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Effectiveness of information technology in reducing corruption in China
A validation of the DeLone and McLean information systems success model

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Abstract

Purpose – The purpose of this paper is to examine the effectiveness of information technology in reducing corruption in China. Meanwhile this paper explores whether electronic monitoring systems (EMS) can be evaluated in terms of the DeLone and McLean information systems (IS) success model.

Design/methodology/approach – The status of the EMS in five cities is first proposed, and then a model of e-government system success is designed to evaluate the EMS. Data are obtained from 387 civil servants in the supervision agencies. Then the effectiveness of EMS in reducing corruption is deeply assessed, and the DeLone and McLean IS success model is validated.

Findings – The findings show that the application of EMS has a positive effect on reducing corruption. IT thus has the potential to reduce corruption, but the institution and the people are more important.

Originality/value – Although many theories about reducing corruption have been proposed, the EMS application in reducing corruption has seldom been addressed. This study is the first, to the author's knowledge, to examine EMS and corruption reduction from the point of view of the IS success model.

Keywords China, Information technology, Corruption, Electronic monitoring systems, Information systems success model

Paper type Research paper

1. Introduction

With the development of IT, technologies play an important role in reducing corruption. IT provides new approaches for enhancing transparency and reducing corruption. Can the use of IT achieve the goal of reducing corruption? How do we use IT to reduce corruption better? This paper assesses the electronic monitoring systems (EMS) used in five cities in China based on the information systems (IS) success model. Concerning how to use IT to reduce corruption, scholars mainly discuss the following aspects.

First, corruption can be reduced by using IT to enhance transparency. Many corruption cases have shown that lack of information greatly increases the costs of corruption (Bussell, 2010; Bhatnagar, 2003). Timely disclosure of true, accurate and complete information can enhance transparency, and the public can access more government information. All of this is an important prerequisite for reducing corruption (Mulgan, 2007; Jaeger and Bertot, 2010). Kim and Lee analyzed the implementation effect of South Korea's Online Procedures ENhancement for Civil Applications (OPEN) and demonstrated that the development of OPEN could reduce the incidence of corruption by enhancing transparency (Kim *et al.*, 2009). Shim and Eom stated that IT can promote

government transparency and accountability, and has great potential to reduce corruption. It can effectively reduce and quickly control internal corruption (Shim and Eom, 2008).

Second, IT can help the public monitor corruption and effectively reduce corruption through information publicity and information sharing. Information technologies can help the public to track government activities by supervising and controlling the government's actions, which achieves the goal of reducing corruption (Shim and Eom, 2009). Anderson estimated the impact of e-government on the control of corruption in 149 countries during the period from 1996 to 2006, and found that the application of e-government can effectively control the tendency of government corruption. The control of corruption intentions can further improve the adoption of e-government innovations (Anderson, 2009).

Third, IT effectively reduces the likelihood of corruption by reducing human operations. Anderson found that it can reduce contacts between the public and tax officials through restructuring the whole tax system and the tax departments, thereby reducing the opportunities for bribery in Pakistan (Anderson, 2009). Studies suggest that the application of the OPEN system in South Korea, a best practice in information technology application, can improve administrative transparency, and public supervision mechanisms reduce the opportunities for illegal connections between government officials and citizens and effectively prevent corruption (Kim and Cho, 2005; Shim and Eom, 2008; Kim *et al.*, 2009). In a word, scholars mainly examine the relationship between IT and corruption reduction by case studies and statistical analysis methods, and they have found that enhancing transparency, strengthening public supervision and reducing corruption opportunities can effectively reduce corruption.

The measurement of IS success has been widely investigated. DeLone and McLean (1992) reviewed research on IS measures and proposed an IS success model with six categories:

(1) system quality;

(2) information quality;

(3) use;

(4) user satisfaction;

(5) individual impact; and

(6) organizational impact.

Figure 1 shows how these categories work together.

