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Discussing the Impact of Management Information System (MIS) on Improvement of Efficiency and Quality of Services of Hospitals

Case Study: Tehran's Madayen Hospital

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Abstract

In every industry, improvement of efficiency is one of the main priorities of managers. Increased efficiency has more importance in service based industries, because in these industries improvement of efficiency turns into a software category and in fact, in these industries increased assets can not necessarily lead to increased efficiency. In such conditions, the focus should be shifted towards software development. One of the most important service providing sections is the section of healthcare. Both at the macro level of nations, especially Iran and the micro levels including families, healthcare services are crucially important. This section is in contact with the vast majority of people and as a result it can affect the views and satisfaction of people and therefore, is highly emphasized. In spite of that, there is several information flows embedded in the section of healthcare and especially in hospitals. Hospitals include a large flow of information and management of this information requires advanced systems. Management information systems can be crucially useful in terms of management of this information. Every year, hospitals spend huge costs for implementation of management information systems. For organization managers it is important to know that to what extent these systems can impact the quality of services. In this research it has been tried to fulfill this question and for this purpose, the existing information in Madayen hospital is utilized. For the purpose of analysis of results, the approach of analysis of structural equations was applied through the LISREL and SPSS software. Results indicated that management information systems have impacts on financial dimensions, customer orientation, quality of services and quality of internal processes.

Keywords: management information systems, efficiency, quality, services

1. Introduction

Management Information System (MIS) is an integrated system consisted of users and machines for providing information for backing up operations, management and organizational decision making. This system benefits from computer based software and hardware, instructions, analysis, programming, controlling and decision making models as well as a database. MIS is a system which collects environmental data and registers the data related to organizational exchanges and operations. Afterwards, the data are filtered, organized and selected and next, the data are handed out to the manager as information. This information provides managers with instruments for generation of required information (Xue, 2012).

An organization's management information system is not separated from other systems. Rather it provides a framework based on which, other information systems are synchronized. During time, it was turned out that the concept of implementation of a completely integrated system is crucially difficult. The fact is that an integrated system does not necessarily address a uniform structure. Rather it implies that all the components of the system are based on a general schema or design. Currently MIS is considered as a federation of sub-systems which are designed and implemented in case of necessity. However, they are all based on general designs, standards and MIS procedures. On this basis, instead of a unitary information system, an organization can include several interrelated information systems which fulfill managerial requirements at different levels in different ways. Empirically, it is impossible to have a fully integrated system. There are several elements which should be

considered for in a simultaneous fashion and also maintenance of such a system is extremely difficult (Cooperman et al., 2013).

Nematollahi and Hatam (2012) performed a study and elaborated on designing a pattern for a sectorial information management system of optional counseling and testing for diagnosis of HIV infection in Iran. Following the analysis of current situations in Iran and detecting the lack of a complete system, the researchers introduced the pattern of sectorial information management system of VCT based on the study of WHO and by implementing the experiences of America, Australia and Britain according to needs of Iran in four main axis including collecting and reporting data, clarification of data, analysis of data and distribution of data. Akbari and Asemi (2012) carried out a research in which they elaborated on discussing the status of management information systems in central libraries of universities of Tehran from the view of managers. According to their findings, designing and completing a standard and desirable management information system according to the information requirements of library managers is suggested. Asadi et al. (2013) carried out a research in which they discussed the status of management information systems of outpatient care in hospitals of universities of medical sciences throughout the city of Tehran. Their results indicated that none of the information management systems of outpatient care had utilized a qualitative analysis for improving the quality of collected data. In addition, 62% of emergency centers and 78.6% of the studied clinics had not taken any steps for organization of data within files. Having a dynamic outpatient care information management system is crucial and necessary. Therefore, more attention should be paid to processes and regulations related to collection, storage, processing and distribution of information in information management systems of outpatient care.

Nowadays, in every organization, the issue of implementing information technology and management information systems is addressed and the usefulness and necessity of implementing such systems are discussed. As a result, in terms of spending and investing on implementation of information technology and MIS, managers are faced with this question: to what extent there should be investments on this technology? Technology gains importance as a more effective solution in contrast to traditional solutions. For this reason, managers should be aware that to what extend the implementation and application of information management systems could be useful and effective. In other words, management information systems affect indexes which are all considered as the primary terms and conditions for success of modern organizations. Determining the amount of this realization is one of the main challenges of organizational decision makers. The present study discusses the effects of implementing management information systems on effectiveness of the organization from the view of users of such systems. Among the dimensions of management information system, increased tasking speed, increased tasking precision, in-time information recovery, storage of increased amounts of information and increased information access speed are chosen. In terms of the aspects of research, the effects of these dimensions on the effectiveness of the organization is discussed which is to provide desirable services for customers.

