Modeling the external perspective of Information System Quality

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Summary
Measuring Information System Quality (ISQ) requires the perception of all IS intervening, as well internal one represented by Managers and technical staff, as external intervening that are functional staff and users. A set of indicators was proposed within a hierarchical model for ISQ named "ISysQ model" taking into consideration the five IS components which are: human resources, hardware, software and applications, procedures and data. These indicators allow to quantify numerically the quality level of each IS component, leading this way to a quantification of ISQ as a whole. To achieve this goal, adapted surveys were designed for every IS intervening, including a sub group of ISysQ model indicators, that belong to the expertise area of the different IS intervening.
This contribution focuses on the surveys designed for external IS intervening, by relating questions, characterized by their literal significance with indicators, which have more abstract meaning. On the basis of the formulas linking questions to indicators, the component values for each external IS intervening are determined, which provide the external perception of ISQ model.
Key words:
Information system, quality, modeling, users.

1. Introduction

In context of free market economy, organizations want to be more competitive in order to increase their market share. To do so, quality rises as a medium of efficiency and achievement, and considering that organizations rely more and more on their information system [8] to accomplish almost all their functions, a given ISQ level is required.
Measuring ISQ has been discussed in many research [4; 5; 7; 9; 10; 11; 12; 14], however the major part of these researches treat this issue from only one side by considering ISQ equivalent to Software and Application quality. Also, most research in that field are based on the technical staff perspective, few ones rely on managers [6] or users separately.
The conception of the ISysQ model took into account enlarging the measuring method of ISQ by including all IS intervening type, who are IS managers, technical staff, functional staff and users.
On previous work [1; 2; 3], sub models relative to IS managers [13] and technical staff [16] were developed making the internal perception of ISQ. The external perspective of ISQ requires the two other sub models involving functional staff and users, which is the main purpose of this contribution.
On the following, first we provide the ISysQ model background for functional staff and users. Then, we give the aggregating formulas for questions into indicators. After that we move to the aggregation of sub models components into external perspective components leading this way to the final purpose which is measuring ISQ from an IS external perspective. Finally, the paper concludes with a discussion of the findings, implications, limitations and directions for future research

2. The Information System Quality Model

2.1 Theoretical Background

The literature review about ISQ has revealed a multitude of models that treat this issue. However these models are all focusing on one side of IS, like service quality, development quality, or software quality. One more weakness of these models is that when it comes to collect information in order to supply the model with appropriate data, only developers are asked. On few studies, managers or users are also requested separately. Nonetheless, measuring ISQ is equivalent to determine the quality level of its five components (human resources, hardware, software and application, procedure and data) from all IS intervening perspective (managers, technical staff, functional staff and users).
Figure 1 shows the distribution of the indicators by IS component.

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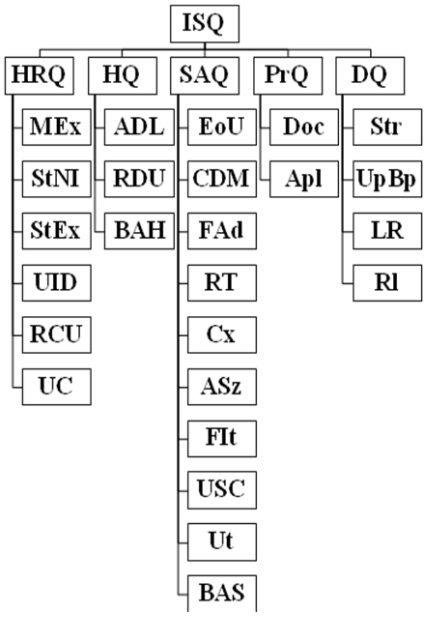

Fig. 1 IS quality model indicators

The 25 indicators listed above don't concern all IS intervening at the same time, in fact, for each type, some indicators are missing from the model. Table 1 gives the left indicators for both functional staff and users sub model.

Table 1: Corresponding ISysQ model indicators for external IS intervening

ISQ Components	Indicators	Functional Staff	Users
HRQ	MEx		
	StNI		
	StEx	×	
	UID	×	×
	RCU		×
	UC		×
HQ	ADL		
	RDU		
	BAH		
SAQ	EoU	×	×
	CDM		
	FAd		
	RT	×	×
	Cx	×	
	ASz		
	FIt	×	×
	USC	×	×
	Ut	×	×
	BAS		
PrQ	Doc		
	Apl	×	×
DQ	Str		
	UpBp	×	×
	LR	×	
	RI		×

2.2 External IS Intervening

2.2.1 Functional Staff

The Functional Staff in every organization is composed of the departments' personnel who are supposed to handle software and applications in order to accomplish their daily tasks. The functional staff's assignments consist in designing functionally an application by specifying the users' requirements and then formalize them to propose adapted solutions.