The primary contribution of their research was that it proposed six dimensions of success as dependent variables, and examined the interrelationship among these six dimensions. For example, their research proposed that higher system quality can lead to higher use and user satisfaction (DeLone and McLean, 1992). After the IS success model was proposed in 1992, many other researchers conducted an empirical study of IS success measures (Seddon and Kiew, 1994; Goodhue and Thompson, 1995; Jurison, 1996; Li, 1997; Igbaria and Tan, 1997; Guimaraes and Igbaria, 1997; Rai *et al.*, 2002; McGill *et al.*, 2003). Seddon (1997) presented an extended version of DeLone and McLean's IS success model, which is represented by Figure 2.

Seddon's IS success model includes three classes of variables:

(1) Measures of information and system quality.

(2) The general perceptual measures of net benefits of IS success model. In these measures, Seddon proposed that information system use is a behavior, but not a success measure. He used the measure "perceived usefulness" instead of "use".

(3) The third variable was other measures of net benefits of IS use. Seddon also proposed net benefits from IS use for three constituencies: individuals, organizations and society.

In 2003, DeLone and McLean proposed an updated IS success model. This updated model, based on the explosive development of e-commerce, added a new indicator "service quality". This updated model also integrated the impact on individuals (DeLone and McLean, 1992; Torkzadeh and Doll, 1999), organization (DeLone and McLean, 1992; Mahmood and Mann, 1993) and society (Seddon, 1997) into one measure "net benefit" (Seddon, 1997). Figure 3 shows DeLone and McLean's updated IS success model.

To deeply assess the effectiveness of EMS in reducing corruption, and validate the DeLone and McLean IS success model, this research explores IT adoption and corruption reduction from the point of view of the IS success model. This study surveyed the IS application in corruption cases in two official Web sites from 2004 to 2012. The research questions are as follows:
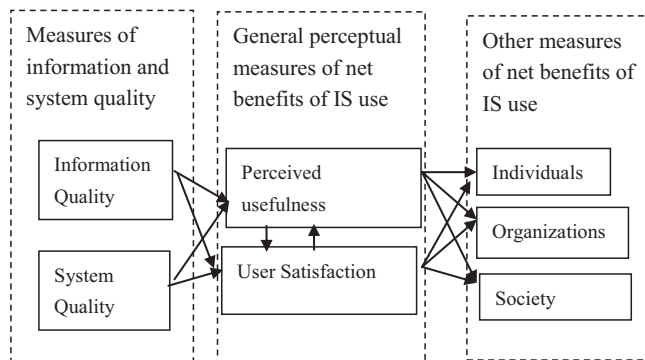
RQ1. What is the status of the EMS in China?

RQ2. Can these EMS can be evaluated in terms of the DeLone and McLean IS success model?

RQ3. Can the EMS successfully reduce corruption in these cities?
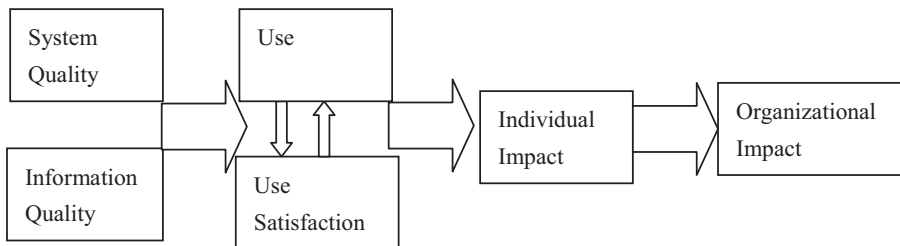
Figure 1.
DeLone and McLean's (1992, p. 87) IS success model

Figure 2.
Seddon's (1997, p. 245) IS success model

2. EMS application in China

In the context of this study, "EMS" refers to the public monitoring organization that integrates three systems:

(1) the e-government internal office systems;

(2) the system for video supervision of government offices; and

(3) the supply of Internet service by the government.

