CHAPER 8

An Analytical Evaluation of the Impact of Computer Technology on Managerial Levels

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ABSTRACT

The impact of computer-based information technology has been addressed in many literature's, however in more or less in an abstract view. No one denies the importance of computers, however, very few have tried to analyze such an impact in quantitative manner. In most cases, information specialists have to face both declared and hidden forms of fractions while achieving their automation activities in organizations. It would be quite important to analyze different forms of the impact attempting some acceptable figures of the extent that such technology would impose on the managers from different attributes. Such studies have to consider some form of analytical as well as forecasting models to reach to indicators good enough to for specialists as well as organizations in terms of impact on the number of managers, their work practices and other related aspects. It would also highlight the truthfulness of fear from computers ending in labor number cutting as well as redistributing powers in a certain organization.

Throughout this paper, an analytical study has been made to quantitively estimate the effect of information technology on managers based on two main axioms: First, the nature of the business mission of individual managerial levels has been analyzed. Second, the extent of contribution of the computer technology; based on the undoubted figures of the new advances, has been correlated with the basic needs of the managerial levels. The study has also considered some typical comparative figures based on a statistical study on a group of 150 managers from fifteen Egyptian companies working in the sector of construction from the general business sector. Such figures have also been compared to similar results from international successful announced companies in literature. The study has resulted in a

number of logically accepted as well as interesting results from the perspectives of extent that technology can do as a replacement of human managers as well as the importance of reforming their work practices and roles. For instance, results has come up with figures ranging from 30% to 70% of dramatic change in the definition problems regarding both number and new work procedures of the business mission of different levels of managers.

INTRODUCTION

Computer technology has been dramatically improving the information systems in most fields of business applications. Many literature have addressed the scope as well as different examples of applying computer technology in many fields, even from managerial level perspectives [1, 2, 3]. While most specialists agree upon the importance of relying on such technology, there are a number of questioning regarding the extent that such techology would reduce the need to different managerial levels. Obviously, work procedures as well as management practices of the managers have to change in presence of successful Computer-Based-Information Systems (CBIS). Figure (1) presents a model indicating the different components of a CBIS from the Input-Process-Output perspectives. From the figure, managers are directly included in the two components of the knowledge workers and methods and procedures, while also implied by the different other components of the model. Meanwhile, most specialist have agreed upon classifying CBIS in terms of their functions into a number of types. Figure (2) illustrates the span of types as reflected to the different pyramidal managerial levels. In this figure, few comments would be important for subsequent analysis:

Management-Information-Systems (MIS), would provide managers with information in different forms such as summaries, statistics, graphs as well as highly structured modeled problems. Despite the value of such types in terms of improving managerial reporting as well as clear monitoring to the work problems, such types wouldn't help much directly in the decision making process!.

* Decision Support System comprlete the value of the preceding MIS to the extent of providing managers with useful indicators to solve problems, thus supporting the decision making process. Although, dialogues of What-If? Question experience answer sessions are still relying much on the knowledge as well as the quality of the still relying much on the knowledge as well as the quality of the managers.

* Expert systems while need to be field specific have employed advances in artificial intelligent and computers, attempt to provide managers with almost ready to go solutions. However, it is important to remind here that many problems in the

managerial work domain are highly unstructured, besides that successful ES 's cover a very specific scope of the work domain.

* Executive Information Systems, EIS while being introduced in the last few years, target improving the work mechanisms of executive managers as a special enhanced form of MIS and DSS. Shch systems need to face challenging nature of highly structured problems that managers need to solve.

* Office Automation has gained a dramatic jump in terms of their impact on the flow of data and information in and out organizations reducing much the time and paper work. Recent technology has contributed significantly to new forms of automation including electronic mail, conferencing and services through networks especially the INTERNET.

An in-depth study to the impact of technology on managerial level would then become important but difficult if one targets detailed undoubted figures in a quantitative manner. The difficulties of such analysis can be summarized due to the following:

1- Both technology and managerial business missions are highly dynmic due to the every day innovations and advances.

2- Study need to probe into the processing needs of the business such a study would mission of individual managerial levels

3- It would be important to retrieve logical indicative figures from the continuously changing power of computer technology in different fields as well as different functions of CBI's.

