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Investigating the Strategies for Successful Development of Health Information Systems: A Comparison Study

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Abstract: Today, in many developed organizations, Management Information Systems (MIS) assist managers to effectively delegate power to employees from different rankings and consequently aid in the process of decision-making. As a result, it is a fact that Health Information Systems (HIS) play a major role in changing the management practice of conducting the healthcare organizations by providing powerful tools for managers to carry out both their traditional and newer roles. The main reasons behind conducting this study are to analyze the current situation of healthcare and to carry out a comparison between the current level of MIS in the public health sector and its level before 13 years ago by re-testing the guidelines used in developing successful Management Information Systems (MIS) for public health sector. Furthermore, for the purpose of comparison the following key elements were used in both studies: The Determination of Corporate Needs; Management Commitment; User Attitudes and Expectations; User Involvement; Performance Measurement and Measurement Techniques. The study is divided into five sections. Section one presents the background, the problems and reviews the relevant literature and covers a historical and general review of MIS and MIS in health care. In addition to this, the section also reviews the measurement of success in MIS. Section two compares its own methodology with that of the previous study by taking into consideration the data collection mechanisms, questionnaire design, procedures, pilot study and distribution. This section also identifies the organizations and participants who were chosen to take part in the previous and the current study. Section three is based on the survey, analysis of the data and the findings of the previous and current study in relation to the key elements on which the guidelines are based. Section four concentrates on the application of the proposed guidelines in the Bahraini Healthcare environment. Section five concludes the results of the research and provides recommendations for further work.

Key words: Information systems, management commitment, measurement techniques, user attitudes and expectations, user involvement, strategy, performance measurement, Nolan stages theory, HIS, health, Bahrain

INTRODUCTION

The expansion in information combined with the variety of information sources further complicates the repossession of helpful information. Moreover, digitized information is increasing rapidly, apparently beyond the capability of business to manage and control it. Hence, information system is the optimal solution that helps in creating an information sharing culture within organizations, which is critical because intellectual assets, unlike physical assets, increase in value with use (Quinn *et al.*, 1996). In developed organizations, information systems assist managers to effectively delegate power to employees from different rankings and consequently aid in the process of decision-making. As a result, it is a fact that Management Information Systems

play a major role in changing the management practice of conducting the organizations by providing powerful tools for managers to carry out both their traditional and newer roles. Vast improvements have been made in MIS and it is well documented both in practice and in writing however, the design, implementation and operation of MIS are difficult tasks, which require careful planning, commitment and involvement by appropriate managers and users (Al-Alawi, 1991; Thompson and Strickland, 2003).

The performance of MIS in profit-making organizations is measured by the amount of profit made after its implementation; however, when it comes to non-profit organizations (e.g., Public Health Sector), measurement of the performance of MIS is a difficult process because it is intangible and depends on factors such as user satisfaction, involvement etc. However, there

are local problems, which slow down the development of supportive systems. The local problems as stated by Al-Alawi (1991) are:

- Shortage of trained personnel in the MIS field;
- Lack of managers trained in MIS;
- Lack of management appreciation of the role of such systems that can play in aiding forward planning and decision-making;
- Lack of communication between departments within organizations;
- Lack of MIS literacy and
- Issues of tradition and resistance to change.

The previous problems remain with no change since they have not been tackled.

In addition to the abovementioned local problems, Roymaxion (2003-2004) stated the following problems, which could be considered as local problems according to the current situation in the Kingdom of Bahrain:

- The officers often do not have the knowledge to make the correct decisions about purchasing computer devices and upgrades;
- Most of the officers do not recognize how to protect and maintain their data safe or do not think it is essential until they face a computer breakdown;
- Managers trained in MIS are considered as a necessity; and
- Contact between departments within the organization is weak.

More details about the public health sector in the Kingdom of Bahrain and its services can be found in (<http://www.moh.gov.bh>)

The main reasons behind conducting this study are to re-test the guidelines used in developing successful Management Information Systems (MIS) for public health sector obtained by an earlier similar study conducted in Bahrain during (1988-1991) by Al-Alawi (1991). Furthermore, another objective behind this study was to carry out a comparison between the current level of MIS in the public health sector and its level before 12 years ago. For the purpose of comparison the following key elements were used in both studies (this study and Al-Alawi 1991 study):

- The Determination of Corporate Needs;
- Management Commitment;
- User Attitudes and Expectations;
- User Involvement;

- Performance Measurement and
- Measurement Techniques.

Both studies surveyed HIS in the public health sector at different levels of management. Some of the selected managerial groups asked to participate in both studies are directly concerned with the introduction of MIS in their organizations.

Review of Management Information Systems (MIS): Managers working in all types and sizes of organizations require information to create decisions. Electronic data processing with its huge capacity for data storage and retrieval has enabled managers to have more information than ever before. Because of the significance, accessibility and cost of data, managers have found it necessary to consider and carefully decide what information they require. This thought process has led to the formation of a formal plan for information creation, storage and retrieval called Management Information Systems (MIS).

Survey of definitions of Management Information Systems (MIS): Al-Alawi (1991) surveyed the Definitions of MIS in both public and private sectors and he illustrated the following definition for MIS:

“MIS is a system, which provides historical, present and predictive information derived from both the internal operation of the organization and the external environment. MIS supplies accurate, selective and timely information and supports the information needs of management at all levels of management activity to assist in decision-making”.

The above definition of MIS will apply to both profit making organization as well as non-profit organization as it provides and supplies all different types of information for all levels of management activity in order to help them in their decision-making. While the Ministry of Health (MoH) understand the purpose of HIS as to provide the right information to the right people at the right time that will facilitate improvements to the staff and services to produce the best health results at reasonable cost (Health Information Directorate, 2003).

Review of Health Information Systems (HIS): Over the past few years, the state of the art of a fully integrated HIS was improved and Information Systems have become more and more imperative in healthcare delivery. The use of developed decision support systems is predicted to improve quality of clinical decision-making (Raghupathi and Narur, 2000; De Velde and Degoulet, 2003). However, there was still scope for large-scale improvement in the

development, implementation and applicability of HIS. The term HIS will be used throughout the study to signify HISs.

In the literature there were no reports of computerized HIS in the 1950s, that is most HIS were completely manually oriented. Nevertheless, during the 1960s there was rapid development of computer technology that increased the hospital uses of computers. Computerized management information systems were needed in the early 1970s to support planning, management and the operation of hospitals (Ball, 1988). The reason that triggered the need for such a system was growing clerical workloads and associated costs (Maheu *et al.*, 2001).

The 1980s emphasized that HIS is a rapidly growing interest. Friedman (1982) stated, It is still a young field and many of the problems...are simply hallmarks of an industry that is changing so quickly. Hospitals started evolving in the field of information system development with the introduction of HIS and the increasing attention given to microcomputers.

Ball and Boyel (1980) in their paper Hospital Information Systems: Past, Present and Future referred to three different classes of hospital information systems, Class A, Class B and Class C.

- Class A is individual stand-alone systems, which address the specific requirements of single departments or specialties.
- Class B is a type of HIS which crosses departmental and specialty boundaries.
- Class C is another type of HIS, which is oriented to the patient medical record and the computer linkage of historical patient information is the foundation.

During the 1990s more sophisticated low cost HIS were introduced. Kim and Michelman (1990) reported that the present state of HIS is far from being the integrated system that had a full range of functionality across all application areas. One of the apparent difficulties is that the typical HIS does not regard communication among clinical users as its core mission, even though repeated studies of information needs and practice patterns show that communication is the leading cost in today's health care environment (Harman, 2001; Guise and Kuhn, 2003; Memel, 2003). The development of integrated HIS has long been the aim of many hospitals, but only a few have been able to achieve it.

Characteristics of Health Information Systems (HIS): Wiederhold and Perreault (1990) have mentioned, that the purpose of HIS is to manage the information that health professionals need to perform their jobs effectively and efficiently. Thus HIS is more than an electronic medical

record system. The term HIS seems to have the same problem as the term MIS, which is, there is no homogeneous definition. HIS may mean different things to different people.

According to Dixon (2004), Health information management direct and manage the activities of a health information center in health care facilities. The health information management may also be responsible for the following areas:

- The development and maintenance of a patient information system.
- The control of data quality.
- The management of a computer based information system.
- The coordination of performance improvement programs.
- The daily supervision of personnel.

Woodworth (2003) studied the simplification of medical paperwork.

A HIS is not an isolated system. Integration of data and functions are consequently the main characteristics of HIS.

Measures of success in Management Information Systems (MIS): Laudon and Laudon (2006) concluded that the measures of Information System Success are the following:

- High levels of system use (assuming use is at least partly voluntary);
- User satisfaction with the system;
- General favorable attitudes towards the IS function;
- The system achieved its stated objectives;
- There was a net financial payoff.

