

Measuring the effectiveness of human resource information systems in national iranian oil company an empirical assessment

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Abstract:

While the growth of MIS investment and its influence is making MIS evaluation ever more indispensable, little attention has been paid to assessing and communicating system effectiveness. This paper attempts to empirically assess the effectiveness of integrated human resource information system in Iranian oil industry.

As suggested by recent research, the widely accepted IS success model is based on end user satisfaction. Therefore, we have examined IS effectiveness through assessing user satisfaction about system quality and information quality of system as well actual System use by DeLone and McLean model. Data from four surveys in four different organizations in Iranian Oil Industry are pooled to explore the end user satisfaction and the degree of using system by these users.

The results of surveys show that user satisfaction from information quality, system quality and system use is respectively 0.92, 0.82 and 0.91. Therefore, the integrated human resource system has high effectiveness. Implications of these findings are discussed along with some directions for future research.

Key words:

Human resource information systems, Effectiveness, TAM, Measuring instruments.

Paper type: Research paper

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Introduction

There is ever increasing pressure on IS units to provide supplementary services to end-users. These changes are being brought about by the diffusion of client-server architectures, the growth in intranet and Internet usage, continuously evolving IT product line, growth in end-user literacy levels and needs, and emergence of alternative channels for distribution of IT products and services (Applegate, McFarlan and McKenney, 1999).

The notion of delivering high quality IS services and the costs associated with delivering such services are debatable. However it can be logically argued that the quality of IS service may actually reduce costs associated with inferior software selection, poorly aimed end-user developed applications, increased maintenance of applications, lack of training for end-user computing, lack of education to enhance computer literacy skills, and poor selection of hardware. IS effectiveness can be measured from different perspectives. As a result, several IS success measures have been adopted by researchers. Providing a comprehensive review of the past literature, DeLone and McLean (DeLone and McLean, 2003, pp. 10-25) propose an IS success model to guide research. Key IS effectiveness variables in their model included: system quality, information quality, system use, user satisfaction, individual impact of IS, and organizational impact of IS.

Sustaining service levels is a formidable task (Watson and Kavan, 1998, pp. 61-79). Nevertheless, providing quality IS service is critical from effectiveness standpoint. Summarizing their arguments for the need to focus on IS service quality, Pitt et al. suggest that: "multiple instruments are required to assess IS effectiveness (Pitt and Kavan, 1995, 19(2), pp. 173-186). Recent evidence supports the notion that IS service quality does influence user satisfaction, a commonly used assessment of IS effectiveness (Jiang and Klein, 2000, pp 725-744). Given the importance of including service quality as an appropriate surrogate for IS effectiveness, a partial model of the one proposed by Pitt et al. is present below in Figure 1.

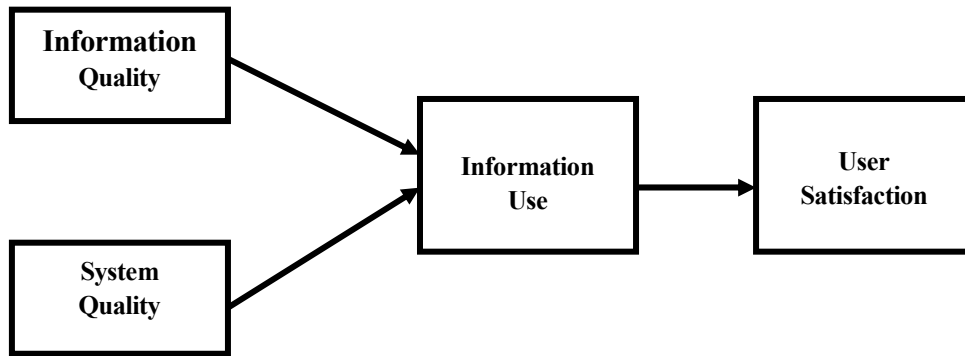


Figure 1. Research Model

In order to examine the degree of Information use, we have used Technology Acceptance Model (TAM). This model was presented by Davis in 1989 and is present below in Figure 2. TAM was rooted in the theory of reasoned action, a model concerned with determinants of consciously intended behaviors. Theory of reasoned action proposes that beliefs influence attitudes, which in turn lead to intentions, and then generate behaviors. TAM assumes that beliefs about usefulness and ease of use are always the primary determinants of IT/IS adoption in organizations. According to TAM, these two determinants serve as the basis for attitudes toward using a particular system, which in turn determines the intention to use, and then generate the actual usage behavior. Perceived usefulness is defined as the extent to which a person believes that using a system would enhance his or her job performance. Perceived ease of use refers to the extent to which a person believes that using a system would be free of mental effort (Liu, Yao, Lu, Yu 2003, p 207).