As a result it can be stated that the main research question is: what are the effects of information management systems on efficiency and improvement of quality of services at hospitals?

2. Methods

In terms of purpose, the present study is considered as an applied research and in terms of data collection methods, it is considered as a descriptive research. Also in terms of description, it is an analytic research. The population of this research includes the experts of information management context and the patients of the Madayen hospital. In order to estimate the sample size, the Cochran's formula was applied and the obtained sample size was 73. The applied sampling method in this research is a simple random sampling method. In addition, the data collection instruments include questionnaires. In order to determine the validity, the questionnaires were handed out to a certain number of management scholars and professors. Upon receiving the feedbacks from the experts and scholars and making necessary eliminations and adjusting the questionnaire, the questionnaires were distributed among 30 individuals of the population in order to determine its reliability. After collecting the completed questionnaires back, the reliability of the aforementioned instrument was calculated through the Kronbach's alpha method and by the use of the SPSS software. The value of the calculated Alpha was 0.98. The implemented method for analysis of data in this research is making use of structural equations. Through this method we can test the acceptability of the theoretical models in certain populations through making use of correlation data. The same method is applied in this research for the purpose of analysis of data.

3. Results and Findings

This section is concerned with analysis of items:

As it was previously mentioned, for measurement of each hidden variable, the observable variables are used. For this purpose, questionnaires are implemented. The questionnaire which was utilized in this research includes the following questions and each question is related to measurement of one of the hidden variables.

While performing a factor analysis, first it should be made sure that the existing data are qualified to be used for analysis. In other words it should be asked if the number of data of interest is suitable for factor analysis or not? For this purpose, the KMO index and the Bartlett's test are implemented. The KMO index is an index of sampling qualification. This index has a 0-1 limit. If the value of the index is close to 1, then the data are suitable for factor analysis and otherwise (usually smaller than 0.5) the results of factor analysis will not be suitable for data. In addition, the Bartlett's test discusses the time of recognition of the correlation matrix. If the resultant significance of the Bartlett's test was smaller than 5%, then a factor analysis would be considered suitable for recognition of the structure because in this case, the hypothesis of correlation matrix being recognized is rejected. Upon confirming the suitability of the KMO index and significance of the Bartlett's test, for the purpose of discussing the validity of the structure it should be referred to load factors. There are different opinions regarding the basis of significance of these loads. However, according to an empirical regulation suggested by statisticians and researchers who have implemented factor analysis several times, load factors of larger than +-0.3 are considered significant. In addition, load factors of larger than +-.04 are highly significant and also load factors of lager than +-0.5 are considered as extremely significant (Kalantari, 2013). In order to assure the suitability of validity, items with load factors of smaller than +-0.3 are not included in analyses.

Table 1. Items status

Bartlett's test	KMO test	Factor coefficient	Item number	variable
0.000	0.947	1.98	Q1	MIS
		0.96	Q2	
		1.68	Q3	
		1.42	Q4	
		1.69	Q5	
		1.41	Q6	
		2.35	Q7	
		1.20	Q8	
0.000	0.743	2.43	Q9	financial
		1.61	Q10	
		1.21	Q11	
		1.34	Q12	
0.000	0.851	1.26	Q13	Customer orientation
		1.52	Q14	
		1.45	Q15	
		0.95	Q16	
0.000	0.852	1.09	Q17	Internal processes
		1.42	Q18	
		1.89	Q19	
		1.63	Q20	
0.000	0.879	0.89	Q21	Quality of services
		0.98	Q22	
		2.71	Q23	
		1.25	Q24	
		1.27	Q25	

Value of factors according to the output of LISREL software:

MIS factor:

Figure 1. Analysis of MIS factor

Financial indexes:

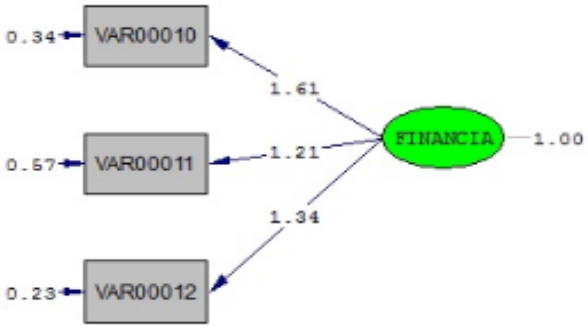

Figure 2. Analysis of financial indexes factor

Customer orientation index:

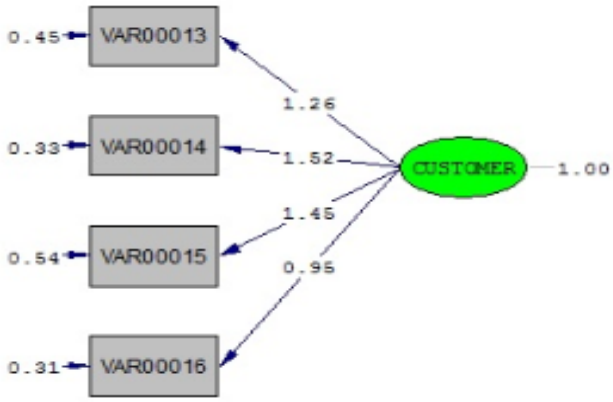

Figure 3. Factor analysis of customer orientation index

Internal processes:

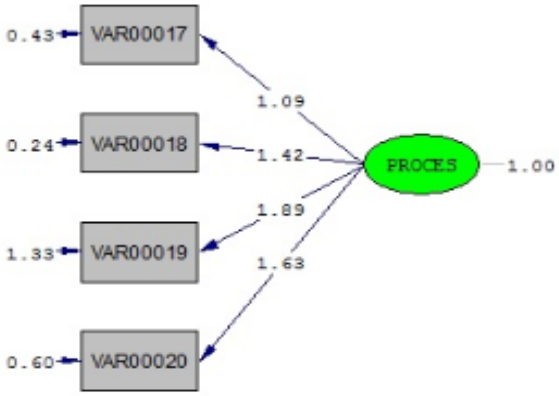

Figure 4. Factor analysis of internal processes

Quality of services:

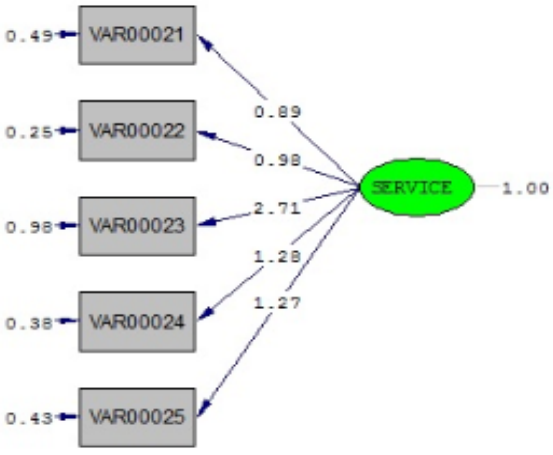

Figure 5. Factor analysis of quality of services

Results of the Bartlett's test and the KMO index as indexes of qualification of sampling revealed that the values of the both indexes are suitable and desirable. The value of KMO index was larger than 0.5 for all variables and the significance of the Bartlett's test was also less than 0.05 for all variables. After assuring the suitability of sample size, the load factor of each item was discussed. As it can be seen in the upper table, the load factor of all items is larger than 0.4 and therefore, none of the items were excluded from the analyses.

4. Results of Structural Equations

This section is concerned with analysis of results in terms of structural equations. This process helps us with making conclusions in terms of suggested hypotheses. For performance of calculations in this section, the software of LISREL was used and the results are reported according to the format of the software. In addition, calculations are performed according to co-variance matrix method.

In the following, a route analysis is suggested according to the conceptual model of the research.

The structure of the model which is designed according to the conceptual model is as follows. The following figure is the actual output of the LISREL software.