Mumford (1980) suggested that end-user participation in the development and implementation of the IT system is a necessary actor for the success of the project. Research in the field of measures of success of MIS was done mainly for 'profit' organizations (Gold, 1992). In terms of 'non-profit' organizations, activity in this area is very limited. For 'profit' organizations, measurement of success was often seen as a straightforward cost-benefit analysis. Whereas for 'non-profit' organizations, measurement of success was seen as the total satisfaction of the end users, which can be achieved by applying the user involvement theory (Roberts, 1988).

Management Information Systems (MIS) Evaluation

Dimensions: In order to be capable to assess IT/IS-investments, many methods and techniques have been suggested over the years. More traditional methods center on financial measures that have long been known: the 'return on investment' (ROI), the 'net present value' (NPV), the 'internal rate of return' (IRR) and the simple and popular 'payback time' (PB). These methods recommended a phenomenon called 'IT Black Hole' which means that the profit of the investments might not be as high as originally estimated (Farbey *et al.*, 1991; 1992, 1993).

A further approach to the problem is called 'Information Economics' (IE) (Parker *et al.*, 1988; Parker and Benson, 1989). This method permits to account for more intangible benefits like an improved customer service or a higher degree of competitiveness. And now, the BSC (Balanced ScoreCard) found its way to evaluating IT and its investments. Kaplan and Norton (1992, 1993, 1996a and b, 2001) propose this method in order to evaluate a company's progress from four different perspectives: the financial perspective, the perspective of internal processes, the client's perspective and the innovative perspective. Another method to conduct an evaluation to the company's MIS is to find out its strengths, weaknesses, external opportunities and threats, which is commonly known as SWOT analysis.

The four elements of SWOT analysis could be defined as the following:

- Strength is something the MIS is good at;
- Weakness is something the MIS lacks or does poorly in comparison to others;
- Opportunities for the MIS are those where accompany has most potential for a competitive advantage; and
- Threats are certain factors in an MIS external environment that make the company's situation and outlook quiet tenuous (Thompson and Strickland, 2003).

Performance Evaluation: Lucas (1971) stated that there are three main purposes of performance evaluation, as follows:

- Selection Evaluation: ... in which the evaluator plans to include performance as a major criterion in the decision to obtain a particular system from a vendor is the most frequent case. The procedure includes both hardware and software evaluation.
- Performance Projection: ... is oriented toward designing a new system, either a hardware

component or a software package. The goal here is to estimate the performance of a system that does not yet exist.

- Monitoring: ... provides data on the actual performance of an existing system. These data can be used to forecast the impact of changes in the system, such as a reconfiguration of the hardware or an improvement in the frequently executed software modules.

There is a range of metrics for evaluating information systems performance. For instance, the eight major evaluation techniques discussed by Lucas (1971) are: Cycle and Add Times, Instruction Mixes, Kernel Programs, Analytic Models, Benchmarks, Synthetic Programs, Simulation and Performance Monitoring (hardware and software). Also Lucas (1978a, b and c).

Impact evaluation: Impact evaluation is concerned with those effects on the organization, which result from the development and use of information systems. Carlson (1974) aimed to mitigate these difficulties by introducing six evaluation methods that can be used for impact evaluations. These methods are Event 1) Logging; 2) Attitude Survey; 3) Rating and Weighting; 4) System Measurement; 5) System Analysis and 6) Cost-Benefit Analysis. Carlson suggested seventeen hypotheses concerning the impact of information systems.

The socio-technical point of view looks at workers and their physical, psychological and higher order needs. Information systems success should be examined from a more holistic point of view in order to develop systems with genuinely serve as an advantage to the organization. In non-profit organizations, Willcocks and Mark (1988) concluded that if computer systems are to be effective, managers need to concentrate more on the human aspects and new policies regarding their implementation need to be formulated.

MIS evaluation dimensions must take into account all factors that may have a role in the efficiency of a system. Note, however, that techniques for measuring the role and social impact of system are scare and not well developed. There certainly is a need for evaluation techniques which can work in real situations. Nevertheless there are quite a variety of techniques found in the literature to cover the measures of success/evaluation of MIS in profit making organization (Allingham and O'conner, 1992; Smithson and Hirschheim, 1998). It could be said that evaluation of MIS in 'non-profit' organizations was in its early stages and no such well-constructed criteria were available to assess the successful development of MIS (Brooka and Kiddle, 2000).

Summary of Literature Review: The number of definitions of MIS tends to increase with the increase in technology development and the broadening of the MIS tasks and functions, due to the fact that there is no one comprehensive definition for MIS. However, HIS definition is still in its infant stage and needs further studies in order to establish a standard definition. Al-Alawi's (1991) definition of MIS underlines the key features of MIS which are universal and independent of the particular situations in which MIS can be used. This definition will apply to both profit making organizations as well as non-profit organizations.

MIS has come a long way since it was first introduced in hospitals, this mostly applied to the USA and Europe where it was successfully developed and improved. Unfortunately, HIS in the Middle East is still a ways behind. Assessment techniques that were sufficient in the past might not be appropriate these days, due to the fact that the MIS nowadays plays a greater role in organizations. Measuring the success gained from the utilization of MIS in profitable organizations is in itself a difficult task. It tends to become even more difficult when it is to be measured in non-profit organizations, as no general profit exists.

MATERIALS AND METHODS

Introduction: In this section the author will provide information about the survey methodology in relation to the earlier study conducted in 1991 and this study which was conducted in 2003. The Public Health sector has been selected as a test bed for the study of MIS in non-profit organizations. In both studies, the methods that were used to collect data involved visits, interviews and distribution of questionnaires. The interview and visits were conducted followed by telephone calls and emails with the Head of Application Development in the Health Information Directorate. The purpose of the questionnaire was to determine management's opinions and their likely level of agreement with the research hypotheses.

Choice of organizations: The first study covered the MoH and Bahrain Defense Force Hospital, whereas the second study covered only the public health sector.

Choice of participants: The targeted sample of respondents for 1991 study was managers from different managerial levels. There were a total of 100 individuals in the Bahraini population for the questionnaire for both studies. In the second study, a list of the managers' names of the public health sector was obtained to be used as a guide in distributing the questionnaires. The

population for both questionnaires was categorized as executive level and other managerial levels.

Design of the questionnaires: In the beginning of the questionnaire, the respondents were reassured of the confidentiality of their responses. The questionnaire of Al-Alawi (1991) was reused in the second study except part one; some slight modifications were made. Position and grade, department/section, organization and phone number were requested from respondents. Part two of the questionnaire focused on the study hypotheses.

Questionnaire procedures: Most of the questions simply required the respondent either to tick an appropriate box or to circle an appropriate number from a scale (0-5).

Pilot study: In the study of 1991, the questionnaire was tested on the managers of National Health Services (NHS) in the United Kingdom and the Kingdom of Bahrain. Approximately 80 percent of the pilot questionnaires were returned with no significant problems in understanding or completing the questionnaire (Al-Alawi, 1991). In the study of 2003, no pilot study was conducted due to the clarity of the questionnaire.

Distribution of the questionnaires: In the first study, the author personally reminded each department and section manager to complete the questionnaire. In the second study, some of the respondents were also reminded regarding the questionnaire and have been asked if they had any difficulties in answering the questions.

Summary of responses: In the earlier study, 100 copies of the first questionnaire were distributed within the three organizations and 85 were returned, a response rate of 85%. In this study, 100 copies of the questionnaire were distributed within the MoH, Salmaniya Complex and to all of the Public Health Centers. Thirty Seven questionnaires were returned, a response rate of 37%.

The purpose of the questionnaire: The survey methodology used for collecting data was described in this section and the main mechanism was the questionnaire. From the first study, it was found that this technique was the most appropriate way of collecting data because, basically, it gave the managers the flexibility to complete the survey in their free time. However, it was the complete opposite in the case of the second study. The researcher ascertains from the conversations with some of the respondents that many of these individuals were almost likening it to an examination paper and thought of

handing the questionnaire to someone professional to answer it. Those managers who did not completely understand a question would either adopt the middle of the scale response or the highest positive response. Moreover, some of the respondents even go on to reply with I don't know even though the zero on the scale is labeled I don't know.

The purpose of the questionnaire was to determine managements' opinions and their likely level of agreement with the research hypotheses. The targeted sample of respondents for both studies was managers from different managerial levels. In the first study, this method was generally found to be the best technique to collect data from a large group of respondents in a short time and provides the opportunity for the respondents to give frank and open answers. The author found that a very small number of respondents had some difficulty in replying to certain questions either because the respondents lacked experience in completing a questionnaire or because of a lack of understanding some of the terms used (Al-Alawi, 1991). In the second study, we have found that most of the respondents had difficulties in replying to most of the questions.

The reasons behind those difficulties were limited English language skills and a weak MIS background. For example, we have received calls from some of the respondents asking us whether it is possible not to write their names and others were saying: No, I don't want to write my name, which is really something ironic because in the questionnaire we have mentioned that it is OPTIONAL. Moreover, some of the managers thought that their secretaries are better in answering the questionnaire because they are more knowledgeable in Microsoft Office. In addition, some of the respondents were not completely honest with their responses due to fear of their top-level management, though we have mentioned in the questionnaire that the responses will be kept confidential and will be used for study purposes only. In our opinion, this fear is due to the unreasonable firing cases that happened within the same period of the questionnaire distribution and the management instability. Hence, the Government replaced the Minister of Health who was on the seat for only few months. This is very unusual in the Kingdom of Bahrain.