14 indicators among 25 are not related to functional staff including four for HRQ: MEx (Managers Experience), SNI (Staff Number Involved in IS), RCU (Resistance to Change of Users), UC (Users Competency), the whole set of HQ indicators since it involves only managers and technical staff, four indicators for SAQ: CDM (Code Development Maintainability), FAd (Flexibility or Adabtability), ASz (Application/ Software Size) and BAS (Budget Allocated to Software and application), Doc (Documentation) for PrQ, and Str (Structure) and RI (Relevance) for DQ. The excluded indicators from the functional staff sub model are all either technical or organizational.

2.2.2 Users

The users can be defined as anyone who uses software and application, website or any other tool offered within IS. Their interactivity and awareness affect the IS quality, especially the quality of data provided on different forms.

14 indicators among 25 are not included on the users sub model namely MEx (Managers Experience) and SNI (Staff Number Involved in IS) for HRQ, all the HQ indicators, CDM (Code Development Maintainability), FAd (Fexibility or Adabtability), ASz (Application/ Software Size), Cx (Complexity) and BAS (Budget Allocated to Software and application) for SAQ, Doc (Documentation) for PrQ, and Str (Structure) and LR (Lack of Redundancy) for DQ.

3. Aggregating Variables Questions into Variables Indicators

The indicators of ISysQ model are expressed differently depending on the survey type. Indeed, even if functional staff and users are both kind of end users of IS, functional staff remains an active participant on implementing available software and application according to the required tasks, unlike users who are pure consumers of applications and services provided by the organization.

Table 2 gives the aggregating [15] formulas of variables questions into variable indicators for each external IS intervening.

Table 2: Aggregating formulas of variables questions into variables indicators by component for Functional Staff and Users

Component	Indicator	Intervening	Question	Formula
HRQ	StEx	Functional Staff	ExMet	StEx=NvFct*ExMet/3
			NvFct	
	UID	Functional Staff	NbUt	
		Users	TExp	
	RCU	Users	NvSI	
	UC	Users	ExMet	UC=(ExMet+NvEt+ 2*SpTch+ (4/5)*Ancien)/4
			NvEt	
			SpTch	
			Ancien	
HQ				
SAQ	EoU	Functional Staff	TExp	EoU=6*(TExp/4+ Erg/2)/2
			Erg	
		Users	Erg	EoU=6*(Erg/2+ DifUt/3)/2
			DifUt	
	RT	Functional Staff & Users	RT	
	Cx	Functional Staff	DifUt	
	FIt	Functional Staff & Users	FIt	
			FItN	
	USC	Functional Staff & Users	DifSp	USC=(DifSp+CfSpI)/2
			CfSpI	
	Ut	Functional Staff & Users	UtTp	Ut=(UtTp+UtEf)/2
			UtEf	
PrQ	Apl	Functional Staff & Users	PrAp	Apl=(PrAp+PrRap +PrErr)/3
			PrRap	
			PrErr	
DQ	UpBp	Functional Staff & Users	UpBp	
	LR	Functional Staff	LR	
	RI	Users	Obj	

It can be notable that the indicators which are represented on the survey by one question, the corresponding variable indicator is equal to the variable question. Also, the hardware quality component does not contain any indicator from the three on the general model for IS external intervening, that's because information about that component are purely technical or managerial and does not concern therefore functional staff and users.

For the remaining indicators which include more than one question, the variable indicator is computed via the average of related variables questions if the number of levels is the same for all of them. Otherwise, the variable indicator is a weighted average of the variable questions by the level's number.

Let's take the example of the variable Staff Experience (StEx) to illustrate this case: StEx has four levels as ExMet, so the indicator is equal to ExMet weighted by the variable NvFct: the higher the level of qualification, the quicker the accumulation of experience is made.

Table 3 gives the levels of variable questions and variables indicators composing the HRQ for users sub model.

Table 3: Levels of HRQ indicators for users sub model

Indicator	Answer	Value	Question	Answer	Value
UID	No implication	1	TExp	[0%, 25%[	1
	Low implication	2		[25%, 50%[	2
	Average Implication	3		[50%, 75%[,	3
	High implication	4		[75%, 100%]	4
RCU	No adherence	1	NvSI	No	1
	Low adherence	2		Partly	2
	Average adherence	3		Yes	3
	High adherence	4			
UC	Low level of Competence	1	ExMet	Less than 2 years	1
				Between 2 and 5 years	2
				Between 5 and 10 years	3
				More than 10 years	4
			NvEt	High school diploma or less	1
	Average level of Competence	2		bac+2	2
				bac+3	3
				bac+5 and more	4
			SpTch	No	1
				Yes	2
	High level of Competence	3	Ancien	[0, 5 years[	1
				[5, 10 years[	2
				[10, 15 years[	3
				[15, 20 years[	4
				More than 20 years	5

After computing the indicators values, one can notice that the values are not homogeneous, in fact, if we take the indicators on table 3; UC [1, 3] has not the same scale as RCU and UID [1, 4]. To overcome this problem, we turn to the standardization of indicators values in order to put all the variables on the same scale then determine the component value by computing the average of indicators values that compose it. Once all the components of the two sub models have determined values, ISQ as a whole can also have a value allowing that way to evaluate the quality level of IS in an organization according to external perspective.

