achieve efficiency and competitive advantages. One of such solutions is office automation (OA). It is reasonable to judge the OA impact by comparative evaluation of pre and post implementation scenarios. In this study, five key performance indicators (KPIs) affecting the OA decision were identified. Three of them namely human resource, time, and cost were quantitative KPIs, whereas two KPIs, quality of work and control over processes were qualitative. Analytical Hierarchy Process (AHP) was applied to prioritize the KPI's and to quantify their impact on OA decision. Both the quantitative and qualitative analysis demonstrated that there was remarkable improvement in office operations, once automation decision had been implemented. Overall weight obtained for automated office alternative was more than double as compared to the non-automated offices. The findings were highly motivating for public sector organizations of Pakistan to adopt automated processes.

Keywords: Office Automation (OA), Key Performance Indicators KPI's, Analytical Hierarchy Process (AHP), Engineering Organization, Mathematical Modeling

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INTRODUCTION

Information Technology (IT) enables products and solutions which are being introduced to achieve efficiency and effectiveness in organizations. IT enables environments which emerges as leading dimension for the organizations. Software applications are making the enterprise solutions available for achieving optimum results. One of such solution is Office Automation (OA). OA software solutions automate the business processes in the organizations. It involves use of integrated computer and communication systems to support administrative procedures in the organizations. In OA solutions, manual storage can be replaced with databases, typed letters and faxes with emails, reference books with e-books, manual paper based signatures with digital signatures etc (Tsichritzis, 2008).

OA is defined as "Integration of computer and communication networks for the facilitation of administrative and functional procedures"(Olson and Lucas, 1982). Information Technology and telecommunication technology have introduced new products and services in daily life. These IT enabled products are available everywhere whether it is an office, home or market place and their role is dominating day by day (Tsichritzis, 2008).

Analytical Hierarchy Process is a Multi-criteria decision making (MCDM) tool which structures the problem in an hierarchical way. Due to its strong mathematical background and a systematic way of data

collection, it has been applied in numerous multidisciplinary fields since its initial development (AHP) (Saaty, 1980).

Despite being utilized for years, it is still acting as a nice research tool in researcher's tool kits. The latest literature survey shows that it is still flourishing and getting attention in different innovative and exciting applications like green manufacturing (Deshamukhya and Ray, 2014), open source software selection (Jusoh *et al.*, 2014), hydropower development (Singh and Nachtnebel, 2015) and even in social issues like country rankings (Sagir and Saaty, 2015) and Israeli-Palestinian conflict (Saaty *et al.*, 2015) etc. However there are very rare AHP applications in office automation problems (Hamidi and Saffari, 2013) and no study has been reported in literature on office automation in the perspective of current scenario of Pakistan.

The literature review depicts that there is a need to carry out a comparative study using an MCDM technique by taking the real world organizational data to evaluate the impact of OA implementation on the organizational performance. This research, therefore, presents a case specific analysis of pre and post OA in a public sector telecommunication engineering organization. This organization provides a variety of ICT (Information and communications technologies) services to different government and semi-government organizations.

MATERIALS AND METHODS

Key performance indicators (KPIs) were divided into quantitative and qualitative categories. These KPIs were evaluated pre and post implementation of office automation in a real world public sector engineering organization using statistical techniques and the analytical hierarchy process (AHP). Actual data of a public sector telecommunication organization was obtained for two complete financial years (pre and post implementation of office automation) to visualize the change in KPIs.

Quantitative Analysis: Quantitative KPIs selected were, time required for performing the tasks, Costs involved in processing / approvals and requirements of human resource capital. Demographic data was obtained to get a true picture of responses.

Evaluating Human Resource: As a first step, the country wide Human Resource HR strength of the selected public sector engineering organization was gathered. Headquarters of the organization was in Islamabad whereas regional offices were located at Lahore, Karachi, Peshawar, Quetta and Multan. Deployment of HR was also at District and Tehsil level. Out of a total strength of 2,670 (HQs and Regions), the HR was categorized into technical, finance and administration. The total number of officers of the organization was 315 (11.79%).