RESULTS AND DISCUSSION

Introduction: The purpose of this section is to provide a detailed analysis of the collected data through the survey and a comprehensive comparison between the conclusions that have been reached through the questionnaires of 1991 and 2003.

The descriptive analysis for this research involved calculating frequencies, percentages and means. In order to assure statistically reliable results it was necessary to classify the managers into two groups. Group 1 consists of the top managerial level, whereas Group 2 consists of other managerial levels. The results related to each of the six key elements are presented separately and tabular summaries of the results are included.

MIS function: The respondents were asked how their MIS functions are structured with regard to management and systems development personnel.

Five options were given and respondents were asked to tick the one that most closely described their organization. Option one: One centralized MIS organization to support the entire enterprise. In 1991, the responses showed that 42% of respondents specified this option and in 2003 the figure was close to the one in 1991, which is 46%. Option two: Each division/department has its own independent MIS section. 6% of respondents specified this option in 1991 while 10% specified this option in 2003. Option three: Each division/department has its own MIS section, but these report to the corporate MIS organization. In 1991, 10% specified this option compared with 16% in 2003. Option four: None of the above (Please specify briefly). In this option the respondent has the opportunity to specify any other structure not included in the above options. The result showed that in 1991, 5% of the respondents specified options other than those set out above whilst none of the respondents of 2003 specified other options than those already listed. Option five: Do not have an MIS function. 37% of 1991's respondents specified this option compared with 21% in 2003. Table 1 gives more details and a breakdown for each managerial level.

MIS installed: The respondents were asked to state whether they have a computerized MIS installed in their organization or not. This question was used to direct the respondents to certain related questions. In the first study, a majority (62%) said there was no computerized MIS installed, while in the second study a majority (64%) of the respondents said there was a computerized MIS installed in their organizations. Table 2 is an overall analysis of responses, while Table 3 shows the breakdown by managerial level.

System development: Respondents who said they had a computerized MIS were asked to identify how their current MIS was developed. The analysis is shown in Table 4 presents the responses from the two studies. From the earlier study 29% and from the latter study 41%

Table 1: Structure of MIS function

Managerial Level	Options					Row total (%)	N.A.(%)
	1(%)	2(%)	3(%)	4(%)	5(%)		
Bahrain 1991							
Top Managerial Level	17	5	5	0	11	38	0
Other Managerial Levels	25	1	5	5	26	62	0
Total	42	6	10	5	37	100	0
Bahrain 2003							
Top Managerial Level	5	0	0	0	2	9	2
Other Managerial Levels	41	10	16	0	19	91	5
Total	46	10	16	0	21	100	7

Table 2: Computerized MIS Installed

Year of Study	YES		NO		Total		N.A.
	(%)	n	(%)	n	(%)	n	
Bahrain 1991	38	32	62	52	100	84	1
Bahrain 2003	64	23	36	13	100	36	1

Note: For the purpose of this table: 1 = Yes 2 = No

Table 3: Computerized MIS installed (Breakdown by Managerial Level)

Managerial Level	YES		NO		Total	N.A.	
	(%)	n	(%)	n		(%)	n
Bahrain 1991							
Top managerial level	15	13	20	17	36	30	0
Other managerial levels	23	19	42	35	64	54	1
Total	38	32	62	52	100	84	1
Bahrain 2003							
Top managerial level	8	3	3	1	11	4	0
Other managerial levels	56	20	33	12	89	32	1
Total	64	23	36	13	100	36	1

Table 4: Sources of MIS development expertise

Year of study	Department MIS staff		Outside consultants		Headquarter MIS staff		Vendor		Others	
	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n
Bahrain 1991	29	25	13	11	18	15	2	2	2	2
Bahrain 2003	41	15	32	12	24	9	30	11	3	1

indicated it was developed by departmental MIS staff; 13% from the first study and 32% from the second study stated outside consultants are employed; 18% from the 1991's study and 24% from the 2003's study indicated development was undertaken by headquarters MIS staff. In 1991 only 2% of the responses indicated development by vendors, whereas in 2003, 30% of responses indicated the same statement, which is a vast difference.

Computerized systems: Table 5 and 6 show from the responses to question 53, the extent to which hospital systems were computerized. The systems were ranked in order to find the level of computerization in each study. To simplify the statistical analyses and for the purpose of this table, note that N = not at all and to a small degree, M = to a moderate degree and F = fully computerized (to a large and maximally/essential)

Respondents comments: In the last question of the questionnaire the respondents were given the

opportunity to make any further comments. In the study of 1991, some of the respondents wished regarding MIS and 19 availed themselves of the opportunity. It was difficult to draw any conclusion from the comments.

However, in the study of 2003, only 10 of the respondents answered this question. The comments could be divided into two categories; the first category was wishing to spread the use of MIS to all of the employees in the MoH and emphasized on the tremendous benefits that could be yielded by applying and developing MIS in the Health sector. The other category mentioned that MIS in the MoH is undergoing a project for replacing the existing system which will take 3 to 5 years.

Analysis of the key elements: In the following analysis each key element will be discussed separately. To simplify the statistical analysis procedures it was decided to classify the responses on a scale which measured respondents' level of agreement. These were formed into

Table 5 Level of computerization

Questionnaire Items	Bahrain 1991			Bahrain 2003			
	N	M	F	N	M	F	N. A.
Payroll	21	25	54	30	14	41	16
In-patients	32	22	46	32	19	30	19
Stores	27	33	40	27	11	46	16
Patient Administration System (PAS)	29	37	34	22	16	43	19
Patient Master Index (PMI)	40	29	31	38	11	32	19
Personnel	60	10	30	19	30	32	19
Out-patients	66	11	23	19	24	35	22
Administration	64	18	18	38	14	24	24
Works	63	25	12	24	19	32	24
Psychiatric care	61	29	10	35	19	22	24
Catering and Hotel	78	15	7	35	19	19	27
Maternity care	81	9	10	51	11	11	27
Waiting lists	83	7	10	43	14	16	27
Accident and Emergency (A and E)	83	7	10	46	11	16	27
Intensive care	83	7	10	43	24	5	27
X-Ray	81	14	5	43	19	11	27
Pharmacy	84	10	6	30	19	27	24
Pathology	84	10	6	43	14	22	22
Radiology	83	11	6	30	22	32	16
Nursing	84	10	6	22	14	43	22
Community care	86	10	4	43	19	14	24
Day care	87	10	3	35	11	35	19

Table 6: Level of computerization (Breakdown by Managerial Level)

Questionnaire Items	Bahrain 1991						Bahrain 2003					
	Group 1 %			Group 2 %			Group 1 %			Group 2 %		
	N	M	F	N	M	F	N	M	F	N	M	M
Payroll	6	24	70	43.0	28.8	28.5	0	67	33	39	11	50
In-patients	33	7	60	31.5	31.5	37.0	0	100	0	44	15	41
Stores	35	40	25	25.0	36.0	39.0	25	25	50	33	11	56
Patient Administration System (PAS)	27	40	33	31.5	40.0	28.5	33	33	33	26	19	56
Patient Master Index (PMI)	53	40	7	26.0	20.5	53.5	67	33	0	44	11	44
Personnel	62	13	25	66.5	11.5	22.0	0	67	33	26	33	41
Out-patients	60	7	33	80.0	10.0	10.0	0	100	0	24	24	52
Administration	81	6	13	62.0	24.0	14.0	33	67	0	52	12	36
Works	61	31	8	76.5	13.5	10.0	33	67	0	32	20	48
Psychiatric care	67	20	13	58.0	33.5	8.5	33	67	0	50	17	33
Catering and hotel	75	25	0	85.0	5.0	10.0	33	67	0	50	21	29
Maternity care	86	7	7	78.5	14.0	7.5	33	67	0	75	8	17
Waiting lists	87	0	13	86.5	9.0	4.5	67	33	0	58	17	25
Accident and Emergency (A and E)	86	0	14	81.0	14.5	4.5	67	33	0	60	16	24
Intensive care	84	8	8	87.5	4.0	8.5	33	67	0	63	29	8
X-Ray	79	14	7	77.5	19.5	3.0	67	33	0	58	25	17
Pharmacy	86	14	0	82.5	8.5	9.0	33	67	0	40	20	40
Pathology	86	7	7	86.5	9.0	4.5	33	67	0	58	12	31
Radiology	86	7	7	82.0	15.0	3.0	33	67	0	36	21	43
Nursing	86	14	0	88.5	4.0	7.5	33	67	0	27	12	62
Community care	87	13	0	89.0	5.5	5.5	0	100	0	64	16	20
Day care	86	14	0	91.0	4.5	4.5	33	67	0	44	7	48

a scale as Disagree contains responses ‘Not at all’ and ‘To a small degree’, Moderate represents agreement defined as ‘To a Moderate degree’, whilst Strongly Agree represents agreement as measured by ‘To a large degree’ and ‘Maximally Essential’.