The EMS enables us to mine, extract and evaluate government information and also implement real-time monitoring and early warning error correction, and provide evaluation and information services through the unified electronic platform. The EMS provides an effective tool for reducing corruption, and has become an important means to improve the level of execution of corruption prevention.

The supervision departments of government in local government agencies are in charge of the electronic system. In China, in November 2004, Shenzhen city built the first EMS of the administrative examination and approval system, which supervises the whole process of administrative examination and approval by an electronic platform to help the government agencies perform and provide more efficient and transparent public management and services. After that, other cities throughout the country quickly started IT anti-corruption projects through the construction of EMS. Most of the data for this study are from a questionnaire survey and the government Web sites of the supervision agencies. The whole supervision organization structure in China is shown in Figure 4, which is summarized from the Ministry of Supervision (MoS) Web site (www.mos.gov.cn).
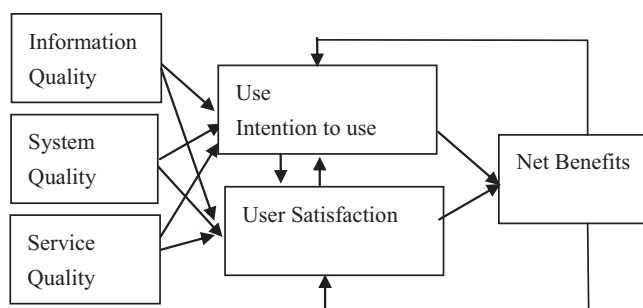
Figure 3.
DeLone and
McLean's (2003,
p. 24) updated IS
success model
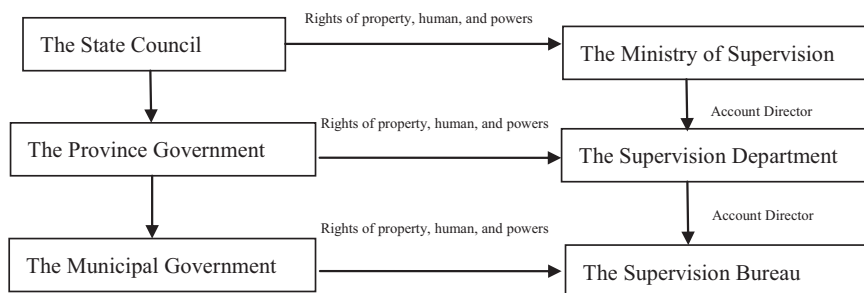
Figure 4.
The supervision
organization
structure in China

The major functional organizations for combating corruption are the MoS and the National Bureau of Corruption Prevention of China (NBCP) in China. All the initiatives of the local government are collected from two official Web sites, NBCP (www.nbc.gov.cn) and MoS (www.mos.gov.cn) Web sites. Two MPA help us read all the technical combating corruption initiative practice in two Web sites independently, and then generate keywords. Meanwhile, the software ROST is used to find the most frequently used words. Finally, the high-frequency words are obtained by the two methods mentioned above (Table I; Figure 5 and Figure 6).

3. Research framework and research hypotheses

In accordance with DeLone and McLean (2003), this paper proposes a multidimensional model of e-government system success. According to the design parameters of the G2B model, which relies on the online interaction between the central and the local government and the business enterprise, its purpose is providing business information and services for the business sector, while at the same time making it more convenient for the government to manage the business sector – for example, using IT to monitor well-known pollution sites and collect data allows the government to create viable strategies for reducing pollution produced by the business sector. With these benefits in mind, this paper focuses on five dimensions that will help ensure efficiency and continued application of the G2B IS success model: information quality, system quality, service quality, use, user satisfaction and organizational perceived net benefit. One can see how these six dimensions work together in Figure 7.

This research model is as DeLone and McLean's (2003) IS success model. This model contains six dimensions, and it is very important to study the interrelationships among these six dimensions. Thus, the following nine hypotheses were tested:

H1. Information quality will positively affect use.

