Criteria for measuring and comparing information systems

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Abstract: Whether designing a new system or evaluating an old one it could be useful to be able to compare the system with another system, intended or existing. One way to evaluate and compare information systems would be through a set of criteria encompassing factors thought important. For such criteria to be useful they need to be operational and measurable. This article presents a list of criteria found in literature, combined with a few criteria not found, and a categorization. The criteria are presented in a collected hierarchical model organizing them into the categories of Organization, Individual, Information, Technology and Systemics. It is concluded that the criteria model may be useful, for example as a checklist during design, but that it needs to be operationalized, and be exposed to practice and empirics.

Keywords: Information system, evaluation, measurement, comparison, criteria

Introduction

When confronted with an information system (IS) and an unspecific expectation to make the IS "better", it could be useful to measure the current IS and compare it with another IS, intended or existing. With operational criteria for measuring an information system, a foundation can be laid for improving the IS in the aspects of which it is found lacking.

Further, an information systems designer needs to know what the goal is, and a buyer of the services of the designer needs to know whether the goals have been fulfilled. With a set of criteria for deciding this, there could be a checklist before, during and after a design phase: Does the system do what it is supposed to do, and to what extend does it do it as compared with, for example, a previous system?

When searching for criteria which characterize an information system, I have not yet been able to find a complete model which encompasses all the aspect I find interesting. In the literature section below, I will list those models I have found (and which are relevant for the discussion).

The lack of encompassing models is part of what makes this article relevant: I have not found a usable overall model, and the models for measuring or evaluating details did not take each other into account when they were formulated. A summary and reformulation is thus useful.

Purpose of the article

The purpose of this article is to provide a collected framework for criteria for the measuring and comparing of information systems.

Assumptions

In the following discussion, a few assumptions will be held. First, the definition of what constitutes a good system varies between stakeholders, perspectives and system purposes. To paraphrase Ashby (1962), there is no information system which is good in an absolute sense.

Second, because of the assumption of relativity, it is necessary to choose a perspective from which to conduct the discussion. In this article a managerial perspective is chosen.

Thirdly, it is assumed that a healthy information system will require that all stakeholders are reasonably satisfied. Thus even with a managerial perspective, we need to look at what is good for the participants in the information system.

Terms

In this article, an information system is all that, abstract or not, within an organization that contributes to and shapes the distribution of information. Humans are parts of the information systems rather than users of the information system. There is no such thing as information system without a human, but it is perfectly conceivable to have an information system without a single computer. (Palmius J, 2005b)

Other core terms used here are "evaluation", "measurement" and "comparison". The measurement is an observation and quantification of a phenomenon, as formulated in the criteria list below. The evaluation is a measurement paired with

an observation of what would be desired (by the person doing the evaluation). The comparison is putting two evaluations against each other.

Method

The procedure for producing the criteria framework has been the following:

First I started with a broad search on the net for terms such as “good information system” and “evaluation of information system” to find encompassing models fitting what I wanted (a model for the evaluation of information systems). This basically resulted in the DMSM (DeLone W, McLean E, 1992) mentioned more in detail below.

Secondly I tried arranging criteria according to time (pre-hoc measurement, normative statement, post-hoc evaluation), but decided it was not a good structure, because it was difficult to place criteria.

Thirdly I drafted a rough hierarchy based on a organization-individual-technology-systems view and found that this made it easier to categorize criteria. Along with finding new criteria I placed them into the top categories, and made sub-categories from what to me seemed to be the major groups found in literature.

Late in the work I moved all criteria related to information from the organization category to a category of its own.

Criteria from literature

The following is a summary of what I find to be important literature for my purpose: To find a set of operational criteria for evaluating IS in an organizational sense.

There are several models for evaluating information systems, and a plentitude of models for evaluating specific details within an IS. Searching on Google's aggregated article database (http://scholar.google.com), one can see that most of the literature for evaluations falls within one of these categories:

- Economical benefit, such as return on investment
- Usability measurements, mainly of interfaces
- Measurements of user and/or customer satisfaction

Literature also exists, but in significantly lesser degree, for measuring organizational benefits, systems quality and performance (for performance, lesser degree on an organizational level: there is much literature concerning performance on a technology level).