The data gathered from the questionnaires were analyzed in two phases. The first phase was concerned with analyzing and identifying respondents’ opinions and their likely level of agreement with the research hypotheses. The second phase of data analysis involved

comparing the different managerial levels and their likely level of agreement with the research hypotheses.

Analysis of the key elements: Many of the questions are relevant to more than one key element. In the following section a conclusion of the analysis will be provided for each key element.

Determination of corporate needs: This key element was concerned to find the importance of determining of

corporate needs. Corporate needs are concerned with defining the strategic aims and long term objectives of the organization. Determination deals with establishing corporate needs and gauging the extent to which MIS can fulfill these needs. It can be seen the respondents in both studies, 86% in 1991 and 75% in 2003 strongly supported the view that MIS should have an effective strategy to deliver useful, integrated decision support systems for its users. The proportion of respondents within each level who strongly agreed with this statement and produced the following statistics: for Group 1 managers 82% of the first study and 50% of the second study strongly agreed with this statement, whilst for Group 2 managers 93.5% of the first study and 80% of the second study agreed with this statement.

The respondents who stated there was no MIS installed in their organizations, 80% in 1991 and 83% in 2003 of the respondents strongly agreed with the fact that there was a need for MIS in their organization. The proportion of managers within each level who strongly agreed with a need for MIS within their organization can be broken down as follows: for Group 1 managers 76% of the respondents of 1991 and 100% of the respondents of 2003 strongly agreed, whilst for Group 2 managers 90% of the respondents of 1991 and 80% of the of the respondents of 2003 agreed with this statement.

The majority of respondents in both studies, 80% in 1991 and 83% in 2003, strongly believe it is important for their organizations to have MIS. The proportion of managers within each level who strongly support this statement: for Group 1 managers 76% of the first study and 100% of the second study have strongly agreed, whilst for Group 2 managers 90% of 1991 and 80% of 2003 have agreed with this statement.

The research shows that of the respondents from both studies, 67% in 1991 and 63% in 2003 strongly supported the view that MIS investments that are not in support of corporate strategy will not help achieve corporate strategic goals. The proportion of managers within each level who strongly agreed with this statement: for Group 1 managers 70% of 1991 and 60% of 2003 respondents strongly agreed, whilst for Group 2 managers 71.5% of 1991 and 65% of 2003 of respondents strongly agreed.

When respondents of both studies were asked whether the installation of MIS should reduce costs of their organization, it can be seen from the tables that there is a significant degree of agreement between managerial levels. The analysis shows that 62% in 1991 and 76% in 2003 of the respondents strongly agreed with this statement and the managerial breakdown was similar. For Group 1 managers 56% of respondents agreed with this in

the first study and 60% agreed with this in 2003, whilst for Group 2 managers the level of agreement was 65% in 1991 and 79% in 2003. The analysis shows that 43% of the first study respondents and 36% of the second study respondents supported the claim that MIS is designed to support all levels of management in the organization. When the respondents of 1991 and 2003 were asked if there was a need for Arabisation of MIS, it also shows that 42% in 1991 and 41% in 2003 felt strongly that there was a need for Arabisation of MIS. The proportion of management within each level which strongly agreed with this statement was: in 1991, 37% of Group 1 managers strongly agreed, 45.5% of Group 2 and similarly in 2003, 40% of Group 1 and Group 2 managers strongly agreed.

The analysis also shows that only 38% of the first study respondents felt that increasing MIS expenditure yielded higher management performance, while 52% of the second study felt that increasing MIS expenditure would improve the performance and yield imperative benefits within the managerial field.

Though the time gap between the two studies is more than a decade, managers from both studies agreed on the importance of and the need for MIS, which has an effective strategy to deliver useful, integrated decision support systems which are designed to support all levels of management and for MIS investment to achieve strategic corporate goals. The raw data from this part of the survey show that managers are significantly support the idea of determining the corporate needs first as a starting point for MIS development.

Management commitment: Key element two is concerned with the level of management commitment to developing MIS and the importance attached by management at different levels to computerized MIS. According to the previous percentages and analysis, we can conclude that managers without doubt endorse the concept that management commitment and support is imperative for developing a successful MIS.

It can be seen from the research that the majority of respondents in both studies agreed with the statement that management should actively promote training in computerized MIS for potential users of MIS and ranked it as number one for this key element. The analysis also shows that the proportion of managers within each level which strongly support this statement was as for Group 1 managers 90% in the first study and 100% in the second study of respondents strongly agreed, whilst for Group 2 managers 98.5% in the first study and 97% in the second study of respondents strongly agreed.

The majority of respondents in both studies, moderately/strongly agreed on the level of importance

they attached to management commitment and involvement in the design and development of MIS. The overall percentages were 69% in 1991 and 75% in 2003. The proportion of managers within each level who had moderately/strongly held views with regard to this question were: for Group 1 managers 50% of the 1991 and 2003 respondents were agreed on this question, whilst for Group 2 managers the level of agreement was 88.5% of the 1991 study and 80% of the 2003 study.

Respondents were also asked for their opinion of management support and commitment to MIS development. The analysis also shows that 48% in 1991 and 46% in 2003 of respondent strongly believed their support was adequate. The research shows that of all respondents, 53% in the first study and 67% in the second study felt that in comparison to other projects within the organization, management placed a high priority on the development of MIS. According to the previous percentages and analysis, we can conclude that managers without doubt endorse the concept that management commitment and support is imperative for developing a successful MIS.

User attitudes and expectations: This key element is concerned with discovering if users possess attitudes which are for or against MIS as well as their expectation from MIS.

From the responses, it is clear that User Attitudes and Expectations are important, will influence MIS development and will be influenced by it as well. Previous experiences affected these attitudes and expectations and must be discovered before users can be effectively involved in the development process.

In the study the respondents were asked about the importance of computing which will lead to greater efficiency. The analysis shows that in the year 1991, 88% of respondents agreed on its importance, whereas in the year 2003, they were 92%. Respondents were asked how highly they valued MIS in order to find the level of importance attached to MIS. It shows that in the year 1991, 80% of the respondents agreed on the value of MIS, whereas in the year 2003, they were 75%. The respondents strongly agreed with the high importance attached to MIS and this was as in the year 1991, 82% of managers from Group 1, while from Group 2, 88.5% of the respondents agreed. In the year 2003, there were 50% of managers from Group 1 who strongly agreed, while from Group 2, there were 80%.

The study shows that in the year 1991, 80% of all respondents were in strong agreement that ease of system use is more important than complexity, while in the year 2003 respondents who strongly agreed were 76%.

Question aimed to determine respondents' opinions on whether MIS specialists should be actively involved in corporate planning, shows that in the year 1991 there were 48% of the respondents and in the year 2003 there were 76% of the respondents who strongly agreed that the MIS specialists should be involved in corporate planning.

The respondents were asked if it is important for every manager to have a terminal or a PC connected to the main computer to access information. The analysis shows that in the year 1991, there were 74% respondents who strongly agreed, while in the year 2003 there were 97% respondents in strong agreement.

The analysis shows that the majority of respondents in both years, 88% in the year 1991 and 87% in the year 2003, moderately/strongly believe that executives are more interested in results and information that simplifies goals than in how the information is found.

The respondents were asked how highly would they rate the probability of MIS being a success in their organization in the future the study shows that in the year 1991, 65% of the respondents maintaining that MIS would be a success in their organization, while in the year 2003 the respondents were 67%.

However, in 1991 about half of the managers who stated that they have an MIS acknowledged that the MIS is not a success in their organization.

In question 34 respondents were asked if MIS was designed to support all levels of management, it shows that in the year 1991, 43% of respondents strongly agreed and in the year 2003 they were 36%. The study shows that in the year 1991, 55% of respondents use MIS to a high extent, while in the year 2003 they were 57%.

The analysis shows that in the year 1991, 46% of respondents strongly agreed with the statement that the use of MIS has resulted in improvement of user decision-making, while in the year 2003, respondents were 52%. When the respondents were asked whether MIS has changed the attitudes of users to computer systems it shows that in the year 1991, 38% of the respondents were in strong agreement with this situation whereas in the year 2003, respondents were 60%. Respondents were asked to determine whether they were satisfied with their current MIS, the analysis shows that in the year 1991, 33% of respondents were well satisfied, where as in the year 2003, respondents were 8%. These numbers imply that respondents were not satisfied with their existing MIS systems.

Respondents were asked whether they agreed with the claim that some managers are afraid of computerization. The analysis shows that in the year 1991 the mean for respondents was 2.53, indicating that respondents disagree with this statement, while the mean

for the year 2003, which is 2.45, indicates that respondents, as well, disagree with this statement. Hence, the mean values of equal to 3 and less than 4 indicated moderated agreement and those equal to or greater than 4 indicated strong agreement. It can be seen from this analysis that managers do not fear computers and they are negative about this state.