4- The main problem would be then, the correlation between the needs of a manager's business mission and the extent the computer technology would satisfy, a problem that has been always for debate!!.

The following sections would attempt to introduce analyze the main problem of this research along the highlights of the aforementioned difficulties.

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ANALYSIS OF THE BUSINESS MISSION OF MANAGERS

The business mission of different managers has a number of common characteristics in terms of their processing needs. Most literatures have identified a number of atributes towards modeling the business mission of managers. In order to develop our own refinement criterion we have considered the following methodology towards setting a quantitative frame for the job processing needs as well as skills needed for each level of the managers from the perspectives of data and information processing:

1- define a detailed list of responsibilities and requirements based on the job description.

2- for each accountable responsibility, a number of skills to guarantee effective perfomance of the job responsibilities.

3- perform a statistical frequency analysis based on a satisfactory sample of managers 'job description. For instance, we compute the relative percentage of cited skills needed from the entire span of responsibilities identified for each manager.

4- Analyze the cited frequencies of targeted skills from perspectives of its main processing requirement: planning, organizing, decision making, managing data and/or information, controlling, administrating, and making directions as well as communications.

In order to highlight the aforementioned procedure, an in-depth analysis has been made to a number of publisbed manager's careers based on proper job description. A questionnaire has been prepared and used to verify the adequacy as well as the realistic implementation of such listed needs and skills. The study has considered a set of companies working in the field of contacting, engineering and distribution covering a range from 20-30 managers from each level. The results have shown some basic differences in terms of the monitoring problems, supporting the decision making, automating work procedures and flow of data communication.

The listed needs of the manager's skills can be supported or categorized in the main functions of CBIS. For instance, controlling analyzing and monitoring are typical functions of MIS and Decision support systems.

Figure (2) summarizes the main functions supported by an CBIS as reflected to the different managerial levels. The relative presented functional areas in Figure (2) has intentionally attempted to give relative weighting of the impact of each function in terms of the business mission of managerial levels.

ANALYSIS OF THE IMPACT OF COMPUTER TECHNOLOGY A PROPOSED MODEL

Developing a quantitative model to analyze the impact of computer technology has to face a number of challenging problems:

* There has been no specific criterion to quantitatively weight the effect of individual advances of the different computer fields to each level. For instance, improving transaction processing while has direct impact on the business missions of clerks also improve the flow of information to the managerial levels.
* Many of the listed figures about the evolving technologies over time have been based on logic judgment with intention to show the grow up of the targeted techniques over time. For instance, success reports of developing more dedicated Expert Systems, or maturity of developing some EIS to assist executive management are given to illustrate how relatively the technology has encountered more semi structured type problems to computer solutions.
* There has been; to the best of my knowledge; no correlation mechanism that would relate or weight the impact of certain evolving technique or attribute of the computer technology to the different levels of management.

The aforementioned factors reveal the challenging nature of the targeted model. However, it has been decided to suggest a guideline criterion which can be applied to find a correlation mechanism between the business mission model defined in the preceding preceding section and the different forms of computer technology attributes.

In order to explain the model, a number of important guidelines and assumptions need to be highlighted. **First**,We have to accept the fact that certain impact on a lower level of managament would indirectly leads to the improvement of work procedures of a higher level. However, there are some features which would appear of more impact on a certain level rather than on the other level. For instance, long term planning and organizing is more relevant to the top management rather than to the other levels. **Second**, there are a number of qualitative measures regarding the proper use, satisfaction, and successful implementation of the computer projects in the host organizations. **Third**, remains the fact that availability of computer based solutions does necessary means that technology resources are highly utilized to their maximum extent.

Consequently, in order to simplify the matter the model has considered the assumption of applying the available technology to full extent. Figure (3) Summarizes the analysis criterion adopted in this research; with the following steps:

1- Identify the main attributes of business mission of individual management levels by analyzing the jop characteristics in terms of the relevant tasks and skills needed to accomplish the job efficiently. Models suggested by business management's experts would be a starting point to be further refined via empirical as well as ststistical analysis to define a distribution of major tasks over a certain job span of needs and requirements. Analysis of such attributes should focus on categorizing the different skills and tasks from perspectives of their processing requirements. This would, in turn, result in a number of tasks and functions such as those given in Table (1) which accounts for the relevant business tasks identified for managerial levels.

