SUCCESS FACTORS IN INFORMATION TECHNOLOGY APPLICATIONS IN SMALL AND MEDIUM SCALE INDUSTRIES – THE SRI LANKAN EXPERIENCE

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ABSTRACT

This paper argues that the industrialist in developing countries should make use of the opportunities made available by the rapid advancement of information technology to enhance the competitiveness. Most of the enterprises that have made an attempt towards this have not realized the expected benefits of implementing Management Information Systems (MISs). The main reason for this being the lack of understanding of the factors which influences the success of MISs. The main objective of this paper is to identify the factors having a positive influence on success of MISs.

The present levels of application for each of the potential areas were assessed. The impact of several factors, which are likely to influence the success of the MISs were analysed. This paper identifies the importance of high commitment of management, efficient manual procedures, high level company wide computer literacy, adequate knowledge of management techniques of the systems analysts and a number of other factors for the success of MISs argues the need for a shift of the policy of IT and management education to strengthen the success factors.

Keywords : Information Technology, Management Information Systems, Small and Medium Scale Industries.

INTRODUCTION

The advancement of computer technology has made personal computers extremely powerful (Lind, 1996). Also their costs have been reduced to an extent that even small enterprises in Developing Countries (DCs) can afford to own a business computer system. As a result, Information Technology (IT) is within their reach. However, in DCs Small and Medium Scale Industries (SMIs) have not realized the full benefit of these advancements in Hardware and Software (Munasinghe & Jayawardena, 1996). This paper makes an attempt to identify the factors on which SMIs should concentrate in order to make investments on IT applications more rewarding.

It is well known that the economies of DCs are mainly dependent on SMIs. In DCs, the contribution to the GNP and employment by SMIs are significant. In the recent past, a number of major changes have taken place globally (Desia, 1996; Dehejia, 1996; Hussain, 1996a; 1996b), which have forced all countries towards free trade. Some of these have imposed severe challenges to DCs. The most prominent of these being acceptance of the GATT agreement, which has removed a number of tariff and non-tariff barriers. This agreement, initially set up to promote local industries in DCs and formation of strong economic groupings, has set trade norms and policies on quality and environment. It has also helped liberalization of central planning in former command driven economies in various parts of the world and has lead to the commercialization of large state owned enterprises in those countries. This coupled with their technological capability and relatively low cost labour, has posed a major threat to the markets so far enjoyed by developing countries

Considering the significance of SMIs and the indicated global developments (WTO 1995, Vincent 1994), an enhancement of the competitiveness of the industries in DCs is found vital for their survival (Massey, 1986, Lincon & Warberg, 1987; Lees & Lees, 1987). However, the present level of productivity and competitiveness of the industries in DCs are far below the satisfactory levels (Baker, 1987; Goonatilake, 1988a; 1988b; Molloy & Schenk, 1995; Davis, 1984), to enable the industrial sector to compete effectively in the emerging global free trade regime (Billo *et al.*, 1996).

Some of the reasons for SMIs in DCs to be less competitive identified by (Dun & Bradstreet (1981) and Goonatilake (1983) are:

- Problems with receivable / collections
- Problems with inventory control
- Low capacity utilization
- Failure to meet delivery dates and
- Problems with quality control

IT can be made use of to effectively overcome almost all of these reasons and also be competitive.

A golden opportunity therefore exists for the industrialists in DCs to make use of the technological advancements of computer technology towards achieving higher levels of performance and facing the challenges imposed by global changes (Chau, 1994).

Most of the research done to date, on Management Information System (MIS) applications of SMIs has been conducted towards the technical (Lees, 1987), end-user satisfaction (Montazami, 1988), organizational (Raymond, 1985; 1987), and software (Margaret, 1990; Heikkila *et al.*, 1991; Chau, 1994;) aspects, which are also important for the success of MISs. Yet very little has been done concerning the factors affecting the success of individual functional areas of a business. Therefore, an attempt is made in this paper to identify the factors, which influence the successful usage of MISs in respect to the key functional areas.