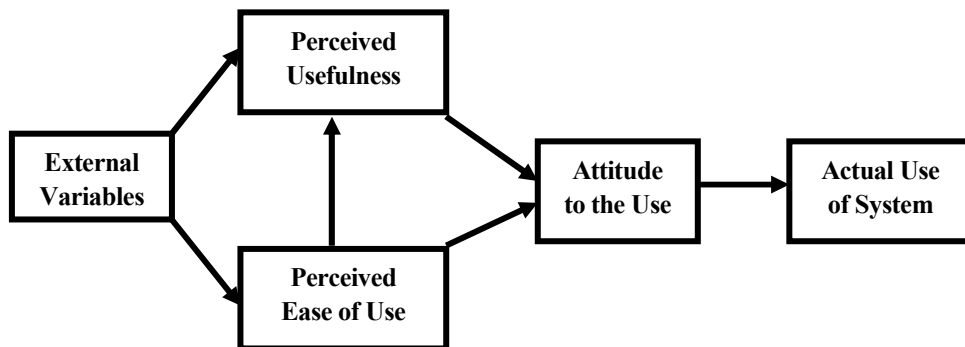


Figure 2. Technology Acceptance Model (TAM)

Literature review

Although the effectiveness of information systems in general is one of the most extensively researched issues in the literature, scholars have not yet arrived at an agreement on a definition of “effectiveness” and its operationalization (Wierenga et al., 1999). Epistemologically, according to the *Oxford English Dictionary*, it is “the power or capacity to produce a desired result”. This makes it clear that effectiveness is about outcomes, consequences and results, and represents a synonym for success, since being effective means achieving the outcomes and results initially planned for. Grover et al. (1996) suggest that the notion of information system effectiveness is a construct comprising such facets as, among many others, efficiency, productivity, internal communication, flexibility, control and information management.

However, this apparently straightforward construct is in fact fairly complex, because it is difficult to systematize the effect of the systems on the entity of the organization and its operations (DeLone and McLean, 2003, pp. 10-25). This is the probable explanation for the fact that an empirically validated instrument to assess the effectiveness of information systems has yet to be derived (Panigyrakis and Chatzipanagiotou, 2006, pp. 91-100).

However, the importance of system quality, information quality and systems success has been recognized by many researchers as key ingredients in developing a competitive advantage. New scales and measures, along with continued research into organizational effectiveness and user satisfaction are needed. Accordingly, documents found here have been sorted using a model of IS Success developed by William H. DeLone and Ephraim R. McLean (DeLone and McLean, 2003, pp. 10-25).

A great number of studies have attempted to assess the effectiveness of IS, especially in the general IS field. The majority of the research on the IS effectiveness is limited to the financial indices measurement, such as ROI, ROA, etc (Qing and Plant, 2001, Krishnan and Sriram, 2000, Ryan and Harrison, 2000, Thatcher and Oliver 2001), the market share and the cost study (Gurbaxani and Mendelson, 1990, Railing and Housel, 1990), the productivity analysis (Qing and Plant, 2001, Hitt et al., 2002, Grover et al., 1998), the profitability (King 1998, Hitt and Brynjolfsson, 1996).

In an empirical investigation, the Impact of Design Characteristics and

Support Services on the Effectiveness of Marketing Information Systems was examined. In this research, the impact of five specific variables, namely: a) system quality, b) information quality, c) quality of the Marketing information system (MrkIS) technical support, d) the MrkIs compatibility, and lastly e) the MrkIs flexibility, on the effectiveness of MrkIS were investigated. The effectiveness measurement is based on the Competing value model which allows the definition of effectiveness on four basic dimensions. The results define the positive impact of these factors on the several dimensions of the effectiveness (Panigyrakis and Chatzipanagiotou, 2006, pp. 91-100).