H2. Information quality will positively affect user satisfaction.

H3. System quality will positively affect use.

H4. System quality will positively affect user satisfaction.

H5. Use will positively affect user satisfaction.

H6. Use will positively affect perceived net benefit.

H7. User satisfaction will positively affect perceived net benefit.

H8. Perceived net benefit will positively affect use.

H9. Perceived net benefit will positively affect user satisfaction.

4. Research design and method

4.1 Measures of the constructs

According to the DeLone and McLean (1992) model, information quality is the measure of information that the system produces and delivers. As to the information system, high information quality is the most important factor in making correct decisions (Jeong and Lambert, 2001). High information quality can greatly encourage the public to use it (Cullen and Hernon, 2004). System quality is the measure of the actual system operation. Use can be measured by the number of user visits. User satisfaction measures how the

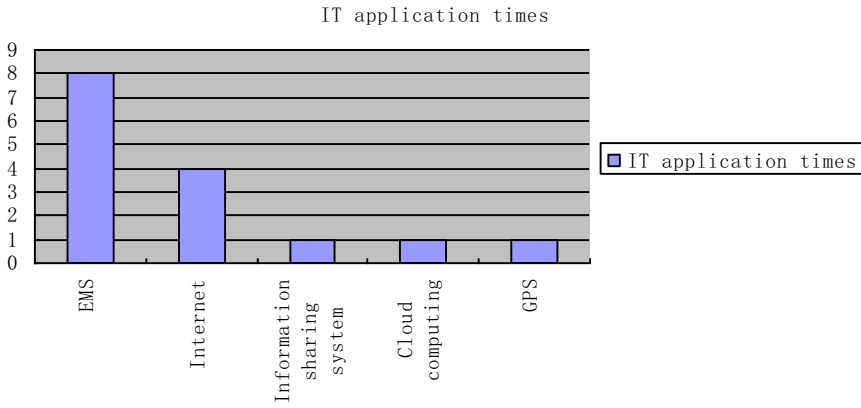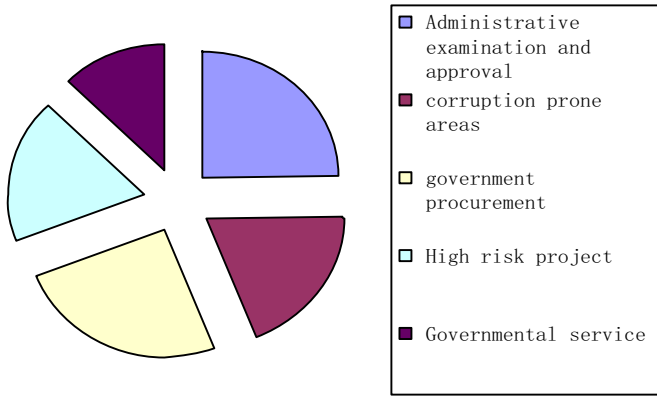| Year	Type of IT	Goal	Areas	High-frequency words	Cases
2004	EMS	Achieve the goal of reducing corruption through an EMS for administrative examination and approval	Administrative examination and approval; other corruption-prone areas	Transparency; information disclosure; high-risk points; early warnings; real-time supervision; administration examination and approval	Shenzhen create the EMS brand
2005	Government web site	More transparency and information sharing	High-risk project management system	Pre-warning; transparency; information disclosure; high-risk points	Beijing: Government Web site for corruption
	EMS	Monitoring key areas of corruption for a better effect in corruption prevention	Government procurement, administrative examination and approval	Key areas; leadership; transparency; integrated monitoring system	Suzhou: An integrated monitoring system on the executive power
2006	EMS	Prevention corruption on the risk points	Administrative approval, administrative performance complaints, land transactions, mineral resources, trading, property rights, government procurement	Real-time monitoring; administration examination and approval; transparency; information disclosure	Hangzhou: EMS for prevention corruption
2007	EMS	Improve the social security system and avoid the illegal practices	Social security funds monitor the whole process–the line model	Social security funds; transparency; real-time monitoring;	Shanghai: Social security funds online monitoring
2008	Internet Tip-off System	The Internet became a major platform for people to supervise the behavior of officials and supervise corrupt behavior	Civil servants' inappropriate or corrupt behavior	Online public opinion Internet anti-corruption tip-off; security; database	Guangzhou: Internet anticorruption
	EMS	The Huizhou Supervision Bureau achieved the purpose of reducing corruption by attaching great importance to the leadership and support	Administrative approval, administrative performance complaints, land transactions, government procurement, construction, and so on	Prevention corrupt; high risk; key areas; leadership anticorruption	Huizhou: Strengthening support of executive leadership in EMS