Overview of IT application in DCs

Although enterprises have been practicing MISs (Dock & Essick, 1981; Liebenau & Backhouse, 1990; Lucas, 1990) for several decades, only the ongoing computer revolution has made its usage truly meaningful, as it is impossible to achieve the features demanded without the use of a computer. Therefore, in the present context, a MIS is essentially a computer-based system that provides information required by managers at different levels to perform their managerial functions effectively and efficiently. Also the information requirements vary as time passes by. Therefore, it has to be flexible enough to accommodate the changes.

Even though SMIs now have access to computers, they are mainly used for routine accounting, payroll and invoicing functions (Cragg & King, 1993). Any way, SMIs were performing these accounting functions satisfactorily long before the computer made inroads. Hence, the net impact of IT in SMIs is basically faster processing of accounting/payroll data, a function effectively but laboriously carried out even in the past.

The impact of IT on production planning & control, inventory control, sales & marketing, cost accounting and strategic planning is minimal (Goonatilake, 1983; Goonatilake, 1984).

The issues related to competitiveness, productivity and enterprise growth are all linked to production management. It is well known that only a few SMIs in DCs apply modern production planning, inventory control and quality control systems. Production Management Information Systems (PROMIS) for controlling production, monitoring costs and preparing long term plans are virtually non-existent. A further constraint limiting the application of production management systems and using MIS is the shortage of trained personnel in DCs.

The ongoing information revolution poses different challenges and opportunities for DCs. In the industrial sector, the application possibilities of IT can be divided into two key areas, namely the Computer Aided Design/Manufacture (CAD/CAM) and Computer Aided Production Management (CAPM) (Goonatilake, 1987). High technology oriented large scale manufacturing facilities competing in the global market place would ideally benefit from CAD/CAM. By the same criterion, CAD/CAM application possibilities in developing countries would be minimal.

On the other hand, the key problem in the manufacturing sector in SMIs is the shortcomings resulting from inadequate production management. As such, application of CAPM provides a golden opportunity for industrialists to improve their competitiveness and growth potential to leap frog.

Measurement of effectiveness of IT applications

Review of literature suggests several methods for evaluating the success of IT applications (DeLone, 1988). The usage of information systems by the management and the impact of information system on organizational performance are two of the main methods suggested.

If the mere usage of the suggested methods by the management is considered as a measure of success, the effectiveness of such applications is not reflected. Its effectiveness has to be measured by determining the effect of the computer system on the profitability or cash flow of the firm. However, there are many other uncontrollable and un-measurable factors which influence the performance of a firm. Therefore, these too are inadequate measures.

This study, therefore formulates a measure that incorporates the following desirable attributes for the success of IT applications:

- **Accuracy:**
The system provides accurate information when the data collection, entry and processing are organized systematically so as to generate precise information consistently.
- **Completeness:**
When all the information necessary to make a decision is provided, it is said to be complete. However, more than what is required should not be provided
- **Conciseness**
When data is appropriately summarized, so as to highlight exceptions to normal planned activities, it is said to be concise.
- **Timeliness:**
When the information is provided within the required time range to make a decision, it is timely. Also the information with specific shelf-life would become obsolete if not provided in time.
- **Relevance**
Information is relevant when each manager is provided with what he needs *to know*.
- **Cost-effectiveness**
The value of information to the manager should justify its cost.

Potential areas for IT development

None of the studies done to date are focused on all functional areas of an organization, but have concentrated on specific tasks. These functions very often are narrow in scope. This study, therefore, has concentrated on the key functional areas of a SMI with a view to provide a conceptual base for company-wide implementation of MISs. Since the influence of the different factors could vary for different functional areas, the study avoids considering the effect of factors for the organization as a whole.

The key areas, which have a potential for implementing MISs in SMIs in DCs are as follows.