Information quality

Organizations today have access to vast stores of data that come in a wide variety of forms and may be stored in places ranging from file cabinets to databases, and from library shelves to the Internet. The enormous growth in the quantity of data, however, has brought with it growing problems with the quality of information, further complicated by the struggles many organizations are experiencing as they try to improve their systems for knowledge management and organizational memory. Failure to manage information properly, or inaccurate data, costs businesses billions of dollars each year (Wang, 2005, p12). Measures of information quality focus on the output produced by a system and the value, usefulness or relative importance attributed to it by the user. Most of the measures, therefore, are perceptual in nature. Bailey and Pearson identified nine characteristics of information quality including: accuracy, precision, currency, output timeliness, reliability, completeness, conciseness, format and relevance and this began a stream of research in user satisfaction (Bailey and Pearson, 1985, pp 530-545) Other researchers have added criteria such as understandability (Srinivasan, 1985, pp. 243-253), report usefulness (Mahmood and Jeanette, 1985, pp 137-151), sufficiency, freedom from bias, comparability and quantitiveness (King and Barry, 1983, pp. 34-45).

During research on executive information systems, Rainer and Watson defined five characteristics of information quality: accuracy, timeliness, conciseness, convenience, relevance (Rainer and Watson, 1995, pp. 83-98). Seddon⁶ also included accuracy, timeliness, and relevance in his definition of information quality (Seddon, 1997, pp 240-253).

System quality

Measures of system quality typically focus on performance characteristics of the system under study. Some research has looked at resource utilization and investment utilization (Kriebel and Raviv, 1980, pp 297-311), accuracy, processing speed, time of response, easy access, easy use, friendly working environment and latest technology in the hardware and software of system (Panigyrakis and Chatzipanagiotou, 2006, pp. 91-100).

Hamilton and Chervany's list of system quality measures is probably the most well known: data currency, response time, turnaround time, data accuracy, reliability, completeness, system flexibility and ease of use (Hamilton and Chervany, 1981, pp 55-69). More recently, Seddon considers system quality to be concerned with "bugs" in the system (system reliability), user interface consistency, ease of use, documentation quality, and quality and maintainability of the program code (Seddon, 1997, pp. 240-253).

User satisfaction

The reliance on user satisfaction in measuring information system success is common among MIS researchers and practitioners (Ives and Olson, 1984, pp. 586-603) and several standardized instruments have been developed and tested (Doll and Torkzadeh, 1988, pp. 259-274). The User Information Satisfaction (UIS) instrument is grounded in research performed during the 1980s by Bailey and Pearson that introduced a list of 39 factors affecting computer user satisfaction (Bailey and Pearson, 1983, pp. 530-545).

In follow-up research, Ives, Olson, and Baroudi, in an effort to improve internal consistency and reliability, produced an abbreviated survey instrument by eliminating factors with the lower correlations (Ives, Olson and Baroudi, 1983, pp. 785-793). Baroudi and Orlikowski later reaffirms the reliability and validity of the Ives, Olson, and Baroudi short-form measure as an effective tool for evaluating user satisfaction (Baroudi and Orlikowski, 1988, pp. 44-59). Most of these instruments, however, are geared towards the evaluation of a specific application rather than end-user computing in general. Doll and Torkzadeh introduced another measure of user satisfaction in the late 1980s, called the End-User Computing Satisfaction measure.

Though Ives, Olson, and Baroudi's user information satisfaction (UIS) measure and Doll and Torkzadeh's end-user computing satisfaction measure continue to be popular, certain cautions must be known. Melone introduces the notion that, though previously introduced instruments produce valid evaluations of system effectiveness, there is no clear relationship established between system effectiveness and user satisfaction (Melone, 1990, pp. 76-91). More recently, Seddon defines user satisfaction as a subjective evaluation of the various individual, organizational, and societal consequences of IS use. He asserts that the user satisfaction measure is, definitionally, a measure of the net benefits perceived by the information system's stakeholders (individuals, groups of individuals, management of organizations, and society).