(*continued*)

Table I.
The EMS in China
from 2004 to 2012

Table I.

Year	Type of IT	Goal	Areas	High-frequency words	Cases
2009	Internet anti-corruption	The platform for public supervises the behavior of officials and corrupt behavior	Pubic supervise of civil servants' corrupt behavior or inappropriate	Preventing and control; database; Internet anti-corruption; supervision corruption	Shanxi: Internet anticorruption
	EMS	The risk points of prevention corruption in governmental sectors and other public sectors	government procurement activities, major projects monitoring system	E-procurement; prevention corrupt; corruption risk; risk control; monitoring system evaluation system	Wuhan: Focusing on monitoring government procurements
2010	EMS	Better management the funds for agriculture subsidies and reducing the corruption in this area	Electronic monitoring system of funds for agriculture subsidies	Database; e-supervision; funds for agriculture subsidies; prevention corrupt	Shanghai: "Technology + Institution" mode
2011	Information-sharing system	Reducing corruption through information disclosure	Disclosure the construction project information and credit information	Database; information disclosure; sharing; construction project information	Sichuan: transparency and anticorruption
	Grassroots anti-bribery Web sites	Reducing bribe by online forums bribery-reporting	"I-paid-a-bribe" cases "I Made a Bribe" cases	Anti-bribery Web sites; bribery-reporting; anti-bribery; prevention corrupt	Grassroots anti-bribery Web sites: www.ibribery.com
	EMS	Improve the governmental efficiency and prevention corrupt	Administrative examination and approval; governmental service	Governmental efficiency; governmental service; information disclosure	Changsha: EMS and Internet government service
2012	Cloud computing	Information sharing corruption database	Anticorruption education	Collaboration; e-procurement; database; cloud computing	Heilongjiang; Cloud computing for anticorruption education
	GPS positioning system	Improve the supervision efficiency and effectively reducing the project corruption	Supervision of assistance Xinjiang project	Efficiency supervision; online monitoring; supervision project	Jiangsu: GPS for supervision project

IT application times

Figure 5.
Different types of IT
application in
combating
corruption

- Administrative examination and approval
- corruption prone areas
- government procurement
- High risk project
- Governmental service

Figure 6.
Combating
corruption in
different areas
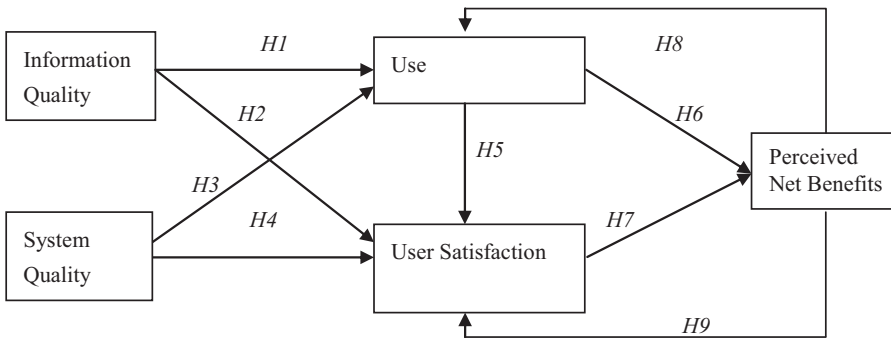
Figure 7.
The research model
and hypotheses

user feels. This feeling of satisfaction is based on whether the user feels the system is useful and plans to be a repeat visitor. Organizational perceived net benefit is the cost and money for the system investment and whether the system achieves the goal. The dimension and definition of the IS success measures are summarized in Table II.