1. Production planning & control (PPC)
2. Inventory control (IC)
3. Sales & marketing (SM)
4. Financial accounting (FA)
5. Cost & management Accounting (CMA)
6. Payroll preparation (PP)
7. Strategic Planning (SP)

METHODOLOGY

Research Model

The study makes use of a research carried out in Sri Lanka to assess / identify the following with respect to key areas given in the research model shown in figure 1.

1. Assess the present level of MIS application.
2. Assess the success of implemented MISs.
3. Identify the factors influencing implementation of MIS.

The Sample

The data necessary for the present research were gathered through the management information development component of a pilot project for enterprise restructuring in Sri Lanka, funded by the United Nations Industrial Development Organization (UNIDO) (US/SRL/93/021).

For the selection of the sample, a total of 152 small and medium scale enterprises were contacted. Completed questionnaires on basic data were received from 43 companies interested in participating in the project. A total of 32 of those companies that showed positive interest, were visited and out of them 15 were identified and short-listed for the final selection. After further screening, the final sample of 10 was decided on. It should therefore be noted that the selected sample could be somewhat biased towards implementing MISs. The sample covered industries manufacturing consumer products, wooden furniture, plastics, metal fabrications, plastic bags, electronic items, rubber products, and stationery items. The employment and export market share of the sampled companies are given in table 1.

Table 1. The employment and % of export market share in the sampled companies

Sample company	Employment	Export%
1	300	30
2	250	10
3	180	100
4	110	0
5	200	30
6	260	100
7	120	5
8	120	0
9	130	0
10	210	10

Figure 1: The research model

Collection of Data

The data required for the research were collected through a structured questionnaire. It consisted of a number of sections.

The first section was to determine the present level of MIS applications with respect to the seven key areas identified in the research model (Fig. 1), which have potential for implementation. The level of MIS application was measured by assessing the level of availability of the following three resources.

1. Hardware
2. Software
3. Trained personnel

The levels considered were: Not Available, Not Adequate and Adequate.

The section 2 of the questionnaire was aimed at measuring the success of MISs, where implemented. A successful MIS should be capable of generating information that is accurate, complete, concise, timely and relevant within an acceptable time frame and at a justifiable cost (Dock & Essick 1981). Thus, the percentage measures of each of the above attributes in the implemented MISs were observed for the determination of success.

The section 3 of the questionnaire was designed to measure the level of availability of key factors likely to influence the success of a MIS. After careful consideration, the following 16 factors, which are likely to influence the success were chosen.

1. Commitment of the management
2. Manual procedures
3. Data flow
4. Computer awareness of the management
5. System design
6. System documentation
7. Knowledge of the management techniques of the Systems Analyst
8. Understanding between the user and the Systems Analyst
9. Usage of general purpose software for a specialized function
10. Usage of tailor made software
11. Local Area Network (LAN)
12. Usage of MIS for decision making
13. Company-wide Computer literacy
14. Maintenance of software by vendors
15. Maintenance of hardware by the vendor
16. System security

Percentage measure of several identified factors were observed with respect to the seven key areas of application, which have a potential for implementation of MISs.

The percentage measures of each of the six attributes in the implemented MISs as well as the percentage measures of the sixteen possible success factors, against each of the potential areas for application, in sections 2 & 3 respectively of the questionnaire were based on the judgment of the researchers.

Hypothesis

The factors identified in the section 3 of the questionnaire were then formulated into the hypothesis. The hypothesis test, whether MIS's of SMI's are successful when there is

- a) high commitment of the management,
- b) availability of efficient manual procedures,
- c) smooth data flow,
- d) high level of computer awareness of the management,
- e) sound system design,
- f) availability of proper system documentation,
- g) adequate knowledge of management techniques of the systems analyst,
- h) adequate understanding between the user and the systems analyst,
- i) high usage of general purpose software for a specialized function,
- j) high usage of tailor made software,
- k) availability of a LAN,
- l) high usage of MIS for decision making,
- m) high level of company-wide computer literacy,
- n) adequate maintenance of software by vendors,
- o) adequate maintenance of hardware by the vendor and
- p) high system security

Correlation coefficients between success of MISs and the testing factors were used to test the validity of the hypothesis for different functional areas. The correlation coefficient gives a measure of the relationship. (+1: perfect relationship, close to +1: high relationship, 0: no relationship, close to 0: insignificant relationship).

