THE STAGES OF GROWTH MODEL FOR INFORMATION TECHNOLOGY MANAGEMENT: LESSONS TO TANZANIAN INDUSTRIES

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ABSTRACT

The Stages of Growth is one of the tools developed with the intention of assisting management in the information technology issues, specifically planning and control issues. The approach was developed with a specific environment in mind, which might not be the same now, or it might not be the same as the environment in Tanzanian industries, which is under consideration here. Through a research, it has been established that although the use of information technology budgets as the basis of identifying the stages was not supported, it was possible to identify the stages by using proven technological benchmarks. These technological benchmarks give an indication of the stage of development of information technology for an organization through establishing the type of computer processing available, such as batch processing, database processing, personal computing, or microcomputer processing. By establishing the composition of the different types of computer processing for an organization, it is then possible to determine the stage of information technology development in an organization according to the Stages of Growth model. With the stages known, it is possible therefore to make use of the other valuable lessons associated with the model, for our Tanzanian industries trying to make proper use of this powerful technology.

INTRODUCTION

The Stages of Growth (SoG) model stresses the importance of identifying the Information Technology (IT) context within the organization prior to developing a management strategy. The process response was to borrow from the social sciences the notion that organisations must assimilate the changes brought about by the introduction of computers through a predictable sequence of steps at a modest pace [1]. The theory held that the sequence, with stages of initiation, and expansion followed by consolidation and maturity, would be similar at all firms [2]. The four-stages were later superseded by a six-stages approach, consisting of

initiation, contagion, control, integration, data administration and maturity [3].

During the expansion of the stages of growth from four to six on the basis of increasing challenge, Nolan [3], suggested a three-step process for the development of an effective strategy and plan. First, management should determine where the company stands in the evolution of an IT function and should analyze the strengths and weaknesses that bear on IT strategies. Second, it should choose an IT strategy that fits in with the company's business strategy. And third, it should outline an IT growth plan for the next three to five years, detailing this plan for each of the growth processes identified.

The model is based on the hypothesis of benefiting from the experience of others through the growth stages primarily by promoting management controls during the crucial transition from a period of great expansion to one of consolidation [1]. Its main emphasis is on developing organisational structures and disciplines necessary to manage the computer room, by identifying isolated applications projects. It also stresses the need to know where a company stands today before trying to plan where it can go tomorrow [1].

The theory behind the model sounds very promising for management use as a planning tool. The model was developed around mid 1970's , and during that period IT use was still at its early stages in the developed countries. In Tanzania, as one of the developing countries, IT use is still at its early stages [4], although the nature of this early stage might not be the same as it was for the developed nations then. However, some current issues concerning IT developments in Tanzania, such as the shifting more and more from centralised to distributed systems, and the expansion of developed applications to cover planning and strategic management issues, are related to the issues addressed by the SoG model. This situation prompted a research work which was the basis of this paper.

Key issues about the SoG model are reviewed in section two of this paper and they are considered from three main areas, namely, the IT budgets, management and personnel issues, and the nature of the IT applications. Section three summarises the research methodology used, while section four gives some analysis of the results of the research. The paper is concluded in section five through a discussion.

KEY ISSUES ABOUT THE SOG MODEL

The SoG model covers three basic areas of interest in the IT use, and these include:

(1)   IT annual budgets.
(2)   Management techniques and personnel organization.
(3)   The nature of the IT applications.

These three areas are elaborated in this section.

IT Annual Budgets

Through examining the IT budgets of companies, Nolan and Gibson [2] noted that the size of the annual budgets for IT forms an S-curve when they are plotted against time. This curve consists of distinct areas, which formed the six stages of the SoG model as mentioned above, namely, initiation, contagion, control, integration, data administration and maturity.

Stage 1: Initiation:

In this stage several low-level IT operational control systems are present in functional areas, particularly in accounting and related functions.

Stage 2: Contagion:

The organization encourages innovation and extensive application of IT by maintaining low "control" and high "slack" in order to facilitate growth.

Stage 3: Control:

This stage involves rebuilding and professionalising the IT activities to give them more standing in the organization. The orientation of management shifts from the management of the computer to management of the data resources. The shift is associated with the introduction of data base technology.

Stage 4: Integration:

In this stage management applies controls to match supply and demand of data. In essence the stage involves retrofitting of the existing applications using data base technology.

Stage 5: Data Administration:

In this stage issues of the determination of data storage location, use and access, design and administration of data bases, are dealt with in a more formal way.