Note that what are treated here are evaluational aspects. There also exists vast amounts of normative literature for how information systems should be organized,

but that is outside the scope of this article, unless the normative criteria can be reformulated in an evaluational fashion.

Models specifically for evaluating IS in general

One of the most cited models for measuring information systems success is the DeLone and McLean Information Systems Success Model (DeLone W, McLean E, 2003) (DeLone W, McLean E, 1992), from now on referred to as DMSM.

The DMSM has a basic model consisting of six categories of IS success:

- Systems quality
- Information quality
- Use
- User satisfaction
- Individual impact
- Organizational impact

The model has later been extended by several researchers, for example by Seddon (1997) who concluded, among other things, that the meaning of "use" in DMSM needed to be better defined. Further, the validity of the DMSM (and of Seddon's extension) has been empirically studied (Rai A, Lang S, Welker R, 2002), and it was found that both DMSM and Seddon's extension were supported.

The criteria presented in this article could be said to be a model of information systems success. They do however differ in the definition of what constitutes an information system, and in their goal: the explicit measurability.

Now, it should be noticed that there are also operationalizations of the DMSM. One such operationalization is the SERVQUAL instrument, which has been shown to be a functional tool for measuring service quality in IS (Pitt L, Watson R, Kavan B 1995). SERVQUAL is however limited to service quality. This is in this article seen as only one aspect of the IS. Further I remain unconvinced that a questionnaire consisting of 45 likert scales, divided along preferences and perceptions, is a good measure of the quality of a whole IS.

Torkzadeh and Doll (1999) has performed a study concerning perceived impacts of information technology on work life, in which a set of four criteria were derived from a larger set of questions. These criteria were task productivity, task innovation, customer satisfaction and management control. It should be noted that the tool only measured the opinions about whether a technological artifact had had a good impact, there were no factual measurements.

Martinsons et al (1999) have developed a balanced score card approach to measuring a set of criteria from four different points of view. These points of views are business value, user orientation, internal process and future readiness. Each perspective contains a set of criteria. For example does the future readiness

perspective contain criteria like age distribution of IS staff, and expertise with specific emerging technologies.

Jiang and Klein (1999) have studied evaluation of IS from the users' point of view and has summarized earlier literature into four categories of criteria: Performance issues, decision quality, personal impact and organizational impact. While the study was focused on measuring how important users felt these criteria were, the list of criteria is interesting in itself because of its concreteness.

Irani (2002) has categorized a number of semi-operationalized criteria. He has first divided the criteria into three major categories: strategic, tactical and operational benefits, and then examined the criteria from what kind of benefit they bring. He sees that benefits can be financial, non-financial and intangible. It should be noted that his article, however, is focused at measuring whether an investment is justifiable. Still, his categorization is interesting since it lists some 30 criteria which can be reformulated to fit into the current context.

Auvo Finne (2005) has reviewed, summarized and extended a number of (mainly normative) selected documents concerning IS quality. He has produced a model for ensuring and evaluating IS quality.

International standards

There are several ISO standards which can be relevant to this discussion. The ones most relevant are those dealing with software development and with quality management. There are likely also other ISO standards concerning quality and organizations, which could be interesting although peripheral. I have not considered these, as the point of this discussion is to find criteria relating to the IS specifically.

ISO 9000 (ISO 9000, 2005) deals with the management of quality and defines terms and fundamentals within the field. It does not specifically deal with the quality of IS, but rather with quality management systems in general, or in other words the construction of a system to manage quality within an organization. However, several terms are directly transferable as criteria. Of particular interest are the term definitions concerning quality, management, organization, and documentation.

ISO 9126 consists of four parts all describing aspects of quality and software engineering. ISO 9126-1 (ISO 9126-1, 2003) describe an overall quality model for the product quality of software products. Terms such as functionality and maintainability are here defined. ISO 9126-2 (ISO 9126-2, 2004) describes external quality metrics, or in other words how well a certain piece of software behaves within the system it is placed. ISO 9126-3 (ISO 9126-3, 2004) describes internal quality metrics, or in other words how well a piece of software behaves when studied as such. ISO 9126-4 (ISO 9126-4, 2004) describes how the models and the metrics can be used in quality work. All the four parts of the ISO 9126 series use the same terms for describing quality.