The respondents were asked whether a satisfaction survey had been carried out or not. The statistics shows that in the year 1991 there were 79% respondents, whereas in the year 2003 there were 64% respondents who indicated that no such survey had been conducted in their organization. It shows that: in the year 1991, 100% of the respondents of Group 1 said that no such survey had been conducted while they were 79% of Group 2. In the year 2003, 0% of the respondents of Group 1 said that no such survey had been conducted while they were 76% of Group 2.

The survey that was conducted in both years, 1991 and 2003, found that most of the respondents had a negative attitude to the state that some managers are afraid of computers. The majority of the respondents agreed with the statement, which implies that the importance of computing in the search leads to greater efficiency. The survey also signified that managers preferred to access computerized information from the main computer. Managers considered MIS as extremely valuable. Data collected proposed that computerized systems do not change the attitudes of their users. Most of the respondents believed that MIS would be successful in their organizations. The survey found that MIS might improve users' decision-making. However, respondents were not satisfied with their current MIS. It was found that user satisfaction survey had not been undertaken. The survey data indicated that the ease of system use was more important than sophistication. From the above responses, it is clear that User Attitudes and Expectations are important, will influences MIS development and will be influenced by it as well. Previous experiences affected these attitudes and expectations and must be discovered before users can be effectively involved in the development process.

User involvement: This key element shows how and when users should contribute in MIS development and it also speaks about the influence that users can/should bring to stand on such development. We can conclude from both the survey data and the literature that user involvement is a very important key element for the successful development of MIS. However, the effectiveness of User Involvement is strongly influenced by the user's attitudes and expectations in relation to MIS and for this reason both are included in the proposed guidelines.

The study shows that in the year 1991, 76% of the respondents had a strong feeling that the users should be actively involved in MIS planning and application development, whereas in the year 2003 the respondents were 67%. The analysis shows the breakdown by the managerial level of question 27 for the respondents who strongly agreed and gives results as in the year 1991, for Group 1, 76% of the respondents agreed, while for Group 2, respondents who agreed were 63%. In the year 2003, for Group 1, 50% of the respondents agreed, while for Group 2, respondents who agreed were 70%. Respondents were asked if they were familiar with MIS development in their own organization. The analysis shows that in the year 1991, 52% of respondents indicated familiarity, while in the year 2003, respondents were 32%. The study shows the breakdown by the managerial level of question 35 for the respondents who strongly agreed and gives results as in the year 1991, for Group 1, 44% of the respondents agreed, while for Group 2, respondents who agreed were 57.5%. In the year 2003, for Group 1, 0% of the respondents agreed, while for Group 2, respondents who agreed were 35%. When respondents were asked whether they had been sufficiently informed about MIS. The analysis shows that in the year 1991, 49% of respondents were informed, whereas in the year 2003, 24% were informed.

Respondents were asked about the extent of their participation in the design and development of MIS, the analysis shows that in the year 1991, 41% said they participated in the design and development of MIS while in the year 2003; respondents who participated were 28%.

The statistical analysis for both years, 1991 and 2003, shows that users should be aggressively encouraged to participate in MIS planning and application development. In the year 1991, the survey data suggest that familiarity with MIS development had been found to be crucial to success. It was found that respondents of the year 1991 were more familiar with MIS development than respondent of the year 2003. In particular, respondents of the year 1991 were more adequately informed about MIS development than respondents of the year 2003. When the respondents were asked about their participation in the design and development of their current MIS it was discovered that the respondents of the year 2003 are more involved with their current MIS system than the respondents of the year 1988. The poor participation of the year 1991 respondents appears to correlate with the managers' dissatisfaction with their current MIS. We can conclude from both the survey data and the literature that user involvement is a very important key element for the successful development of MIS. However, the effectiveness of user involvement is strongly influenced

by the user's attitudes and expectations in relation to MIS and for this reason both are included in the proposed guidelines.

Performance measurement: Performance measurement is the key element, which is apprehensive with evaluating the effects or changes to the functioning of an organization caused by the introduction of MIS. Some operational areas highlight the need for performance measurement to be included in the guidelines for the successful development of MIS, but from the previous points it is concluded that there are poor overall performances of the current MIS in the organizations. MIS development needs to be aimed to achieve improved performance.

The analysis shows that in the year 1991, 25% of respondents rated the overall performance highly while in the year 2003 respondents who rated highly were 36%. From both years, 1991 and 2003, one can see that the majority of responses were in the moderate to low range.

The breakdown by the managerial level of the respondents who strongly agreed and gives results as in the year 1991, for Group 1, 20% of the respondents agreed, while for Group 2, respondents who agreed were 30%. In the year 2003, for Group 1, 0% of the respondents agreed, while for Group 2, respondents who agreed were 38%. Respondents were also asked if MIS has changed the way in which operations are performed, the analysis shows that in the year 1991, 30% of the respondents showed an agreement with the view that operations have changed, while the majority of respondents were unsure whether it had changed at all. However in the year 2003, the majority of the respondents, which represents 57% showed an agreement with the similar state. The breakdown by the managerial level of shows for the respondents who strongly agreed and gives results as in the year 1991, for Group 1, 19% of the respondents agreed, while for Group 2, respondents who agreed were 45%. In the year 2003, for Group 1, 0% of the respondents agreed, while for Group 2, respondents who agreed were 59%. When question asked the respondents if they have an MIS organization and if it issues regular reports on its performance. The analysis shows that in the year 1991, 79% of the respondents said that no such reporting is available, where as in the year 2003, respondents who said no were 48%. The statistics shows the breakdown by the managerial level of question 33 for the respondents who said no such reporting takes place and the results were as in the year 1991, for Group 1, 80% of the respondents said no, while for Group 2, respondents were 78%. In the year 2003, for Group 1, 100% of the respondents said no, while for Group 2, respondents were 52%.

The respondents were asked whether MIS had changed the timeliness of information and reports received, it shows that in both of the years, 1991 and 2003, 75% respondents indicated an improvement in timeliness of information and reports received. The analysis shows the breakdown by the managerial level for the respondents who strongly support the claim of an improvement and the results were as in the year 1991, for Group 1, 69% of the respondents agreed, while for Group 2, respondents who agreed were 80%. In the year 2003, for Group 1, 100% of the respondents agreed, while for Group 2, respondents who agreed were 82%. The respondents were also asked whether MIS has changed the accuracy of the information received. The analysis shows that in the year 1991, 79% of the respondents stated that the accuracy of information they received with MIS had improved, where as in the year 2003 the respondents who stated on the similar claim were 75%. The breakdown by the managerial level of question 47 for the respondents who strongly agreed with improved accuracy of information and the results were as in the year 1991, for Group 1, 69% of the respondents agreed, while for Group 2, respondents who agreed were 88.5%. In the year 2003, for Group 1, 100% of the respondents agreed, while for Group 2, respondents who agreed were 82%.

For both of the year 1991 and 2003, the overall performance of the current MIS in the organizations surveyed has been found to be poor. In the year 1991, one can see that the majority of respondents claimed that the current MIS has not changed the way in which their organizations' operations were performed, while in the year 2003 the majority of the respondents claimed that MIS has change the way that organizations' operations are performed. Some operational areas highlights the need for performance measurement to be included in the guidelines for the successful development of MIS, but from the previous points it is concluded that there are poor overall performance of the current MIS in the organizations. MIS development needs to be aimed to achieve improved performance.

Measurement techniques: It is clear from the survey data that there is great support to use the most important two techniques, which are Cost-Benefit Analysis and Cost-Effectiveness Analysis and there is a clear need, demonstrated earlier, for setting performance standards. If shaping the measurement metrics will be effective, then it should be done as part of the MIS development.

In the previous section, two particular measurement techniques, which are Cost-Benefit Analysis and Cost-Effectiveness Analysis were discussed. Cost-Benefit Analysis is a technique designed to determine the

feasibility of a project or plan by quantifying its costs and benefits. The objective of Cost-Effectiveness Analysis involves in comparing the relative costs of operating a program with the extent to which the program met its goals and objectives Adler and Posner (2001). However, in the questionnaire respondents were offered a choice of other measurement techniques to evaluate both the level of actual use and the level of potential interest across the range.

The respondents who showed that they have an MIS in their organization were asked to choose from a set of criteria, which can be used to measure an investment's attractiveness and asked to signify the extent to which each of the given techniques was actually used to evaluate MIS. The study shows that in the year 1991, 41% of the respondents showed that Cost-Benefit Analysis techniques were used, whereas 36% of the respondents stated that Cost-Effectiveness Analysis techniques had been used, 20% of the respondents reported the use of Break-Even Analysis, 11% of the respondents reported the use of Payback Period Analysis, 14% of the respondents stated the use of Net Present Value and, finally, 13% of the respondents chose the use of Internal Rate of Return. However in the year 2003, shows that 36% of the respondents showed that Cost-Benefit Analysis techniques were used, whereas 40% of the respondents stated that Cost-Effectiveness Analysis techniques had been used, 20% of the respondents reported the use of Break-Even Analysis, 20% of the respondents reported the use of Payback Period Analysis, 16% of the respondents stated the use of Net Present Value and, finally, 16% of the respondents chose the use of Internal Rate of Return.