Stage 6: Maturity:

In this stage the application portfolio is completed and its structure "mirrors" the organization and information flow in the organization. At this stage IT is used to enable the organization attain its goals, and hence the IT systems become user oriented.

Management Techniques and Personnel Organization

In order to apply the stage model and advance through the stages it is necessary to maintain the growth of IT use. This includes the development of IT management and specialised personnel, including the analysts, programmers, operators, and so on. Two key issues need to be considered here:

Centralising and decentralising parts of IT resources:

Decentralisation of IT activities gives the users a high degree of control over the development and operation of their systems. This has some advantages such as sensitivity to user needs, operational responsiveness, and systems flexibility [1]. On the other hand, advantages of centralisation include enhanced personnel utilisation, hardware and software economics, and increased management control [1]. Enhanced personnel utilisation is achieved through the avoidance of personnel duplications, and by the superior ability of larger installations to attract and keep talented individuals. This is because in a centralised environment, only one IT installation is maintained.

The ability to attract and keep competent IT personnel is another aspect of enhanced personnel utilisation. A large organization usually has more career opportunities, more education benefits, and more work assignment varieties than smaller organisations. Therefore, large IT installations, if properly managed, are frequently more effective in retaining competent people than smaller installations.

In centralised environments, economies of scale can be achieved in the acquisition and operation of hardware and software. Better supplier services can sometimes be achieved through large scale purchase or rental.

Using steering committees:

From the above arguments, it is seen that both centralised and decentralised IT resources have advantages and disadvantages, depending on situations. It is likely that organisations, even those considered as having a centralised IT system, will have a certain degree of decentralisation. This being the case, there is a need for organisations to have a management tool for communication and priority setting, and steering committees are very common [3].

IT steering committees provide the formal structure within which IT resources allocation and project responsibility issues are discussed. The main activities of these committees include setting priorities, monitoring systems progress on a very general level, approving major expenditures, and representing inter-departmental interests on the policy level [3].

The Nature of the IT Applications

The SoG model has also been associated with the nature of IT applications in an organization. Particularly, three groups of IT applications have been identified, and they include:

(a)   Operational control applications
(b)   Management control applications
(c)   Strategic planning applications

As their titles suggest, these three types of applications differ in the sense that the more experienced an organization is with IT, the more likely that management control and strategic planning applications will be developed. It was therefore possible to associate this with the six stages

of the SoG model as shown in table 1 [3]. In this table, it shows that during the early stages most of the applications are of operational control nature. As an organization advances through the stages, management control and strategic applications are introduced.

Table 1:   Distribution of the various types of applications on the stages of SoG

Applica-tion/Stages	1 %	2 %	3 %	4 %	5 %	6 %
Operational Control	100	85	80	65	55	45
Manage-ment Control	0	15	20	30	35	40
Strategic Control	0	<1	<1	5	10	15

RESEARCH METHODOLOGY

Nine Tanzanian organisations were selected as representative group for this research. They included three parastatal organisations from the financial services sector, three parastatal organisations, two from the transport sector and one from the energy sector, and three governmental units/departments. One of the key parameters used in selecting these organisations was the fact that they had a mainframe computer as part of their IT hardware, which makes their basic IT operating environment centralised. This was aimed at limiting the sample to organisations which were more or less in the same situation as the ones used in the development of the model.

As the first task was to establish whether the organisations sampled followed the S-curve for their IT development, historical data for the IT budgets for these organisations was collected through a questionnaire. In most of the organisations, data was available for a period of four to five years, which is sufficient when compared to related research, such as that of Lucas and Sutton [5]. It was also felt necessary to check on the various stages of IT development through determining the extent of the various IT application types. Specifically, the intention was to establish

the extent upon which IT is used for operational control systems, management control systems, and strategic planning systems. In this case, the nature of the IT applications present in those organisations was established through a questionnaire and interviews. Specifically, the approach sought to establish the ratio of applications which could be classified as batch and remote entry job processing, database and data communications processing, and personal computing or microcomputer processing. The last part of the questionnaire, was aimed at establishing the IT management issues such as the centralisation and decentralisation of IT activities and the use of steering committees.