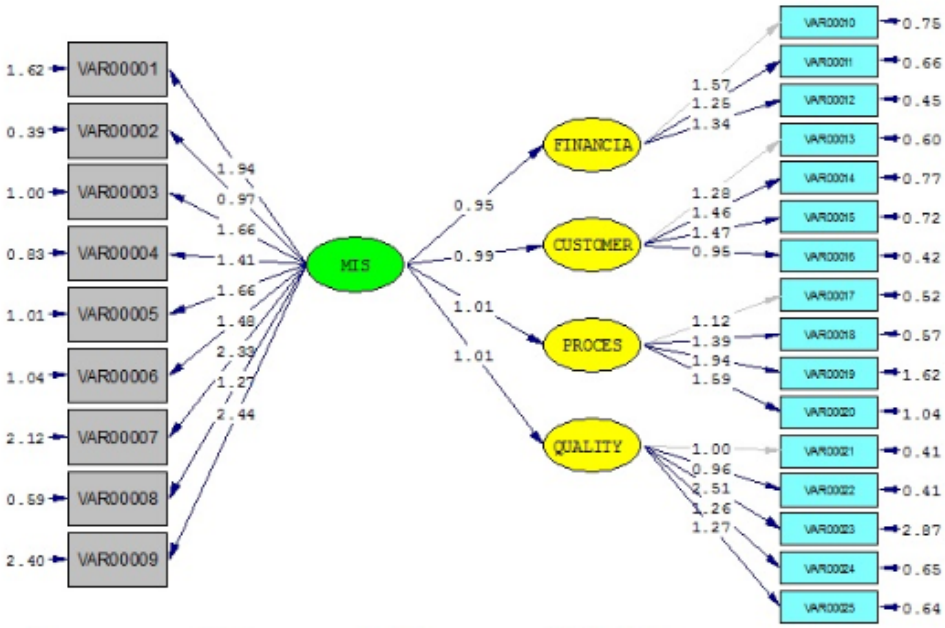

Figure 6. Research model route analysis graph

With respect to the criterion, in the upper model the ratio of Chi-do statistic to freedom degree (0.87) is suitably accorded and the results are sufficiently concrete.

Results of the upper analysis are based on Co-variance and variance matrix.

The variance covariance matrix which yielded from solvation of the model is as follows. Covariance is a criterion for changes of a variable with another variable. Covariance is similar to variance, however in covariance the standard deviation is simultaneously calculated for variables of X and Y through the following equation.

Considering the covariance formula, it can be stated that the value of covariance is affected by the dispersion of data of each variable from the mean. If two random variables are independent, then their covariance is equal to zero. And also if the highest score of a variable is accompanied by the highest score of another variable and also the lowest score of a variable is accompanied by the lowest score of another, then the value of covariance will be positive. On the other hand, if the highest score of a variable is accompanied by the lowest score of another variable, then the value of covariance will be negative (lack of consistency of changes of two variables).

Beforehand to discussing the results of t-test, the indices of the model fitness are discussed.

5. Model Fitness Indices

During the past decade different fitness indices have been proposed for models of structural equations. Although that, different types of these indices are continuously evolving and changing, no majorly accepted optimized index exists. These indices are categorized in different manners. One of the most accepted such categorizations belong to Marsh et al. (1967). They have divided the indices of model fitness into three classes of absolute, relative and modified.

6. Root Mean Square Residual Index

The index of root mean square residual (RMR) in fact shows the difference between the observed elements of the matrix among the sample and the elements of the estimation matrixes considering the validity of the model. The fitted residuals are yielded from difference between the sample covariance matrix and the fitted covariance matrix. As the value of this index closes to zero, the model will have a better fitness.

The RMR value of the model of this research is as follows:

RMR = 0.13

7. GFI and AGFI Indexes

The fitness indices of GFI and AGFI proposed by Charscock and Sorboum (1989) are independent of the sample size and they indicate that to what extent the model will have a better fitness in terms of its absence. The GFI is calculated through the following formula according to the fitness function of F:

$$GFI = 1 - \frac{F(S,\Sigma(\hat{\theta}))}{F(S,\Sigma(\cdot))} \quad (1)$$

In this relation, $\Sigma(\theta)$ stands for the structure of covariance for random observed variables, S stands for the covariance matrix of the sample group, $\hat{\theta}$ is a value of θ which minimizes $F(S,\Sigma(\theta))$ and also $F(S,\Sigma(\cdot))$ is the function of fitness in situations in which all model parameters are equal to zero. In fact, this notion mutually evaluates the relative values of variances and covariance through the model and its range is between zero and one. In spite that the index of GFI is similar to R^2, it still can't be interpreted by the model as the percentage of the explained error percentage. Since GFI is usually larger than other indexes of fitness, some researchers have considered its cutting point as 0.95. According to contracts, the value of GFI should be larger than 0.9 in order to accept the model.