4. Measuring ISQ from External Perspective

Let's reiterate that sub models of ISysQ model don't include all the 25 indicators at the same time. Each sub model contains only the indicators corresponding at IS intervening type. Therefore, the number of indicators by component is different depending on IS intervening type, and must be considered while aggregating the sub models components on ISysQ model's components.

The HRQ component contains six indicators on the general model, two from them concern the functional staff and three the users. Measuring the human resources quality from an IS external perspective, means computing the

weighted average of HRQ in each sub model which coefficients are the indicators number (equation1).

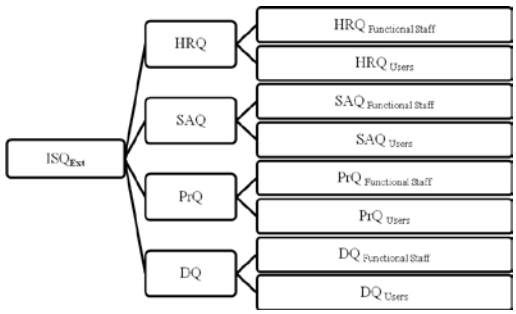

Fig. 2 External perspective design of ISQ

$$HRQ_{Ext} = (1/5) \times (2 \times HRQ_{Functional\ Staff} + 3 \times HRQ_{Users}) \quad (1)$$

Similarly, the equations linking the IS external perspective components to those in corresponding sub models are detailed in equations 2, 3and 4. It is noted that the HQ component does not include any indicator for the functional staff and users sub models.

$$SAQ_{Ext} = (1/11) \times (6 \times SAQ_{Functional\ Staff} + 5 \times SAQ_{Users}) \quad (2)$$

$$PrQ_{Ext} = (1/2) \times (1 \times PrQ_{Functional\ Staff} + 1 \times PrQ_{Users}) \quad (3)$$

$$DQ_{Ext} = (1/4) \times (2 \times DQ_{Functional\ Staff} + 2 \times DQ_{Users}) \quad (4)$$

After determining the components above, the equation relating them to the external perception of ISQ can be stated as (equation 5):

$$ISQ_{Ext} = (1/14) \times (4 \times HRQ_{Ext} + 6 \times SAQ_{Ext} + 1 \times PrQ_{Ext} + 3 \times DQ_{Ext}) \quad (5)$$

Where ISQ_{Ext} is a weighted average of the components which coefficients are the number of distinct indicators on both sub models of functional staff and users.

5. Conclusion

This study is in conformity with the major quality philosophies since it focuses on users which are consumers of IS services. A quality level in an organization must be determined not only by the producers but by the users imperatively.

The external perception of ISQ strengthens the finding of ISysQ model. In fact, instead of relying only on internal intervening who are the main actors in implementing and taking decisions about IS, functional staff and users' perspectives come to complete this evaluation. Organizations are invited to apply the ISysQ model to find out the exact location of failures then figure out the adequate and appropriate solutions to those problems.

Appendix

1. ISysQ Model abbreviations

ISQ	**Information System quality**
HRQ	**Human resources quality**
MEx	Manager experience
StNI	Staff numbers involved in IS
StEx	IS staff experience
UID	Users implication degree
RCU	Resistance to change of users
UC	User competence
HQ	**Hardware quality**
ADL	Average duration of life
RDU	Rate of daily use
BAH	Budget allocated to hardware
SAQ	**Software and application quality**
EoU	Ease of use
CDM	The code development maintainability
FAd	Flexibility or adaptability
RT	Response time
Cx	Complexity
ASz	The application/software size
FIt	Friendly interfaces
USC	Users specifications conformity
Ut	Utility
BAS	Budget allocated to software and application
PrQ	**Procedures quality**
Doc	Documentation
Apl	Applicability
DQ	**Data quality**
Str	Structure
UpBp	Updating and back up
LR	Lack of redundancy
Rl	Relevance

2. Relating variables questions to corresponding questions on the surveys designed for functional staff and users

Variable Question	Question
ExMet	How many professional years' experience do you have?
NvFct	What is your level of qualification?
NbUt	What is the number of users for the software/application?
TExp	What is the exploitation rate of the existing software and applications?
NvSI	Do you think that the new information system practices are acceptable?
NvEt	What is your educational level ?
SpTch	Is your speciality technical ?
Ancien	How many years of service do you have ?
Erg	Is the software/application ergonomic?
DifUt	What is the difficulty level encountered while using the software/ application?
RT	How do you assess the software and applications response time?
FIt	Are the software/application interfaces freindly?
FItN	If no, explain why!
DifSp	What is the difficulty level encountered while specifying requirements to the technical staff?
CfSpI	Is the application in conformity with the initial specification?
UtTp	What is the utility level of the software/application in terms of working time?
UtEf	What is the utility level of the software/application in terms of efficiency?
PrAp	Are the procedures applicable?
PrRap	Is there a tangible contribution of procedures to the timeliness of daily task?
PrErr	Is there a tangible contribution of procedures to errors elimination from daily task?
UpBp	What is the time interval between two successive backups?
LR	Are there any data redundancy?
Obj	Does data coming from used software and/or application help you achieve your goals?

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