ANALYSIS OF THE RESULTS

Four growth models were used to test the growth of the budget figures obtained for the various organisations. Although the intention here was to establish whether the budgets figures followed an S-curve, it was only possible to do this by trying to statistically fit the budgets data to four models, so as to establish the best fit. These four models included:

(a) The S-curve described by equation (1);

$$B = \text{Exp. } (a + b/T), \quad \text{where } b < 0 \tag{1}$$

(b) The exponential growth curve given by equation (2);

$$B = abT \tag{2}$$

(c) The geometric growth curve given by equation (3);

$$B = aTb \tag{3}$$

(d) The linear growth model given by equation (4);

$$B = a + bT \tag{4}$$

where in all the four situations:
B = IT budget in Tshs.
T = time
a, b = parameters to be estimated from budgets data.

By using two measures of the goodness of fit, namely, the degree of correlation and the mean absolute deviation, the budgets data for each organization were fitted on the four curves. It was found out that the linear, exponential and geometric models were better fit for our budgets

data than the S-curve. In other words, the data for budgets of the organisations surveyed did not follow the S-curve shape.

Our second set of results involved trying to identify the stages through analyzing the nature of the IT applications. As it was not possible to obtain data which could directly be used to identify the extent of the various type of applications, this exercise was done in an indirect manner. Technological benchmarks were used [6], as shown in figure 1.

Stage 1   100% batch processing

Stage 2   80% batch processing
20% remote job entry processing

Stage 3   70% batch processing
15% database processing
10% inquiry processing
5% time sharing processing

Stage 4   50% batch and remote job entry processing
30% database and data communication processing
5% personal computing
15% microcomputer processing

Stage 5   20% batch and remote job entry processing
60% database and data communication processing
5% personal computing
15% microcomputer processing

Stage 6   10% batch and remote job entry processing
60% database and data communication processing
5% personal computing
25% microcomputer processing

Figure 1: Technological benchmarks for the SoG model

Technological benchmarks give an indication of the stage of development of information technology for an organization through establishing the type of computer processing available, such as batch processing, database

processing, personal computing, or microcomputer processing. By determining the ratio of applications falling under batch processing, database processing, personnel and micro-computing processing, and so on, it was possible to establish (approximately) the stage of the organisations in the SoG model using figure 1 [6].

DISCUSSION

Past studies, for example the one conducted by Lucas [5], has also found some contradictory results on the concept of the S-curve, in the SoG model. The study suggested that the SoG model is appealing intuitively and is very useful for an organization trying to anticipate the managerial problems of the different stages of the IT development. Further, the study concluded that the SoG model should not necessarily be based on budget curves. The reasons for this separation of the budgets curve in the model is that high levels of computer budgets can be a sign of either a well or poorly managed IT resources. The objective of an IT department should be to provide service to users of the IT systems. If users receive good service, they will request for more applications and this will be reflected in increased budgets. It is also possible for budget growth to occur in an IT department which provides only a few services to users, but instead concentrating on developing sophisticated hardware and software for its own sake.

Instead of relying on budget curves, there is sufficient evidence available about applications to form one possible basis for the study of the managerial problems and actions appropriate during the different stages of computer utilisation. For example, consider the following stages which could be derived from [7].

i	Initiation: computer acquisition and transactions processing system
ii	Contagion: operational control and managerial control applications
iii	Control: integrated applications and data bases
iv	Integration: decision support systems and strategic applications

As an organization progresses through these stages, the mix of applications changes to include a higher proportion of those in more advanced categories like strategic planning.

CONCLUSION

The results in this research does not support the use of budgets as the basis for the SoG model. The results also do not support the S-curve as a model for IT budgets growth in Tanzanian organisations. The data on budgets and interview with different IT managers suggest a model of budgets based primarily on the increased operational costs, and the expansion of IT activities, and not on an increase in the prior year's budget. The operational costs increased due to price escalation, increase in salaries and personnel emoluments, and the increase in the maintenance and running expenses. The increase in the costs of IT activities also included the increase in applications and hardware. Does this necessarily invalidate the SoG model for Tanzanian situation at the time of this research?

The basic conclusion, which is also applicable to our research situation is that the IT budgets are not good indicators for describing and developing the IT systems of an organization. However, by using the technological benchmarks it was possible to estimate the stage of growth for the surveyed organisations. It is therefore possible to conclude that some of the other parameters of the SoG model, such as choosing an IT strategy that fits with the organization business strategy, can provide some valuable insights for Tanzanian industries.

Planning to have an IT growth in an organization is in itself a very positive approach, and here lessons about centralised and decentralised IT resources can be used, together with the issue of using steering committees. One recommendation is that the SoG model should be used as only one of the many other such tools aimed at assisting management in the strategic use of IT. A combination of tools, depending on situations (subject to further research), can be employed.

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