The key independent variables are the measures of EMS information quality and system quality in this study. While, the key dependent variable is organizational perceived net benefit. Some sets of indices are created to operationalize the variables from the literature in Table II. In this study, the author measures the application of EMS in Table III and tries to use the description as the survey. The survey was intended to assess the use of the EMS. After measuring these items by operationalizing the variable from the literature, the Likert scales (1-5) are used, which rate the users' responses to the

IS success measures	Dimension	Definition	Literature
Information quality	Accuracy	The information is correct	Doll and Torkzadeh (1988)
	Timely	The information is timely	DeLone and McLean (1992)
	Understandable	The information is easy to understand	
System quality	Dependable	The system is dependable and accurate	Bailey and Pearson (1983)
			Davis (1989)
	Functionality	The system is available	
Use	Number of visits	The number of users visiting the system	Doll and Torkzadeh (1988)
	Ease of use	The system is easy to use	
User satisfaction	Repeat visits	The action of revisiting the system	Palvia (1996); Rai et al., (2002)
	Usefulness	The system is convenient and helpful	
Perceived net benefit	Saving cost	The system can help to save cost	Etezadi and Farhoomand (1996)
	Saving time	The system can help to save time	
	Achieve the goal	The system helps to reduce corruption	

Table II.
The dimension and definition of the IS success measures

Indicators	Dimension	Description
Information quality	Accuracy	Using the EMS enables me to get accurate information
	Timely	The EMS enables me to get the newest corruption data
	Understandable	The corruption related data from the EMS is easy to understand
System quality	Dependable	I can access the corruption information every time I use the system
	Functionality	The EMS gives me the information I want
Use	Visits number	I always visit the EMS
	Ease of use	Getting what I want is easy for me
User satisfaction	Repeat visit	I depend on the EMS
	Usefulness	The EMS can help me monitor the corruption behavior
Organizational perceived net benefit	Saving cost	This system can help me save money
	Saving time	This system can help me save time
	Achieving the goal	This system has achieved the goal we set for it

Table III.
The measurement of the EMS

EMS from strongly disagree to strongly agree. The data were collected from users who used the monitoring system in the five cities.

4.2. Data collection and analysis
A survey was conducted to verify the research model. Stratified random sampling was used to select the sample. The unit of analyse is individuals in supervision agencies in five cities. The author listed all the staff's names in each supervision agency and then randomly selected the sampling from the list names. The author informed each individual about the research objectives by telephone and asked whether he or she use the monitoring system first and then mailed the questionnaire from the items in Column 3 of Table II to the person with the experience of using EMS, with a stamped addressed return envelope enclosed. Out of 500 questionnaires distributed to the supervision agencies in five cities from March to July 2011, 100 questionnaires for each city, 387 valid questionnaires were completed.

5. Results
The return rate was about 77.4 per cent. In all, 58.7 per cent of the respondents were male and 41.3 per cent were female; 30.2 per cent of the respondents were less than 30 years old, 44.4 per cent between 30 and 40 years old, 22.2 per cent between 40 and 50 years old and only 3.2 per cent were over 50 years old; 25.4 per cent of the respondents were graduates, 66.7 per cent were undergraduates and 7.9 per cent had completed high school; 23.6 per cent were in the high level of the supervision bureau, 43.8 per cent were in the middle level of the supervision bureau and 32.6 per cent were in the low level of the supervision bureau. These data are presented in Table IV.