2- Apply forecasting models to estimate status of relevant computer technology fields of more pronounced impact on business mission as identified by the previous step. Such a step should come up with figures characterizing the relative contribution of technology on major application categories such as planning, organizing, follow-up, decision making ..etc. In result, an accumulative figure indicating the direct impact of the technology as corresponding to individual job needs and requirements irrespective to the different managerial levels can be estimated. The estimated measure of technology impact on each considered function is defined as **'Impact Function' (IF).** For instance, an IF of 80% as resulted from forecasting analysis of the evolving technologies as corresponds to the planning tasks. Obviously, such a figure would reflect the increasing success in the problems encountered by artificial intelligence as well as dedicated EIS supporting planning type operations.

3- Define a weighted impact function(WIF) of technology for each level of management. Such a weighted impact function is derived by weighting the estimated relative impact of the step -2 to account for the different domains as well application definition of a certain business function which differ from one level of management to another. For instance, planning while been necessary to both top and middle management has different scopes of planning problems. Obviously, the top management would deal with higher degrees of unstructured problems rather than the case with other managerial levels. attributes of the business mission listed in Table (1).

4- Correlate between the weighted impact function (WIF) as result from step-3 with the relative weight of individual jop description as identified in the first step. **A correlated impact factor (CIF)** for each category of business mission can then be calcuated as the product of the weighted impact function (WIF) with the relative weights of jop percentage each level exerts or require to satisfy the specific listed job requirements. However, there has been quite an agreement in outlining the requirements from perspective of basic functions supported by the computer-based

technologies. Table (1) summarizes the results of cited frequencies of the skills and needs for each category of the managerial levels. Obviously, different application fields may have different values, however this would serve as an evaluation methodology the cab be similarly applied.

Managerial level Skill/Need	Top Managers cited frequency	Middle Managers cited frequency	Supervisors cited frequency
planning	55%	20%	2%
Oranizing	10%	23%	4%
Controlling Analyzing/	5%	16%	44%
Follow-up Communica-	5%	15%	6%
tions	7%	12%	22%
Decision Making	14%	4%	2%
Supervising, monitoring, observing	4%	10%	20%

Table (1) Results of cited frequencies of the skills and needs.

The figures given in Table (1) has been based on imperical study which covered over150 managers from the selected business field of common characterisitics. On the other hand, the results whenever revealed great dispersion have been correlated a number of agreed-upon figures as suggested by the management models especially the one given by J. Kanter [2], which have proven quite acceptable matching. According to the proposed methodology, we have attempted to map these figures into relative needs from the major functions supported by computer-based-information systems.

Before proceeding into the analysis model, It is important to highlight the following comments:

* although different levels of managers have different job descriptions leading to some divergence in their Business mission, they all perform the listed needs/skills in Table (1).

* Computer technology supports managers at different extents basically in the form of: managing information, reporting, skills and requirements. For instance; if the weighted impact function is 30% of the problems encountered by the planning needed by a certain managerial level while the planning covers a 20% of the job span of needs; then the correlated impact factor (CIF) of technology on this attribute would be 6%.

5-Estimate the overall impact factor of technology for each managerial level by calculating the accumulated sum of the correlated impact functions over the span of business mission of each management level. This would come up with an overall measure of the impact function as corresponding to individual managerial levels. For instance, the estimated overall impact of technology on top management would be the accumulated sum of the individual CIF measures as defined from step - 4 for planning, organizing, control and the rest of the business attributes characterizing the business need for the top managerial level. Similarly, other measures can be estimated for the both middle and supervisory management levels.

RESULTS AND CONCLUSIONS

The research has intensively reviewed many of the recent reported literature covering advances and development in different computer fields. The proposed model has been applied to estimate the averge impact function of technology on each business mission. Table(2) summarizes the results obtained by correlating the relative impact figures with the weight factors of the main job requirements previously listed in Table (1).