Evaluating Processes Time: In order to check the time involved in project processing and approval, a generalized template was designed which covered many steps and activities involved in the processing and approval of cases. A sample of twenty cases/projects was selected to evaluate the utilization of time in processing and approval.

Evaluating Costs : All respective costs associated with automated and non-automated activities involved in planning and approvals process were evaluated before and after implementation of Office automation to see the differences.

Qualitative Analysis: The KPI's included were ,quality of work and control over the organizational processes. Qualitative analysis was conducted using survey amongst employees. Two questionnaires were designed, based on literature review for having the views and feedback of employees who previously worked in manual system environments and now working in automated environments. Responses from all cadres of the organization were gathered to ensure that all categories of employees participated in the survey. Similarly, response from different age groups, different educational levels, and from different demographic locations was included in the survey. The scale of 1-5 was used in questionnaire

with 5 corresponding to strongly agreed and 1 corresponding to strongly disagreed. The value inclined toward 5 was the measure of positive effect of quality of work and control over processes and vice versa.

Evaluating quality of work: Twelve questions were asked in the survey to gauge the impact of office automation on the quality of work in the organization. The questionnaire was based on the six variables identified from literature. These variables included: (i) efficiency of processes, (ii) paper work, (iii) transparency of processes, (iv) availability of information, (v) working conditions, and (vi) mistakes in work. Since the mean was the measure of central tendency; therefore, the responses were identified by estimating the mean values.

Evaluating the impact on control over processes: The 'management control over business processes' was evaluated through eight questions. The questionnaire was based on three variables including tracking of files, monitoring by management and decision making. These variables were based on extensive literature review.

Analytical Hierarchy Process: Analytical Hierarchy Process (AHP) based prioritization of the KPI's and their effects on automated and non-automated offices was evaluated. In this phase of research the problem was restructured to perform AHP to have a comparative evaluation and thus a more deep insight about the leverage of OA. After development of AHP hierarchy and pairwise comparative evaluations, the comparison matrices were constituted which were then solved following the standard mathematical procedures of Eigen Vector method (Saaty and Vargas, 1994).

Let the comparison matrix be denoted by "A". It had an equal number "n" of columns and rows to fulfill the definition of being a square matrix. a_{ij} was the comparative importance of KPI "i" with respect to KPI "j".

$$A = [a_{ij}]_{n \times n} = \begin{pmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{n1} & a_{n2} & \dots & a_{nn} \end{pmatrix} \quad (1)$$

Vector of weights, $w = [w_1 \ w_2 \ \dots \ w_n]$, were calculated in two steps. Normalization of the matrix 'A' which included pairwise values achieved by making use of equation (2) whereas the aggregate priorities were computed using equation (3).

$$a_{ij}^* = \frac{a_{ij}}{\sum_{i=1}^n a_{ij}} \quad (2)$$

where $j = 1, 2, 3, \dots, n$.

$$w_i = \frac{\sum_{j=1}^n a_{ij}^*}{n} \quad (3)$$

where $i = 1, 2, 3, \dots, n$.

A separate questionnaire based on pair-wise comparison of KPIs was used to rank the KPIs and alternatives. Targeted population for this questionnaire was, therefore, managers directly linked with the automation of the offices. The resultant data was then utilized to solve AHP mathematical models by using commercially available software.

RESULTS AND DISCUSSIONS

Quantitative study was carried out on three KPIs which were measured through pre and post office automation (OA) implementation. The brief job description of different categories of employees was studied. Since office automation brings efficiency in the

business processes with requirement of less support staff; therefore, it was revealed that some posts became redundant. It was calculated that 10.79% of the staff became redundant (i.e. 286 out of 2,650) post OA implementation (Fig. 1).