The respondents also were given the opportunity to show which of the measures should be used in their opinion. The study shows that in the year 1991, 74% of the respondents showed that Cost-Benefit Analysis techniques should be used, whereas 72% of the respondents stated that Cost-Effectiveness Analysis techniques should be used, 50% of the respondents reported that Break-Even Analysis should be used, 46% of the respondents reported that Payback Period Analysis should be used, 45% of the respondents stated that Net Present Value should be used and, finally, 42% of the respondents chose that Internal Rate of Return should be used. However in the year 2003, shows that 65% of the respondents showed that Cost-Benefit Analysis techniques should be used, whereas 68% of the respondents stated that Cost-Effectiveness Analysis techniques should be used, 32% of the respondents reported that Break-Even Analysis should be used, 43% of the respondents reported that Payback Period Analysis

should be used, 35% of the respondents stated that Net Present Value should be used and, finally, 32% of the respondents chose that Internal Rate of Return should be used.

It is clear from the survey data that there is great support to use the most important two techniques, which are Cost-Benefit Analysis and Cost-Effectiveness Analysis and there is a clear need, demonstrated earlier, for setting performance standards. If shaping the measurement metrics will be effective, then it should be done as part of the MIS development.

APPLICATION OF THE GUIDELINES IN BAHRAIN

Introduction: The need and demand for healthcare is rapidly increasing. In almost every nation, the growth of both need and demand for healthcare is faster than the rate of increase in resources available for providing it. There are four reasons for this:

Increase in the number of elderly: An increase in the number of elderly people leads to the increase in the need for healthcare.

Rapid Development of Technology: New technology will continue to be developed by industry and research workers within health services and related disciplines.

Patient expectations: Patient expectations of health are rising, reflecting societal changes in attitude towards the provision of goods and services. In most of the developed countries, this trend includes rising expectations of accessibility and quality of services and the accountability of service.

4. Professional expectations: Professional expectations and attitudes are influenced by developments in technology in that any new developments in technology serve as an incentive to increase expectation.

The healthcare industry is experiencing a rapid rate of change. Short term quick fix solutions cannot keep pace with the speed of change and complexity of today's healthcare industry. This section is concerned with the implementation of the guidelines in the Bahraini environment to show how the guidelines may be used for the successful development of MIS in a non-profit making organization, the MoH in Bahrain. This section outlines the current MIS situation in Bahrain and then how the guidelines could be applied in that context. Figure 1 shows how the MoH is responsible for the implementation of the MIS guidelines.

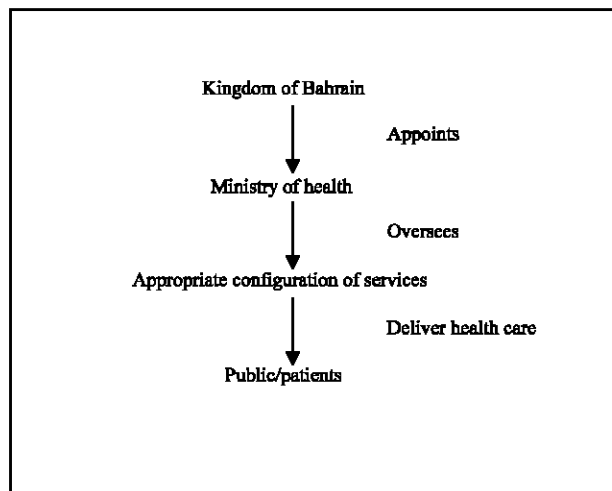


Fig. 1: The MoH responsibility

Planning for Information Systems (IS): It is important for the Ministry to understand that information systems planning for healthcare is a difficult process due to the following reasons:

- **Technologies are changing rapidly:** Technology today is highly dynamic; it is never stable. Therefore the question arises how can one plan when information technology is changing so rapidly? One solution to this difficulty is that planning has to be done continuously to keep up with the changes in technology. It is no longer feasible to plan for example just once a year and implement the plan in the following year. The MoH can appoint a group of people to observe and assess the use of new technology (Memel, 2003, Green and Bowie, 2004).
- **Responsibility needs to be shared:** The MoH cannot assume the responsibility complete of planning and implementation of the information systems. They must be aware of the fact they are not the ones who directly communicate with the patients at the government health centers and hospitals. Hospital administration, doctors, nurses etc. must all have a say in the planning of the needs and requirements of the information systems. Sharing of responsibility can be a difficult process; however, this difficulty needs to be overcome in order to develop successful management information systems for healthcare.

Effective information system management is essential to the continuous growth of the healthcare providers in an increasingly complex environment. No matter what information system planning method we use the

following is a summary of the issues which must be highlighted and discussed (Harman, 2001; Memel, 2003; Green and Bowie, 2004).

- Documenting and assessing the hospital's existing information systems environments to support ambulatory care entities in terms of overall functionality, technical infrastructure and organizational structure and cost.
- Developing and assigning priorities to the hospital's current and future information requirements by focusing on application and data, network/connectivity, organizational support and advanced technological opportunities.
- Developing and evaluating alternative system strategies to support the hospital's future healthcare directions and selecting the best fit.
- Finalizing the information systems plans based on the selected information systems strategy and developing a migration plan that includes detail projects, capital costs and recommended time frames.
- It is very important to keep in mind when planning that no aspect of providing health care to patient should be compromised as in the end it is the patients' well-being that matters.

The current situation of the MIS/HIS in Bahrain: The MoH has established the Health Information Directorate (HID), which is responsible for the implementation and monitoring of Information Technology Services. Figure 2 shows the role that the Health Information Directorate plays.

The Health Information Directorate has played a major role in implementing appropriate information technology services to improve the healthcare outcomes through leadership, qualified team and commitment. Various services such as software, infrastructure and communication have been implemented and managed successfully to deliver the maximum possible information that can facilitate and enable the MoH business.

There are a number of conceptual frameworks that stand out in the MIS area, the best known and most widely cited model of evolution related to organizational information systems being the one developed by Nolan. The model started as a tentative hypothesis (Nolan, 1973) and has since become regarded as an empirical grounded theory (Nolan, 1979) and an accepted description of how organization information systems develop over time. In Nolan (1973) the core concept behind the model was presented as a hypothesis grounded in observation and discussion with managers in three organizations. According to Gibson and Nolan (1973), the four stages of

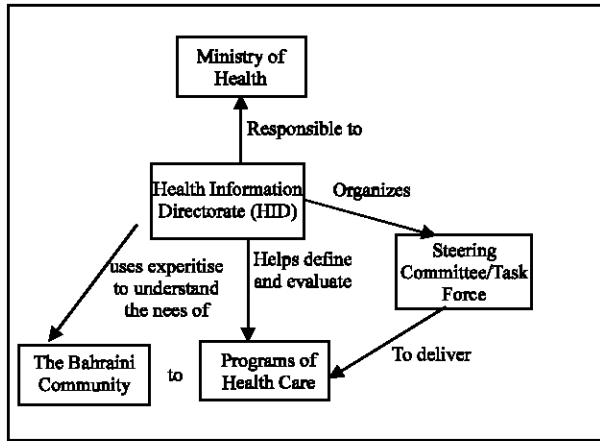


Fig. 2: The Role of Health Information Directorate

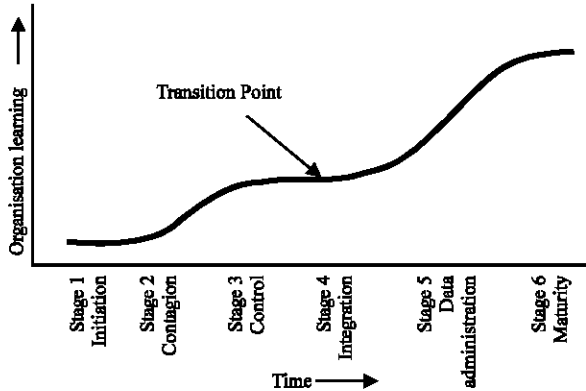


Fig. 3: Nolan's Stages of Growth Model Adopted from Nolan (1979)

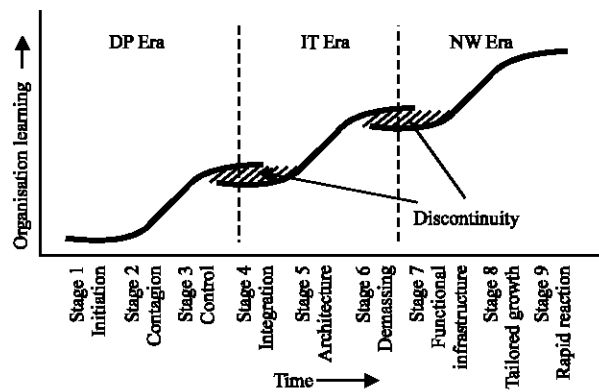


Fig. 4: Three eras of IT growth (Adopted from Mustaers *et al.*, 1997)

Managing stages of information systems growth are Initiation, Contagion, Control and Integration. This four-stage model has been further modified by adding

two more stages Data Administration and Maturity (Nolan, 1979). Figure 3 shows Nolan's Stages of Growth Model.