Seddon maintains that previously introduced user satisfaction measures (eg. Ives, Olson, and Baroudi) do not adequately measure this idealized construct (Seddon, 1997, pp. 240-253).

System use

The actual use of a computer system can be affected by the degree to which systems characteristics match user task needs (Goodhue and Thompson, 1995, pp 213-236). Researchers must consider the nature, extent, quality, and appropriateness of the system use. The nature of system use could be addressed by determining whether the full functionality of a system is being used for the intended purposes. With regard to the extent of use, various states of systems utilization can be identified based on the use or nonuse of basic and advanced system capabilities. Simply measuring the amount of time a system is used does not properly capture the relationship between usage and the realization of expected results. On the other hand, it can be argued that *declining* usage may be an important indication that the anticipated benefits are not being realized.

The rejection of system use as an effectiveness variable when system usage is mandatory is also flawed. Even when use is required, variability in the quality and intensity of this use is likely to have a significant impact on the realization of the system benefits (DeLone and McLean, 2003, pp. 10-25).

Goodhue explored Task-Technology Fit (TTF) which suggests that better outcomes (i.e. performance) will result when there is a match between the task and the technology used. Task technology fit measures would include items to assess the quality, currency, relevance and identifiability of

data (ease of determining what data is available and where), ease of use of the system, response time and presentation (Goodhue and Thompson, 1995, pp. 213-236).

IS in oil industry

The boundary of IT services in oil industry is presented below in figure 3. As shown in this figure, all IT services is provided for National Iranian Oil Company but some of these services are provided for ministry of petroleum. Integrated human resource system services are offered to whole petroleum ministry including NIOC.

This system has been provided and implemented by the latest technology of information storing and recycling (using data bank). This system has over 4000 computer plan, its information volume is 22 GB and has over 180 millions information records with over 3000 users in the oil industry. This system is completely decentralized and online. High security, integrity and relations with other systems are some of characteristics of integrated human resource system.

Methodology

Research objectives

Four research propositions can be derived from the foregoing review of the literature. The studies reviewed in the MIS effectiveness dimensions make it clear that user satisfaction has the potential to influence effectiveness of IT/IS. On these grounds, the following research hypothesis is advanced for investigation:

“The integrated human resource system is an effective system”.

We have examined this main hypothesis by 3 other hypotheses:

1. Users are satisfied by the system quality.
2. Users are satisfied by information quality of system.
3. Users are satisfied by using system.