In order to highlight the estimated results as given in this paper taking in considerations the main assumptions and rules suggested by the model, the following comments are summarized:

First, it is important, prior discussing the implications of the estimated results given in Table (2), to state here that those estimated figures are subjected to change due to a number of reasons in additions to the aforementioned ones in the basic assumptions of the model. These include, the dynamic feature of technology as well as the mentality trends of managerial levels towards letting technology overload their traditional work practices. In order to enhance the model, the resultant percentage of technology impact on each level can be further refined by considering subjective weight factors together with two more other parameters; one for the further improvement in technology and the other to account for successful implementation of CBIS as well as proper use of technology support to justify the different trends towards applying properly the technology. An Enhanced Impact Factor (EIF) can then be defined for each level of management as given in the following equation:

EIF: Enhanced Impact Factor

EIF = RIF * TUF * UF where : TUF: Technology Update Factor

UF: Utilization Factor of Technology

RIF: Relative impact factor

The Relative Impact Factor (RIF) of individual levels as given in Table (2) as: 0.37, 0.44, 0.57 for top, middle and supervisory levels respectively. The relative weight of the Technology Update (TU) is given to account for further improvements that may take place in terms of more problems that can be supported by computer technology due to the fast changeable characteristics of computer technology **First** the degree of successful Utilization of technology in the business mission of managers is considered by the factor UF in the equation. Such a factor can be estimated as the average percentage resultant from evaluating the degree of trend towards letting technology override the traditional work practices and the degree of successful implementation of technology resources.

Table (2) Estimate of the Weighted Impact Function of Computer To Main Job Functions Of Management

	Top Level		Middle Level		Supervisory	
Function	WIF	CIF	WIF	CIF	WIF	CIF
Planning	0.35	19.25	.5	I0	.6	3
Organizing	0.25	2.5	.30	9.9	.5	2.5
Controlling	0.80	4	0.85	I1.9	0.9	39.6
Analyzing/ follow-up	0.50	2.5	.6	9	.8	4.8
Communicat-ions	0.40	2.8	0.4	8.8	0.25	3.5
Decision Making	0.40	5.6	0.5	2	0.5	1.0
Supervising	0.20	0.8	0.2	2.5	0.2	4.0
Average Impact	37.45%		53.6%		56.9	

Second, the estimated impact of technology on individual levels can be looked upon in a number of different ways:

1- It could be employed as an indicator to those interested in number cutting when considering the reengineering of organizational structures of business organizations. For instance, under conditions of proper implementation and

constraints of fully utilizing computer technology, the number cutting would range from 37%,53% and 57% of top, middle and supervisory levels respectively. Obviously, plans for switching training programs or other candidate plans should benefit from such kinds of results.

2- These estimates can present a value added measures of employing computer technology as reflected to each category of managerial levels. This would even has its own impacts when analyzing feasibility of projects moving some of the commonly listed tangible benefits into the domain of tangible ones.

3- It could be also considered as targeted figeted figures of enhancement of manager's time towards efficient achievements of their tasks. In other words, one would claim that almost a percentage over 50% saving of middle managers could be saved when properly trained to use successfully applied computer technology relevant to his domain of activities.

4- The estimates given here could be debated by different arguments including the relative weights suggested for each level as given in Table (1). However, these figures have been selected via correlating both reported measures by business experts [1], and those resulted from the empirical study which covered over 50 manager each level. More truthful measures may result for different application fields, however in analogous manner.

5- Debates could arise also from the suggested weighted impact values listed for each business task, however it's the intention of this research to enhance the study via considering the applicability of more adequate forecasting models ;properly the fuzzy logic.

To sum up, this paper has presented a model with a number of guidelines to evaluate empirically and analytically the impact of technology on different managerial levels. The importance of having such measures have been highlighted focusing on their great help to automating projects as well as re-engineering organizational structures. It has been the intention of this paper to highlight and to stimulate further research towards quantifying the problem of computer technology impact on managerial levels from different perspectives of work practices, job definition and number cutting if targeted. Even debates would stimulate others to enrich such kinds of problems which lack intensive research!.

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