When this study was initially conducted Nolan's Six Stages of Growth Model was used to explain how the MoH has passed through the Nolan stages. However Expansion of the stages theory has continued. Mustaers *et al.* (1997) have described the S-curves model as three eras of IT growth and maturity, the Data Processing (DP) era, the Information Technology (IT) era and the Network (NW) era as shown in Fig. 4. Rather than evolution, business transformation through creative destruction will occur. Each era is characterized by a period of evolution, followed by a period of stability, ending with a period of discontinuity and revolution, before the start of the next era (Nolan and Koot, 1992; Nolan and Crosson, 1995).

An explanation of each stage is provided below:

Stage one: Early successes (Initiation). This is the first stage where the use of new technology is introduced. The computer is introduced within the organization to meet its basic needs. Users are encouraged to use the system but there is slow growth in use due to unfamiliarity and the few applicants which have been developed. Users are not yet ready to request further applications due to lack of computer appreciation. The developed applications are simple and typical of an accounting oriented system. The MIS organization in this stage is often centralized because both the organization and the users must learn the new centralized technology. Control in this stage is loose and planning is almost none existent. There is a chance that some sort of stumbling may occur; however early success can lead to an increase in the interest of exploring new technology. According to Al-Alawi (1991) the initiation stage in the Ministry of Health in Bahrain was the first the computer equipment (IBM 4381) installed for the MoH in the Government Computer Centre during 1985 together with a communication network based on telephone lines with 9600 BPS speed utilizing IBM 3714 and IBM 3274 remote controllers. The first applications were finance and payroll, this latter system being established by the Government Computing Directorate for all the Ministries in Bahrain.

Stage two: Contagion. This stage is based in the early successes, there is a rapid increase in interest as new products and/or services which are based on technology arrive in the market place. These new products and/or services are applied to a wide variety of applications. Growth is uncontrolled and therefore it increases rapidly. In this stage excessive usage of computerized systems is due to top management commitment to exploiting

computing potential plus high expectations among users and requests for the development of many different applications. Computing expenses are often carried as an overhead during this stage computer services are often free to users and therefore new application development is encouraged. This stage which can also be called the proliferation stage can be described as a learning period for the organization. According to Al-Alawi (1991) the contagion stage in the Bahraini government organization occurred from the mid – 1980s. During this stage consultation took place with the Government Computing Directorate and decisions were taken to develop customized systems. The Bahrain Health Information Centre (BHIC) now known as the Health Information Directorate (HID) was established in the Ministry of Health. An Admission Transfer and Discharge (ATD) systems was developed. A CPR (Central Population Registration) was developed to be used as a Patient Master Index.

Stage three: Control. In this stage it becomes evident that the proliferation must be controlled. The management begins to realize that the costs of using the new technology are very high and there is waste in using a variety of different applications. Top management becomes concerned about the level of benefits being received from computerization versus the cost of MIS operation. Cost control measures are determined or set by top management and the MIS manager is charged with designing and implementing adequate control systems. Therefore an attempt is made to try and integrate systems; however, difficulty is experienced in doing so. According to Al-Alawi (1991) the control stage was entered by the Bahraini Governmental organizations from the mid-1980s. The control stage at the MoH occurred during 1987-1989 along the following lines:

- Corporate steering committee for computing established.
- A team of computer/management consultants traveled abroad to see live systems in some recommended hospitals with the aim of purchasing off-the-shelf systems.

Stage four: Integration. During this stage the technology that is being utilized can be considered to be mature and top management begins to rethink the management of computing in terms of data resources rather than computing resources. This stage is characterized by an attempt to take advantage of new technology, typically database, by integrating it into existing systems. The computing costs continue to increase rapidly in this stage

as well as computer usage. To help to move toward data resource management, database systems are introduced and brought into the organization. The MIS function is set up mainly as a utility service for the users. Once this stage is achieved there is a significant transition point in an organization's use of computers. The dominant design of the technology has now been mastered making way for new technologies whose arrival will lead to the repetition of the above stages. The integration stage at the MoH began during the early nineties. When this study was initially conducted by Al Alawi, in terms of integration some use was being made by the Government Computer Centre of database management systems for certain basic applications database orientation of application. Twelve years later the MoH is still in the integration stage however rapid technological changes and improvements are being made. MoH has implemented the McDonnell Douglas Information System MDIS (Health Information Directorate, 2003).

The MDIS software is handling the basic functions such as Admission-Transfer and Discharge, Financials, Radiology, Lab Appointments and Logistic services. Most of the applications are being handling data and are connected by point to point interfaces. MoH has implemented many Local Area Network (LAN) and Wide Area Network (WAN) infrastructure projects. All buildings within the Salmaniya Medical Complex (SMC) are interconnected through a fiber optic network underground. This has minimized the communication cost and provides fast and reliable access to the network resources. In addition, all departments are connected to and managed from one central location through 100Mbps Ethernet network.

Different data types are accessed through the network for example Clinical Data (Radiology, Pathology, Medical Records, etc.), Administrative Data (Financial, Personnel, Materials Management, Drug Control etc.) other services (Internet, email, etc). The MoH is still in the integration stage because implementation of information technology is still under process as not all public hospitals and health centers have been automated (Health Information Directorate, 2003). Secondly MDIS vendor has abandoned the support of the application. The lack of application support from the vendor is driving MoH to find a replacement to this technology. The Health Information Directorate has developed a future application architecture, which consists of forty-four functional application modules that would be deployed across the MoH over the next five years.

As the MoH is still in the integration stage a very brief explanation is provided of the remaining stages of the Three Eras of IT Growth (Mustaers *et al.*, 1997).

Stage five: Architecture. Information dispersed. Data management is critical. New systems focus on strategic business objectives. Rapid increase in top management involvement.

Stage six: Demassing. Disbanding of central IT. Business unit has responsibility for deployment of IT. Outsourcing of processing becomes a commodity. Clear trend towards maintenance of legacy systems.

Stage seven: Functional Infrastructure. Translation of business architecture into a new additional layer of functional infrastructure. Continuous shift towards open and public platforms. IT staff get accustomed to powerful tools. Focus is to develop applications according to quality standards, at high speed and low cost. The focus will move from system integration to flexible module integration. There will be continuous shift towards a client-server environment and attempts of truly integrated office automation.

Stage eight: Tailored growth. IT infrastructure centers operated as profit centers. Expansion of the functional support for users by adding top layer applications that use the functionality provided by the functional infrastructure. Vast amounts of external servers are available and accessible via public networks.

Stage nine: Rapid reaction. Adaptation of functionality with dynamic business team changes. Many required adaptations performed by the users by simply changing the parameters. All development of new applications will have the character of pragmatic engineering with high efficiency.

According to Davis *et al.* (1985), the Nolan Model is a useful conceptual model for understanding the general direction of change. At a conceptual level it aides the planning process by providing a framework for understanding change. The diagnostic measurements and prescriptive elements of the model should be viewed as general guidelines for information system planning.

Application of the proposed guidelines in the ministry of health in Bahrain: The survey has clearly shown that the Ministry of Health has implemented a Health Information Systems however the Ministry of Health does not completely meet the author's working definition of HIS developed in Section One. The remainder of this section suggests how the proposed guidelines will enable the Ministry of Health to successfully meet the definition of HIS.

Management commitment: The survey recognized the significant importance of management commitment in Bahrain as well as in the general case discussed in Section Two. From the survey it was concluded that although appropriate information technology services have been implemented in the Ministry of Health, lack of management commitment exists among the managers of the organization's hierarchy. Reasons for lack of commitment may include fear of information technology, lack of education, inappropriate training facilities etc. To ensure Bahraini managers commitment, the following specific issues must be addressed.

- Establish a free flow of effective communication between the managers and systems builders. From the survey conducted it was revealed that lack of communication existed which was hindering management commitment. In part the structure already described will provide a framework for effective communication.
- It is very important that a program of MIS education and training must be provided for managers.
- Assure managers the MIS established will improve the total organization and management decision-making but without threatening any manager's authority. Managers will make the decisions; the MIS will provide them with information to assist them in their decision-making.

As in general case set out in Section Three ensuring management commitment will provide the following benefits to Bahrain:

- Management acceptance of responsibility for the management of information resources.
- The development of an MIS directed to meeting the real needs of managers.

User attitudes and expectations: Resistance to change by those affected by the introduction of a new system is often a serious problem for organization. Although the survey showed Bahraini managers not to be afraid of computers, there is some empirical evidence, noted earlier, to suggest that they are afraid to admit to their fear of technology. To overcome the problems associated with user attitudes and expectations in Bahrain, appropriate education and training of users is essential. This education and training will give the users a better appreciation of the role of MIS in the Ministry of Health. An extensive process of informal and formal user discussions and open meetings should lead to an

improvement in user attitudes and expectations about MIS in the Ministry of Health.