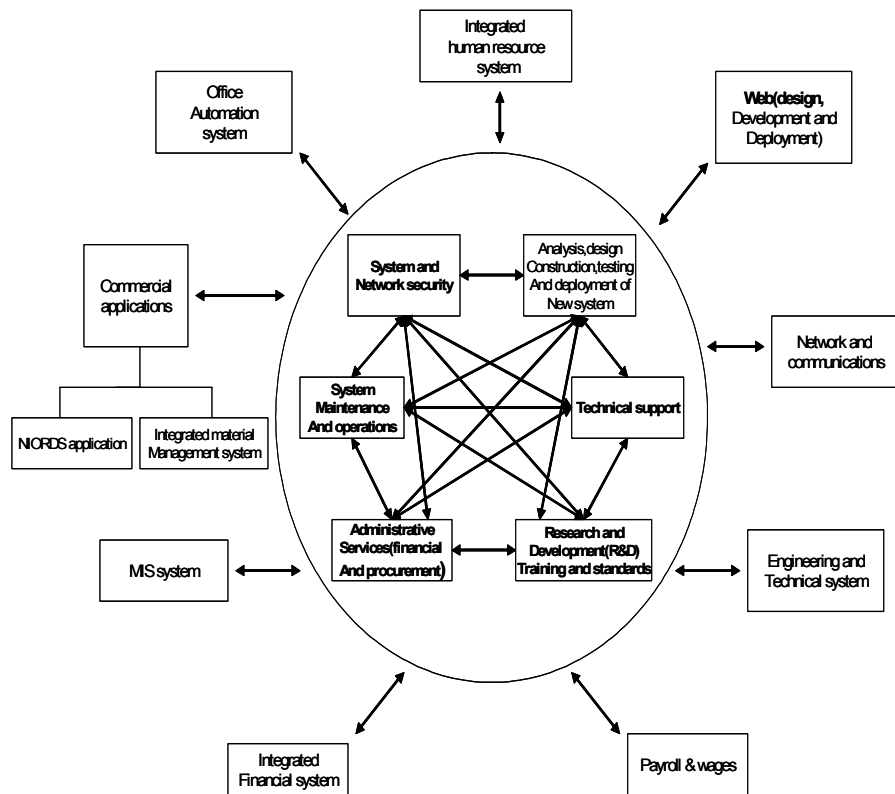


Figure 3. Boundary of IT services in oil industry

Note: Inside the circle means all IT services to National Iranian Oil Company and outside the circle means services to Ministry of Petroleum including National Iranian Oil Company.

IS effectiveness questionnaire

A pilot questionnaire was distributed to the users of system and then some reforms were made. The final questionnaire contained 28 statements, to which respondents indicated their agreement on a five-point Likert scale (from strongly disagree to strongly agree). Four main companies of ministry of petroleum were included in the present research (total of 180 questionnaires). Owing to their knowledge about the integrated human resource system and their ability to give valid answers, only users of this

system were asked to answer the questionnaires. The summary of the questionnaire has shown in the table 1.

Reliability and validity

Reliability is a mechanism employed to check the internal consistency of test items (questions) against every other test item when completed by different participants. In order to estimate reliability, we sent questionnaire to 35 users of system. Overall Cronbach's alpha for the sample was 0.92 which indicate an excellent level of statistical internal consistency of responses to questionnaire items across individuals.

In order to increase the content validity of the research instrument, the questionnaire was "pilot-examined". For this purpose, 20 personal interviews were conducted with managers and experts who agreed not only to fill in the questionnaire, but also to comment on the scales employed. Then, their suggestions were collected and some reformations were made to improve validity of questionnaire.

Concept	Dimensions	Measures
IS Effectiveness	Information Quality	Information Accuracy Information Preciseness Information Completeness Information Timeliness Information Compatibility Information Understandability Information Volume Appropriateness
	System Quality	Limitation of Unauthorized Access Ease of system use Presenting Integrated Reports Time of Response Changeability in the System Conditions Prevention from programs Interruption
	System Use	Job Performance Improvement Goal Achievement Flexible Interaction with System Ease of Doing Tasks with Using System Clear and Understandable Interaction with System Productivity Improvement with Using System Ease of Requesting from System

Table 1. Dimensions and Measures of IS Effectiveness

Data collection

The data presented and analyzed here form part of a broader study of four main companies in Ministry of petroleum in Iran, which use IT/IS services. The sampling frame thus includes these four companies as well the staff of ministry of petroleum. The users of these companies are in the administrative units. To collect the required data, a detailed questionnaire was developed. For the purposes of this paper, three independent variables are of relevance: Information quality, system quality and Information use.

Our research society is the users who are using system in Tehran city. According to the statistical methods, the volume of sample was estimated around 180 users that were selected randomly from four main companies. The method of sampling was appropriate allocation which randomly allocate sample to each company, regarding to overall company weigh. The distribution table of users is present below in table 2¹.

Name of company	Number of users	Company weigh	Allocated sample
NIOC& MOP staff	556	0.5	90
NIORDC	239	0.22	39
NIGC	243	0.22	39
NPC	72	0.06	12
Total	1110	1.00	180

Table 2. Allocated sample to per company

Data analysis

In order to confirm or reject the hypotheses of research, we used Binomial test which is a nonparametric test. Results of hypotheses tests have shown in table 3.

According to the results of data analysis (Table 3), all hypotheses are confirmed. The statistical significance was established at 0.05. Therefore, the

1. Note: NIOC: National Iranian Oil Company, NPC: National Petrochemical Company,

NIORDC: National Iranian Oil Refinery and Distribution Company, MOP: Ministry of Petroleum.

integrated human resource system in oil industry is an effective information system.