RESULTS AND DISCUSSION

Level of application

The availability of hardware, software and trained personnel and adequacy of these in respect to each of the seven identified potential areas of all enterprises in the sample are shown in Tables 1, 2 and 3 respectively.

Hardware

Table 2: Level of application - Availability of hardware (%)

Functional area	Not available	Not adequate	Adequate
Production planning & control	10	40	50
Inventory control	10	30	60
Sales & marketing		60	40
Financial accounting			100
Cost & management accounting	10	10	80
Payroll preparation			100
Strategic planning	30		70

The availability of hardware in the functional areas of Financial Accounting, Cost & Management Accounting, Payroll Preparation and Strategic Planning are adequate (Table 2). In all other areas, it is somewhat adequate. It can therefore be concluded that the availability of hardware is not a constraint for the implementation of MISs for most enterprises included in the sample.

Software

Table 3 : Level of application - Availability of software (%)

Functional area	Not available	Not adequate	Adequate
Production planning & control	60	30	10
Inventory control	20	40	40
Sales & marketing	30	70	
Financial accounting	10	30	60
Cost & management accounting	20	40	40
Payroll preparation		20	80
Strategic planning	80	20	

The availability of software in the area of payroll preparation is adequate, while it is somewhat adequate in functional areas of inventory control, financial accounting and cost & management accounting. In the areas of production planning & control and strategic planning, software is mostly not available (Table 3).

Trained personnel

None of the functional areas had an adequate number of trained personnel. However, for financial accounting, sales & marketing and payroll preparation, the availability of trained personnel is somewhat adequate (Table 4). Thus, availability of trained personnel is a constraint for implementation of MISs.

Table 4 : Level of application - Availability of trained personnel (%)

Functional area	Not available	Not adequate	Adequate
Production planning & control	80	10	10
Inventory control	20	50	30
Sales & marketing	50	50	
Financial accounting	10	40	50
Cost & management accounting	30	30	40
Payroll preparation	10	50	40
Strategic planning	70	30	

From the foregoing, it could be concluded that there is a direct relationship between the availability of software and trained personnel.

The success of MISs where implemented

The of measures of success (%), along with the total success for each of the functional areas in the implemented MISs are given in Table 5. Average percentage value of different attributes for success is taken as a measure of the total success. The percentage of enterprises where MISs are not available for a particular functional area is also given.

Table 5: Success of MISs (%)

Functional Area	Measurements of success						Total success	Not available
	Accurate	Complete	Concise	Timely	Relevant	Value/Cost		
PPC	40	40	37	32	25	27	34	60
IC	49	42	47	33	32	33	40	20
SM	44	33	34	43	40	40	39	30
FA	100	81	68	81	84	86	83	10
CMA	60	48	45	42	48	45	48	20
PP	100	93	99	100	99	97	98	0
SP	27	33	40	25	35	40	33	80

The functional areas, production planning & control and strategic planning were not available in the MIS in a majority of the enterprises. It can therefore be concluded that the majority of enterprises have not attempted to implement MISs for these two functional areas.

In determining the overall success (Table 6), the success of the functional areas which do not have MISs were taken as zero.

All the enterprises are found to have sound payroll and financial accounting miss as indicated in table 6. for other areas, the overall success was found to be unsatisfactory while for production planning & control and strategic planning, it was very unsatisfactory.

Table 6: Overall Success (%) of MISs by potential area

Functional Area	Overall Success (%)
Production planning & control	14
Inventory control	32
Sales & marketing	27
Financial accounting	75
Cost & management accounting	38
Payroll preparation	98
Strategic planning	7

Factors likely to influence success

For each of the enterprises in the sample, a measure of the identified factor that was likely to influence the success of MIS was determined for each functional area. The correlation between these values and the success are given in Table 7.