The modified value of fitness index for freedom degree is calculated through the following formula:

$$AGFI = 1 - \frac{K(K+1)}{2d}(1 - GFI) \quad (2)$$

In this formula, K stands for number of values in model and d stands for model's freedom degree. The least values of GFI and AGFI should be zero. However, in theory its value may yield as a negative number which has no significance. On the other hand, obtaining negative values shows the extreme weakness of the model. The AGFI values of larger than one are accompanied by crucially similar models and also AGFI values of larger than zero are related to models with extremely low fitted models or models based on small sample sizes. In addition, a desirable AGFI value is close to one.

For the fitted model, the aforementioned values are calculated as follows:

Goodness of Fit Index (GFI) = 0.86

Adjusted Goodness of Fit Index (AGFI) = 0.82

8. Root Mean Square Error of Approximation Index

This index is related to the root mean square of approximations. This criterion is defined as a difference value for every freedom degree. The value of this index which in fact is the deviation of freedom degree is less than 0.05 for models with a good fitness and values larger than 0.08 indicate feasible approximation error; models with values of larger than 0.1 have weak fitness. The value of this index in our fitted model is as follows:

Root Mean Square Error of Approximation (RMSEA) = 0.088

9. NFI and NNFI Indexes

Relative indexes try to answer the question that to what extend a model can have a good performance in terms of explanation of a series of observed data compared to other models. The most frequent relative models are known as zero models, since in variance-covariance matrixes they only fit the variances and consider every covariance equal to zero.

Some of the relative indexes which Marsh et al. (1988) call them type 1, compare the fitness of two different models. One of the type 1 relative indexes which were previously of much implementation was the NFI or delta1 index which does not require the presumptions of Chi-square. Since this index is influenced by the sample size, it is not recommended currently (Hue & Bentler, 1995). The other indexes which are called the type 2, not only compare models, but also provide the users with information regarding the expected values of models under a central distribution of Chi-do square. There are several different type 2 indexes which are commonly used and have more coordination with the sample size compared to type 1 indexes. One of these indexes which are highly important is the classical formula of Talker-Louise (1973) which was developed further by Bentler and Bount (1980). Not only that these models have applications for comparing a model with zero models, but also it has numerous applications in terms of making comparisons between different models. This index is also known as the NNFI.

For our fitted model, these values are as follows:

Normed Fit Index (NFI) = 0.96

Non-Normed Fit Index (NNFI) = 0.98

The upper indexes indicate the goodness and appropriateness of the fitness of the model. As a result it can be claimed that the proposed model is well capable of defining the relations between variables. On this basis, the results of the t-test could be considered reliable for discussing the research hypotheses.

10. Hypotheses' Test Results

Results of hypotheses testing by the LISREL software are as follows:

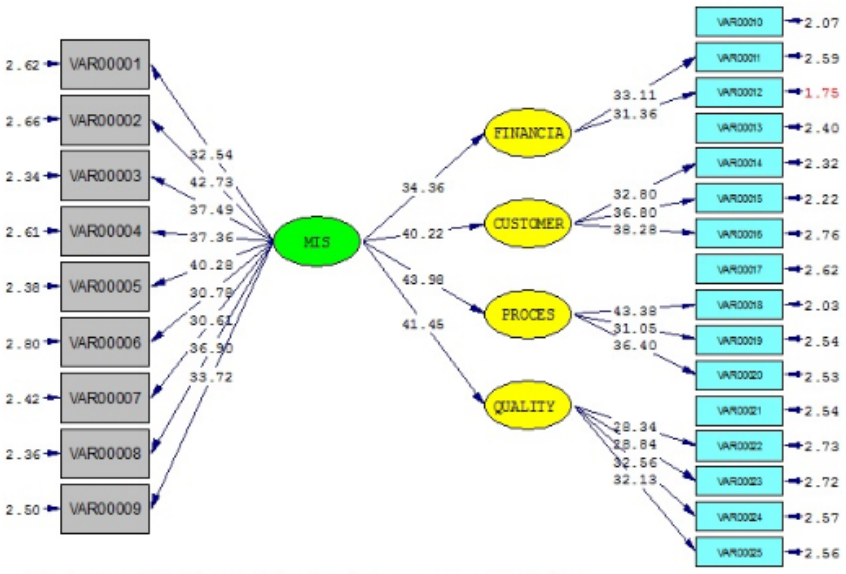

Figure 7. Graph of analysis of structural equations according to t-test

Sections with black color indicate confirmed hypothesis tests:

The following table indicates the results of the upper model:

Table 2. Hypotheses testing

Test result	T statistic	Route coefficient	Hypothesis	Number
confirmed	34.36	0.95	MIS has a positive and direct effect on performance of financial indexes	1
confirmed	40.22	0.99	MIS has a positive and direct effect on performance of customer orientation indexes.	2
confirmed	43.98	1.01	MIS has a positive and direct effect on performance of internal processes indexes.	3
confirmed	41.45	1.01	MIS has direct and positive effects on increased customer servicing speed and reduced waiting times.	4

11. Discussion and Conclusions

Results of this research have shown that management information systems are effective on financial performance of an organization. This affecting is foreseeable and is considered as one of the most important aspects of MIS in terms of making financial and budgeting reports. Such reporting can effectively increase the efficiency of an organization's financial performance and in fact, such financial reporting style can clearly manifest an organizations weaknesses and advantages. In addition, through a suitable and appropriate decision making, such weaknesses could be well eliminated. The MIS plays exactly the same role in the organization. The system ensures that an appropriate data is collected from the various sources, processed and send further to all the needy destinations. The system is expected to fulfill the information needs of an individual, a group of individuals, the management functionaries: the managers and top management. Nematollahi and Hatam (2012) performed a study and elaborated on designing a pattern for a sectorial information management system of optional counseling and testing for diagnosis of HIV infection in Iran. Following the analysis of current situations in Iran and detecting the lack of a complete system, the researchers introduced the pattern of sectorial information management system of VCT based on the study of WHO and by implementing the experiences of America, Australia and Britain according to needs of Iran in four main axis including collecting and reporting data, clarification of data, analysis of data and distribution of data. Akbari and Asemi (2012) carried out a research in which they elaborated on discussing the status of management information systems in central libraries of universities of Tehran from the view of managers. According to their findings, designing and completing a standard and desirable management information system according to the information requirements of library managers is suggested. Asadi et al. (2013) carried out a research in which they discussed the status of management information systems of outpatient care in hospitals of universities of medical sciences throughout the city of Tehran. Their results indicated that none of the information management systems of outpatient care had utilized a qualitative analysis for improving the quality of collected data. In addition, 62% of emergency centers and 78.6% of the studied clinics had not taken any steps for organization of data within files. Having a dynamic outpatient care information management system is crucial and necessary. Therefore, more attention should be paid to processes and regulations related to collection, storage, processing and distribution of information in information management systems of outpatient care.

Another hypothesis which was confirmed in this research implies that MIS is effective on performance of customer orientation in Madayen hospital. MIS can elaborate on reporting the main indexes of health and the main indexes of customer orientation in an organization. On this basis, the aspects of an organization's performance are properly made clear and also by making macro-level decisions, the customer orientation in Madayen hospital could be optimized.

The next hypothesis is related to effectiveness of MIS on performance of internal processes in an organization. MIS can significantly improve the efficiency of internal processes. In fact these systems reduce bureaucracy and increase the speed in hospitals. As a result it can be clearly concluded that MIS is effective on performance of internal processes in hospitals.

The last hypothesis of this research is related to the effectiveness of MIS on quality and speed of providing services. This hypothesis is also confirmed and with respect to the fact that MIS leads to increased working speed and reduced time waste in terms of internal processes of hospitals, it can boost the speed of providing services as well as increasing their quality.

MIS plays a very important role in the organization; it creates an impact on the organization's functions, performance and productivity. The impact of MIS on the functions is in its management with a good MIS supports the management of efficiency, finance, production and personnel becomes more efficient. The tracking and monitoring of the functional targets becomes easy. The functional managers are informed about the progress, achievements and shortfalls in the activity and the targets. The manager is kept alert by providing certain information indicating and probable trends in the various aspects of business. This helps in forecasting and long-term perspective planning. The manager's attention is bought to a situation which is expected in nature, inducing him to take an action or a decision in the matter. Disciplined information reporting system creates structure database and a knowledge base for all the people in the organization. The information is available in such a form that it can be used straight away by blending and analysis, saving the manager's valuable time.

The MIS creates another impact in the organization which relates to the understanding of the business itself. The MIS begins with the definition of data, entity and its attributes. It uses a dictionary of data, entity and attributes, respectively, designed for information generation in the organization. Since all the information systems use the dictionary, there is common understanding of terms and terminology in the organization bringing clarity in the communication and a similar understanding of an event in the organization.

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