Category	N	Observed Prop	Test Prop
Information Quality Group1 <= 3	13	q = 0.08	
Group2 > 3	150	p = 0.92	0.5
Total	163	1.00	
System Quality Group1 <= 3	29	q = 0.18	
Group2 > 3	134	p = 0.82	0.5
Total	163	1.00	
System Use Group1 <= 3	15	q = 0.09	
Group2 > 3	148	p = 0.91	0.5
Total	163	1.00	

Table 3. Results of testing hypotheses

Conclusion

The main goal of this research is assessing information system effectiveness. Since the quality or effectiveness of information systems is so hard to measure directly, many researchers have turned to indirect measures such as user information satisfaction (UIS). Therefore, this paper has presented a scheme for evaluating MIS effectiveness by means of measuring user satisfaction about information quality, system quality and system use. The results of statistical analysis show that users are satisfied with these three dimensions of information system effectiveness. So, with effective training about using system, ease of accessibility to system and relevance of information to the personnel's job, the IT sector managers in oil industry can plan to remove paper from daily working and therefore, employees can do their tasks with high accuracy, precision and speed. We draw the following conclusions:

1-For each research endeavor, the selection of IS effectiveness dimensions and measures should be contingent on the objectives and context of the empirical investigation, but, where possible, tested and proven measures should be used.

2- With the growth of management support systems and the advent and development of e-commerce systems, voluntary systems use is more common today than it was a decade ago. We, therefore continue to advocate the inclusion of “system use” as a critical dimension of IS effectiveness measurement. Actual use measures should be preferred to self-reported use measures. Also, usage measures should capture the richness of use as a system phenomenon including the nature, level, and appropriateness of use, and should not simply measure the frequency of use.

Finally, more field-study research should investigate and incorporate “Net Benefits” measures. Examining satisfaction and usage measures are not an acceptable alternative to measuring performance [i.e., Net Benefits] directly. Although the three variables are correlated, the relationships between them are not sufficiently strong to warrant their use as substitutes for one another.

Managerial implications

The findings of our study have important implications for human resource and IT managers who implement IT-based systems, and for those who design and supply them. They can help users to approach the specification and effectiveness of their human resource system in a more specific and more holistic manner. Our findings show that managers contemplating changes, upgrades or new systems need to take into account how those will fit with the present system, so that the overall effectiveness of the system is at least sustained if not improved.

A second important implication for users of IT-based MIS is the strategic importance of such systems. Since, they can potentially have a significant impact on various aspects of overall effectiveness; decisions pertaining to the information infrastructure should be holistic. This means that both users and other functional managers, as appropriate, should be involved in the decision-making process.

Management needs to consider how a decision to invest in a certain technology might influence the operations and the priorities of different departments, including those that will not directly use the specific information technology. There are parallel implications for companies offering IT solutions and services.

Comprehension of the strategic impact that IT-based MIS can have on their customers' operations will allow them to increase the value of their products and services, and their ability to differentiate their offering from the

competition. The imperative is to develop an integrated value proposition, and to be able to explain how it can contribute to the overall competitiveness of a potential customer. For instance, added-value services such as system maintenance or upgrades not only provide technical assistance to the client but also, equally important, affects its ability to act positively, promptly, and in a customer-focused method.

Limitations of the study and future research directions

Clearly, this study has not been free of limitations. We do not consider that they diminish its contribution significantly, however, because future research can easily tackle them.

Specifically, two issues are a concern. The first is the focus of the study on the oil industry. While the decision to do so reflects the widespread adoption and application of IT at the top end of this sector, it does limit the generalization of our findings to other sectors. Hence, a first direction for further research is to examine the structure and psychometric properties of the proposed measuring instrument in other sectors. Also, the Iranian context of the study may constrain the generalizability of our findings.

Finally, this study has adopted a subjective assessment of MIS effectiveness. While there is general evidence for a good correlation between subjective and objective assessment of effectiveness, it would be advisable to replicate the study in other national contexts and different industry sectors, for a clear picture, particularly with respect to the structure of the measuring instrument that we have proposed for the assessment of MIS effectiveness.

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