Time for processing and approval of all these projects varied from 42 to 58 days (Fig. 2). On an average the time required to complete the processing pre OA implementation was approx. 51 days.

It was observed that the time for processing and approval of all allocated projects varied from 25 to 41 days. The average time required to complete the processing after OA implementation was about 35 days (Fig. 2). The results clearly indicated that OA implementation reduced the processing time.



Figure 1: Comparison of HR requirements pre and post OA

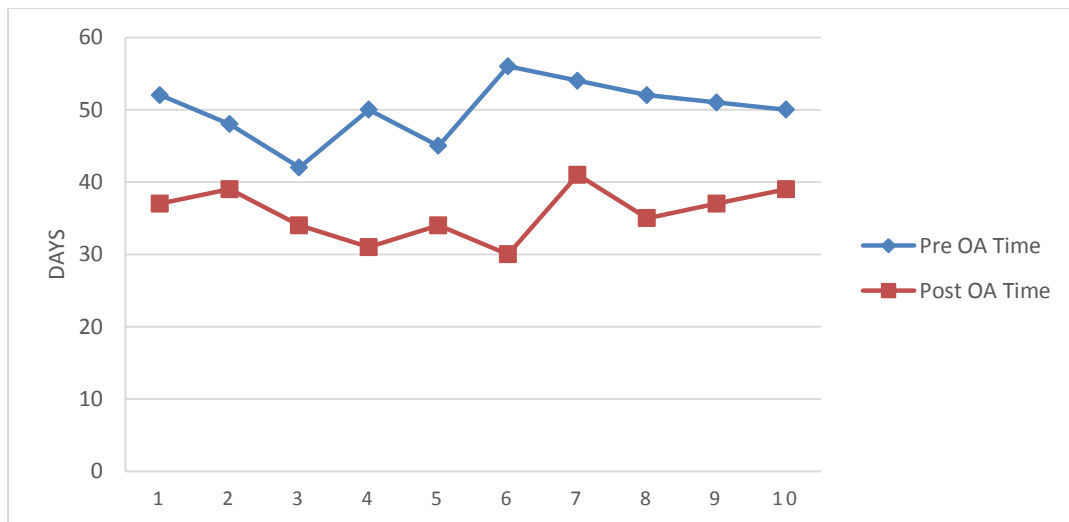


Figure 2: Pre and Post OA times (days) for different Projects

The process cycle for project initiation, planning and approvals was studied to observe the cost effects. There were two components of cost involved in business processes in manual system, listed hereunder including cost on HR and cost on establishment of automated offices. After extensive data collection from experts, following cost figures revealed.

Cost of HR	Rs. 56,808,000
Cost on office estab.	Rs. 5,820,000
Total cost	Rs. 62,628,000

Once office automation was deployed, there were three costs involved to carry out planning and approval of projects; Capital Cost on office automation hardware/software, Cost on supporting staff for OA, Scanning cost for documentation. Each cost component was evaluated for ascertaining the cost involved per annum. Following was the total cost computed by analysis which incurred after implementation of office automation system.

Capital cost on hardware/software	Rs. 5,980,000
Cost on supporting staff	Rs. 960,000
Cost on scanning of record/data	Rs. 1,000,000
Total annual cost	Rs. 7,940,000

It was estimated that the indirect savings in the shape of increase in productivity was Rs. 2.4 Million per annum. Total savings are summarized as under:

Direct savings	Rs. 54,688,000
Indirect savings	Rs. 2,400,000
Total savings	Rs. 57,088,000

Qualitative KPI's were evaluated to observe impact on 'quality of work'.

Since the mean of all responses was near to five, it indicated that quality of work improved with office automation implementation in the selected organization.

The results endorsed the findings of Nahid *et al.* (2015) who proved that productivity increased after OA implementation. However the research of Nahid *et al.* (2015) was carried out in an Iranian school of medicine.