Table 7 : The correlation coefficients between the success and the factors likely to influence success of MISs in different application areas

Factors likely to influence success	Area of Application				
	PPC	IC	SM	FA	CMA
High commitment of the management	0.72	0.89	0.75	0.75	0.57
Availability of efficient manual procedures	0.63	0.68	0.67	0.70	0.63
Smooth data flow	0.54	0.62	0.59	0.77	0.53
Computer awareness of the top management	0.53	0.45	0.58	0.82	0.83
Sound system design	0.60	0.73	0.68	0.75	0.66
Availability of proper system documentation	0.23	0.15	0.27	0.32	0.27
Adequate knowledge of the management techniques of the Systems Analyst	0.45	0.57	0.63	0.68	0.87
Adequate understanding between the user and the Systems Analyst	0.57	0.52	0.51	0.48	0.62
High usage of general purpose software for a specialized function	-	-	-	-	-
High usage of tailor made software	0.56	0.45	0.54	0.21	0.53
Availability of a LAN	-	0.61	0.52	0.73	0.73
High usage of MIS for decision making	0.66	0.62	0.72	-	0.63
High level of company-wide computer literacy	0.65	0.53	0.72	0.56	0.63
Adequate maintenance of software by vendors	0.76	0.63	0.69	0.72	0.62
Adequate maintenance of hardware by vendors	-	-	-	-	-
High system security	0.36	0.28	0.26	0.44	0.45

From the above values, it can be concluded that the following hypotheses are true.

MISs of SMIs are successful when there is

- high commitment of the management,
- availability of efficient manual procedures,
- smooth data flow,
- computer awareness of the management,
- sound system design,
- adequate knowledge of the management techniques of the Systems Analyst,
- adequate understanding between the user and the Systems Analyst,
- availability of a LAN,
- high usage of MIS for decision making,
- high level of company wide computer literacy and
- adequate maintenance of software by vendors.

Commitment of the management, computer awareness of the management and company level computer literacy are three factors that influence the implementation of MISs most. In fact these three factors are very much interrelated and a manager with computer awareness is likely to be committed and have confidence on MISs. A computer literate manager is capable of communicating his or her requirements effectively with the systems personnel. He/she is also likely to give high priority to MIS development and allocate sufficient funds for such projects. If the company level computer literacy is high, the usage of computers in their day-to-day activities too will be high. In addition to increasing the efficiency, this will also make the employees competent to make constructive and useful suggestions for MIS development and improvement. Furthermore, computer literate employees are capable of streamlining procedures, developing source documents and documenting the procedures to suit computerization.

Availability of efficient management procedures and smooth data flows (Boggs, 1988) will make the task of the systems analyst very much easier. Thus resulting MIS too would generate accurate, timely and complete information.

Knowledge of management techniques of the Systems Analyst, adequate understanding between the user and the Systems Analyst, sound systems design, and adequate maintenance of software by vendors are the factors, which are within the control of the systems development team. Knowledge of management techniques will enable the Systems Analyst to understand the user requirements better. A sound systems design, preferably in modular form would increase the efficiency as well as the flexibility of the system. Adequate maintenance of software will minimize the system's downtime and facilitate prompt system modifications to suit the changing requirements. Thus, all these factors will in-turn lead to a successful MIS.

Availability of a LAN will greatly improve communication and therefore the information generated by the system at any given time will be timely, accurate and complete. The user could also be provided with additional information with the least effort.

It can also be concluded from the results that

- a) The availability of proper system documentation
- b) high system security

have no association with the success of MISs for all the functional areas:

The availability of system documentation for the success of a MIS is of long term value. The enterprises in the sample have implemented MISs only in the recent past and thus only now they are beginning to experience the ill-effects of poor system documentation and non availability of source codes of software. Thus the insignificant relationships indicated by the correlation coefficients closer to zero may not necessarily be valid in the long run.

The system security, however, is not a major concern at the current stage of computerization.