User involvement: User involvement in the development of MIS is advocated for Bahrain in order both to increase participation and to ensure accurate specification of user requirements. It is clear from the general case presented in section three that the more active the users are in determining their requirements, the more likely they are to accept the system and utilize it appropriately. It has also been shown that user involvement in the development of MIS can subsequently increase their satisfaction with the system.

Performance measurement: The Health Information Directorate (HID) monitors the performance of the current, HIS which is the McDonnell Douglas Information System (MDIS) on a regular basis. End users are required to provide feedback about the operation of the system including issue any complaints about the working of the system. Performance measurement is monitored and evaluated only by the HID; however, it is important that the HIS be evaluated by an external entity (people not employed by the Ministry of Health). It is therefore recommended that External Information System Auditors be hired from a well known audit institution to conduct an audit on the HIS in order to give an opinion about its performance which is true and fair and free from any bias.

Measurement techniques: It is suggested that the most appropriate measurement technique of the HIS is the SWOT analysis. SWOT represents the first letter as in

- S = Strength
- W = Weakness
- O = Opportunities
- T = Threats

Thompson *et al.* (2003) suggest a SWOT analysis provides an overview of an organization's situation and is a vital element of crafting a strategy firmly matched to an organization's situation.

Strengths: to look for in the HIS would be the following:

- Powerful strategy
- Strong financial condition
- Proprietary technology

Weaknesses: to look for in the HIS would be the following:

- No clear strategic direction
- Obsolete facilities
- Internal operating problems

Opportunities: to look for in the HIS would be the following:

- Openings to exploit new technologies

Threats: to look for in the HIS would be the following:

- Vendor abandoning the support of the application being used.

If the Health Information Directorate (HID) had used SWOT analysis as a measurement technique of their current HIS which is the McDonnell Douglas Information System (MDIS) they would be able to realize that the greatest threat to using this system was the vendor abandoning the support of the system and the greatest weakness was the HID not having a technical team possessing enough knowledge to support the MDIS had the vendor decide to abandon it. Using the SWOT analysis would have saved the MoH a considerable amount of financial resources as they would have opted for system towards which weaknesses and threats were minimized.

Implementation of the HIS: According to Whitten and Dittman (2001) there are four ways that a new information system can be implemented. A brief explanation of each implementation method is given below:

Abrupt cut-over: On a particular date, the old system is terminated and the new system is implemented and placed into operation. This is a very risky method of implementation, as major problems with the system might exist which won't be discovered until the system has been in operation for a certain period of time. Using this method would result in no transition costs. This method of implementation is not feasible for hospitals as errors in the information system can lead to chaos and affect the healthcare provided to patients.

Parallel conversion: According to this approach both the old and new systems will be operated for a certain period of time. This approach will ensure that all major problems, which exist in the new system, will be discovered and solved before function of the system is terminated. This strategy greatly reduces the risk of major flaws in the new system which can cause irreparable harm especially to hospital reputation. This approach is very feasible for

hospitals; however, the disadvantage of this approach is that costs of running two systems at the same time have to be incurred.

Location conversion: This approach suggests that if the same system will be implemented in several geographical locations then it is advisable to convert it at one specific location first, which in our case would any one of the government health centers or hospitals. This approach is also known as incremental deployment. As soon the specific location approves the system it can be implemented at all the other locations. This approach is also very feasible for hospitals.

Staged conversion: Staged conversion like location conversion is a variation between the abrupt and parallel conversion. This approach is based on the version concept introduced earlier. Each successive version of the new system is converted as it is developed using the abrupt, parallel, or location strategies.

The Ministry of Health (MoH) has implemented the HIS by using location conversion. It was first implemented in the Salmaniya Medical Complex following by implementation in all other public hospitals and health centers. Implementation is still under process not all public hospitals and health centers have been automated.

Education and training: Reference has been made earlier in this section to the need for education and training. When this study was conducted in 1988 the following problems were particular local to Bahrain such as shortage of trained personnel in the MIS field, lack of managers trained in MIS and a general lack of MIS literacy. However today in Bahrain this is not the case. Bahrain today has qualified people in the MIS field but unfortunately the Ministry of Health is not utilizing their talents when it comes to planning and implementing a successful Hospital Information Systems.

The University of Bahrain (UOB) established the College of Information Technology in 1997 from where students are graduating with Bachelors in Management Information Systems (MIS). The College of Information Technology provides its students with an up to date educate of all areas of MIS. The MoH is advised to employ these graduates in the planning, development and implementation of the HIS. The fresh graduates are young and they have a better understanding of information technology as they have grown up with Information Technology playing an active role in their lives. Employing fresh graduates would not be a very costly issue for the MoH as these graduates are looking for jobs and will take up any opportunity to display their talents and skills in IT.

Fear of unknown complex system is one of the major obstacles to MIS use and by employing fresh IT graduates this fear can be overcome as these graduates will help other users by helping them involve themselves in the system development process. The MIS users must be informed as to how the new job is going to be performed and the user must be educated about the tangible and intangible benefits for the organization as well as for the individual user.

According to the COBIT (Control Objectives for Information and related Technology) Steering Committee and the IT Governance Institute (2000) educating and training users ensures that users are making effective use of technology and are aware of the risks and responsibilities involved. Such an objective can be achieved by a comprehensive training and development plan and takes the following factors into account:

- Training curriculum;
- Skills inventory;
- Awareness campaign;
- Awareness techniques;
- Use of new training technologies and methods;
- Personnel productivity;
- Development of knowledge base.

The MoH is advised to ask the University of Bahrain's College of Information Technology (which is well equipped and qualified) to conduct training courses or seminars for all its employees who have little or no knowledge of MIS in order to address the issues mentioned above. In order to obtain user support it would be necessary to provide training and education on computerized management information systems by introducing related computer MIS courses with hands on exercise. Training as well as education are very important factors to increasing the level of computer literacy among the older generation currently employed and to provide users with MIS appreciation. Figure 5 shows an outline of a training manual which can be used when training end-users.

The MoH should also consider sending managers with good communicative and teaching skills outside Bahrain to countries currently using Hospital Information Systems (HIS) so they can an exposure to how a HIS actually functions in a hospital. The managers can then effectively communicate their experience to their colleagues and increase their motivation for learning and actively participating in the new MIS. In general studies report that educational level and period of employment at the organization being computerized are positively correlated with attitudes towards computers.

Training manual end-Users guide outline
I. Introduction
II. Manual
A. The manual system (a detailed explanation of people's jobs and standard operating procedures for the new system)
B. The computer system (how it fits into the overall workflow)
1. Terminal /keyboard familiarization
2. First-time end-users
a. Getting started
b. Lessons
C. Reference manuals (for non beginners)
III. Appendixes
A. Error messages.

Fig. 5: An Outline for a Training Manual *adapted from:* System Analysis and Design Methods, Whitten and Dittman (2001)

The Nolan concept was used to investigate and classify the Kingdom of Bahrain and in the MoH in particular to set the scene for application of the guidelines in the Ministry of Health. The MoH has significantly improved its Healthcare Information System situation in comparison with its previous situation when this study was first conducted. However certain drawbacks do exist in terms of management commitment, education and training. It is also suggested that the MoH carefully evaluate all the strengths, weaknesses, opportunities and threats associated with the implementation of the future application architecture of the HIS as completing aborting the use of an information system and switching over to a new information system is very costly and very time consuming in terms of implementation, training and education etc.

CONCLUSIONS

The purpose of this section is to draw conclusions from the discussion in the previous sections, to specify to what extent the study has contributed to HIS and to identify a potential direction for future work.

Review: This study was conducted in three phases: the first phase was concerned with analyzing the first study conducted by Al-Alawi (1991). In the second phase fieldwork was carried out, through the use of questionnaires and visits to government (Public) hospitals. Phase three was concerned with re-testing the guidelines used in developing successful Health Information Systems (HIS) for the public sector.

Furthermore, another concern was to carry out a comparison between the current level of HIS and its level after more than a decade.

Research Contributions: A major contribution of this study is the examination and analyses of the current situation of HIS in MoH after 12 years and gives a clear picture of the progress made. During the study critical weaknesses have been revealed, for example:

- Lack of management commitment;
- Lack of training facilities; and
- Lack of creativity or innovative abilities.

This study is one of the first studies conducted on HIS in Bahrain, therefore, a gateway is opened providing various opportunities for further research to be carried in many areas on HIS.

Recommendations for further work: Critical elements to a successful HIS include the commitment of managers towards the system, positive attitudes and involvement. From our study it can be derived that management commitment is a key success factor, which needs to be thoroughly examined. It is therefore recommended that a study be conducted on why lack of management commitment (among certain managers) exists.

Individuals specializing in technical areas of IT, should carry out an investigation to solve the mystery of migrating from the current application architecture to a new application architecture at such a critical stage of the HIS deployment. External information system auditors are recommended to audit the HIS implemented by the MoH in order to give a true and fair opinion which should be free from bias about the performance of the HIS.

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