A multiple regression was used to examine the relationship among the information quality, system quality, use, user satisfaction and perceived net benefit. The author also

Respondents	No.	Rate (%)
Sex		
Male	227	58.7
female	160	41.3
Age		
Less than 30 years old	117	30.2
30-40 years old	172	44.4
40-50 years old	86	22.2
Over 50 years	12	3.2
Education		
Graduates	98	25.4
Undergraduates	258	66.7
High school	31	7.9
Level in Supervision Agencies		
High level	91	23.6
The middle level	170	43.8
The low level of	126	32.6

Table IV.
The background of
the respondents

chose this method to explore whether the information quality and the system quality of the EMS reduce corruption behaviors. The analysis result is available in Table V.

To examine the monitoring system, information quality and system quality were regressed on the use of the monitoring system. The results of the regression revealed that these two aspects accounted for 41.5 per cent of the variance in the use of the EMS. In the results, $R^2 = 0.415$, $F = 152.681$, $p < 0.001$. As can be seen from Table VI, the element of system quality contributes to the greater use of the EMS, followed by information quality. Then all the dimensions of system quality and information quality were regressed by using the stepwise method, placing the following three dimensions at these marks: usefulness (beta = 0.401, $p < 0.001$), dependable (beta = 0.186, $p < 0.05$) and accuracy (beta = 0.102, $p < 0.01$).

6. Discussion and conclusion

In this article, the relationship between information technology and corruption reduction was explored. To operate this study, the author focused on the EMS in supervision agencies. Then the author tried to examine what is the status of EMS and what is the relationship between the EMS and corruption reduction. Based on the research model in Figure 4, the relationship among the information quality, system quality of EMS, use of EMS, user satisfaction and organizational perceived net benefit was explored. By examining the EMS application in Shenzhen, Suzhou, Huizhou, Wuhan and Nanning supervision agencies, the following conclusions can be drawn.

The support of executive leadership is very important, as can be seen from Huizhou and Nanning supervision agencies' application of EMS. Then, focusing on the corruption-prone areas in administrative examination and approval is another important factor to use the EMS effectively. For example, Wuhan supervision agencies focus on monitoring government procurements, and Suzhou supervision agencies pay more attention to control the key areas of corruption, such as project construction and government procurement. Shenzhen supervision agencies also monitor the important

Indicators	Mean	SD	Cronbach's alpha
Information quality	3.012	0.602	0.875
System quality	3.421	0.624	0.891
Use	3.235	0.683	0.843
User satisfaction	2.867	0.728	0.886
Organizational perceived net benefit	2.586	0.854	0.897

Table V. Analysis results

Measures	Unstandardized coefficients		Standardized coefficients			Collinearity statistics
	B	SE	Beta	T	p	VIF
(Constant)	0.268	0.124		2.012	0.032	
Information quality	0.216	0.052	0.132	3.230	0.001	2.261
System quality	0.524	0.063	0.368	7.487	0.000	2.813

Notes: $R^2 = 0.415$; $F = 152.681$; $p = 0.000$

Table VI. Regression analysis results

investment projects. But there is still a long way to go to perfect the EMS, as now there is still lack of law and policy to regulate the use of EMS.

When the relationship among the information quality, system quality, use of EMS, user satisfaction and organizational perceived net benefit and effective corruption reduction was examined, the conclusion was made that the element of system quality contributes to the greater use of the EMS, followed by information quality. So when the supervision agencies use the EMS, they should pay more attention to the system quality and information quality. In future studies, the degree of EMS's effect on corruption reduction, how to better use the EMS regulatory and how the EMS can be effectively used to achieve better anticorruption effectiveness will be analyzed.

This research studies the EMS's role in corruption reduction and examines EMS application in reducing corruption. It has a strong practical significance in building clean institutional systems and improving the clean institutional execution systems. In China, corruption is still a serious problem, and how the EMS can be effectively used to reduce corruption is significantly important.

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