The results also indicated that high usage of tailor made software is not associated with the success of the functional areas of inventory control and financial accounting while being associated with the success of all the other functional areas.

There are accepted generalized procedures, which can be applied to most industries with respect to inventory control and financial accounting. Therefore, general purpose packages can be implemented successfully while for other functional areas, procedures will mostly depend on the situation and vary for different enterprises. Thus, custom made software packages are better suited for functions such as inventory control and financial accounting only.

There was insufficient data available to test the hypotheses that MISs of SMIs are successful when there is

- a) high usage of general purpose software for a specialized function and
- b) adequate maintenance of hardware by vendors.

The organizational, economic and technological factors as well as the level of computerization and problems faced by SMIs are mostly common to all DCs. Therefore, the contributing factors for success of MIS, identified in the present study would also be common to all DCs.

CONCLUSIONS

Although most of the small and medium scale industrialists in DCs have acquired computer hardware and software with the intention of improving the efficiency of their operations, the positive impact of these efforts is questionable. Most of the industrialists are not fully aware of the factors that influence the success of MISs. As a result, most of the industrialists in DCs have not accrued the maximum benefits from investments on MIS development projects.

The following recommendations would be useful for the successful application of MISs in SMIs.

The commitment of the top management is essential for the success of MISs. However, computer literacy among the managerial staff in DCs was found to be poor. As a result, they do not realize the full potential and get optimum benefits of computerization. Thus, the full commitment of the management too was not forthcoming. Therefore, DCs should take action to make the managerial staff of SMIs computer literate.

This should be followed by company wide computer literacy programs with the objective of giving a working knowledge of computing to as many employees as possible, in order to promote usage of computers in all their day-to-day activities. This would promote the co-operation of employees for implementation of MISs. The literacy program should cover areas such as introduction to computers, operating systems, word processing, spread sheets, database management systems and MIS applications.

Very often the SMIs in DCs do not have efficient and well defined manual procedures. Consequently computerization of such procedures will not bring the anticipated benefits. Therefore, proper manual procedures should be initially developed and data flows should be streamlined prior to computerization. Employees at all levels should be encouraged to use computers for their day to day work with the help of word processing, spread sheets and other common packages. In addition to increasing overall productivity, this will make the workforce familiar with computers and make computerization much easier.

Unlike accounting software, which can be applied to existing manual situations, CAPM and related MIS software have to be drawn up to suit individual situations. Often, enterprises do not even have a manual production management system and a manual MIS system in place. Therefore, the promotion of CAPM/MIS has to be carried out methodically by experienced industrial management specialists, having a knowledge of CAPM.

However, DCs lack such expertise. Therefore, it is very necessary to have institutional mechanisms for short-term and long term human resources development and to promote the applications of CAPM / MIS in manufacturing enterprises. DCs may also consider initiating regional co-operation to achieve these objectives.

SMIs very often are financially ill-equipped and cannot absorb mistakes (Charlesworth, 1972). Therefore, the management should not rush into computerization; instead it should take into account the factors discussed above and should have a well phased out implementation plan.

Information however precise and important, may not be of much use if it is not used for decision making. Therefore, regular and formal meetings at different levels of management should be held to discuss the generated information. This will enable the management to take appropriate corrective action and realize the intended benefits of a good MIS.

The training programs for Systems Analysts, should pay greater attention to make them aware of the importance of proper documentation and modularity of software and the need for a proper dialogue with the user. Also the Systems Analysts should be encouraged to learn management techniques.

Thus the DCs should make an effort to improve the aspects discussed under the section on factors that are likely to influence the success in order to take the best advantage of the ongoing computer revolution. It is therefore imperative that the Information Technology and Management education be geared to strengthen positive factors revealed for the success of MISs. Thus, there is a strong need for the relevant institutions to offer certificate and diploma courses as well as undergraduate and postgraduate programmes. This could best be achieved by incorporating measures to this effect to the national policy of computerization and Information Technology and Management education.

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