It was clear from the above results that management control over processes increased with implementation of office automation. This endorsed the study conducted by Azizi *et al.* (2014) who claimed that OA reinforced the process of correct and efficient decision making. However that study was limited in the context of Iran. Furthermore, the highest advantages were observed in monitoring by management; whereas, the least control was obtained in decision making.

AHP based prioritization of KPI's and alternatives:

The developed AHP models were solved in commercially available software.

Since AHP analysis was based on pairwise comparisons, it was necessary to check if there were any inconsistencies in the results. Using the defined models, the 'Inconsistency Index' was computed by the software and it was 0.04 i.e. well below the Saaty's recommended upper value. The results were, therefore, proved to be mutually consistent. For a complete implementation of previously developed AHP models, it was necessary to comprehensively compile all these statistical results for both the alternatives of automated and non-automated offices with respect to each KPI.

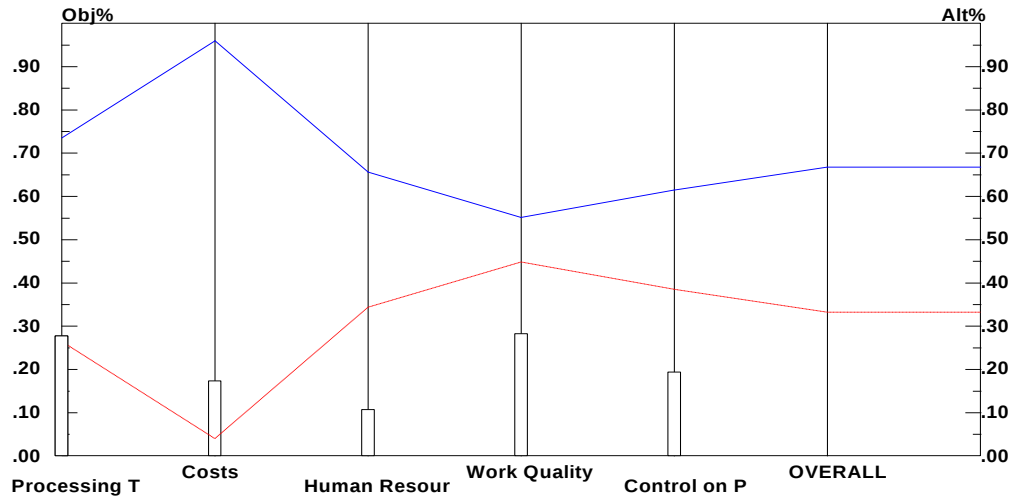
On the basis of collected data the KPI were classified into two categories; 1) Desirable KPI's (higher values). 2) Undesirable KPI's (lower values). Utility curve features were accordingly defined in the software to accommodate all the KPI's at par (Fig.3).



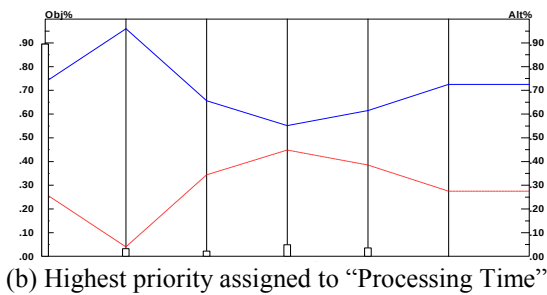
Figure 3: AHP based ranking of KPI's

The weightage obtained for the alternative of automated offices was almost double than that of the non-automated one. This quantitative analysis proved that the OA had a strong leverage over the manual operation. To have a more clear picture of this outcome and to analyze the impact of all individual KPI's, the sensitivity analysis was performed in the respective software which was not performed in most of the studies like Yang and Chen (2015). Alternative of automated office was remarkably

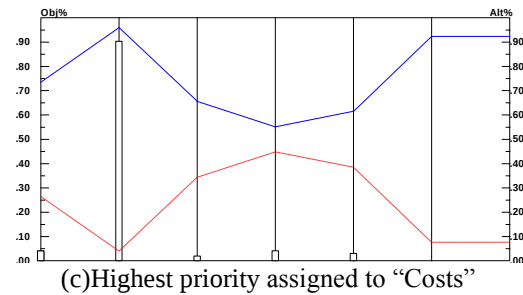
strong in almost all of the KPI's (Fig. 4). In order to perform a sensitivity analysis, the priorities of each KPI were hypothetically changed to check their effects on the overall results. These artificial scenarios were plotted in (b), (c), (d), (e) and (f) parts of Fig. 7. In a single scenario, one of the five KPI's was given extremely high importance while giving the extremely low importance to the rest. This procedure was repeated for all KPI's one by one.



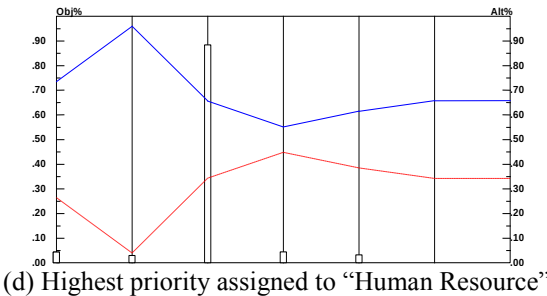
(a) Actual performance of both alternatives w.r.t. each KPI



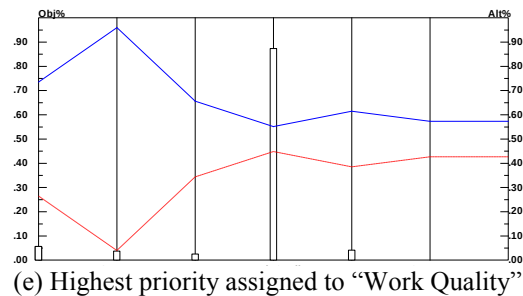
(b) Highest priority assigned to "Processing Time"



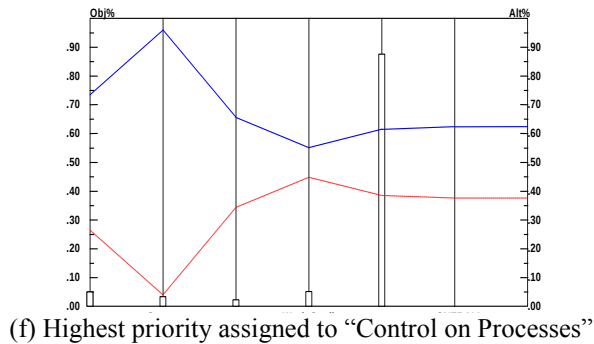
(c) Highest priority assigned to "Costs"



(d) Highest priority assigned to "Human Resource"



(e) Highest priority assigned to "Work Quality"



(f) Highest priority assigned to "Control on Processes"

Figure 4: Sensitivity Analysis

The results depicted that the AHP model showed a stable response in all of these extremes. The difference became huge when the extreme priority was given to

costs whereas it was the least in case 'work quality'. However the alternative of automated offices retained at top position. These findings were innovative and were

not achieved by the research performed by Hamidi and Saffari (2013) which was limited to the software selection.

Conclusions and Recommendations: The findings of the study revealed that there were significant improvements in the KPIs once the OA was implemented. There was a decrease in the human resource capital requirements and almost ten percent staff became redundant and available for other tasks/assignments in the organization. Total costs saved after OA implementation was estimated to be as much as rupees fifty seven millions per annum whereas, about thirty one percent time was saved. The AHP based prioritization and sensitivity analysis confirmed that the OA alternative had many competitive advantages over the manual operations. Office automation systems were, therefore, proved to be highly effective in public sector engineering organizations resulting in not only improvement in efficiency of processes but also economic advantages.

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