Information and record quality

One of the problems with describing a general way for evaluating information systems is that the information within the system looks very different from case to case. I will thus make a slight separation between system and information here: The information system is something that operates on and with information.

The term "information quality" is by necessity rather subjective, or at least dependent on situation: It is more a question of what is applicable in a certain setting than what is objectively good.

However, some aspects of information quality can be said to be generally applicable. One such aspect is that of archivability. It has been noted (Borglund E, 2006) that in order to retain quality in the transformation of information into records, the records have to retain certain properties, such as authenticity and reliability. It is my view that these criteria can as well be applied to the source material (the information). Borglund (2005) further lists sixteen criteria for attaining trustworthiness in e-records. Several of these will be used below. Borglund and Öberg (2006) further put forward the notion that one of the main purposes of records is that of "evidence". This will be taken into account although reformulated.

Models for evaluating details in an IS

There are also several models for evaluating parts of an information system (that is, parts of what in my definition constitutes an information system). Many of these relate to what in the categorization below is called "technology".

One big category of evaluation details is the area of HCI literature and usability measurements. These measure and study the user interaction with the interface to the technology. One of the most influential books concerning the measurements is written by Nielsen (1993), in which he defines usability as a set of measurable factors consisting of "learnability", "efficiency", "memorability", "error" (or free from) and "satisfaction". Here he also stresses the important issue that usability is not something absolute: Rather it is something highly dependent on what user we are talking about, and in which context.

While Nielsen's recommendations and definitions are primarily written to fit graphical user interfaces, I find that the aspects are generalizable enough to be useful to be applied to information systems as a whole.

Another significant part of the available literature deals with software quality. Apart from the normative literature concerning software development, the ISO 9126-x standards documents provide a comprehensive framework for software evaluation. These documents are recent and can be assumed to be built on the best concurrent practice.

In the non-technical literature concerning quality of IS, economics takes a significant part. Hitt and Brynjolfsson (Hitt L, Brynjolfsson E 1996) defines three

basic criteria for evaluating whether information technology is valuable. According to them, the three major criteria would be productivity, business profitability, and consumer surplus. While the major point of the referenced article is to decide whether IT investments are good for all three of these criteria (they find that they are not), the article is still interesting from the point of their definitions of important criteria.

Another non-technical area concerning IS, is that of IS use. I am aware of this area, but have elected to exclude it despite its prominence in literature. The reasoning behind this is that use is a product of system quality, not the other way around. Thus it would be counter-intuitive to measure use as an independent variable for determining quality. This decision might be changed eventually, but for now IS use will not be taken into account.

Patricia Rogers (2007) has compiled a list of evaluation literature with implications for action research. Several sections in this bibliography describe meta-evaluation frameworks for things such as organization and policy. Describing these meta-evaluation frameworks here is however beyond the scope of the paper.

Normative literature

Since most of the literature within the IS field is normative (or at least this is my impression), there is no lack of sources to search among. The question rather becomes what to choose and what is relevant for a list of evaluational criteria. In the end I have limited this section to a few major (if a bit dated) systems model and a contemporary collection of design guidelines.

Within the systems field, there is an implicit language which is more or less agreed upon. This language contains terms such as system, system boundary, feedback loops and viability. Many of these terms can be converted into points of observation when studying an information system. One example of a book which summarizes these terms is that of Flood and Carson (1993).

Further within the systems field, there are classical systems models, or models for analyzing systems. Of these, I will here mention the Viable Systems Model, VSM (Espejo R, Harnden R, 1996), and the Living Systems model (Miller JG, 1978). Both of these are rather dated and are not used to any significant extent in contemporary systems design. They do however provide good models for analyzing systems to see if something is lacking. They both list functions which are thought necessary for a viable system.

Another normative approach which has aged with more grace is the Soft Systems Methodology, SSM, (Checkland P, Scholes J 1997). SSM is still frequently referenced in contemporary organizations- and systems development literature. For the sake of evaluation, SSM provides a good basis for identifying stakeholders and cultural problems.

There are of course other systems models available. I am aware of these. Of particular note might be critical systems and multi-modal systems approaches. At this point in time I do however not think they would contribute to the end model, but I'm open for later inclusion.

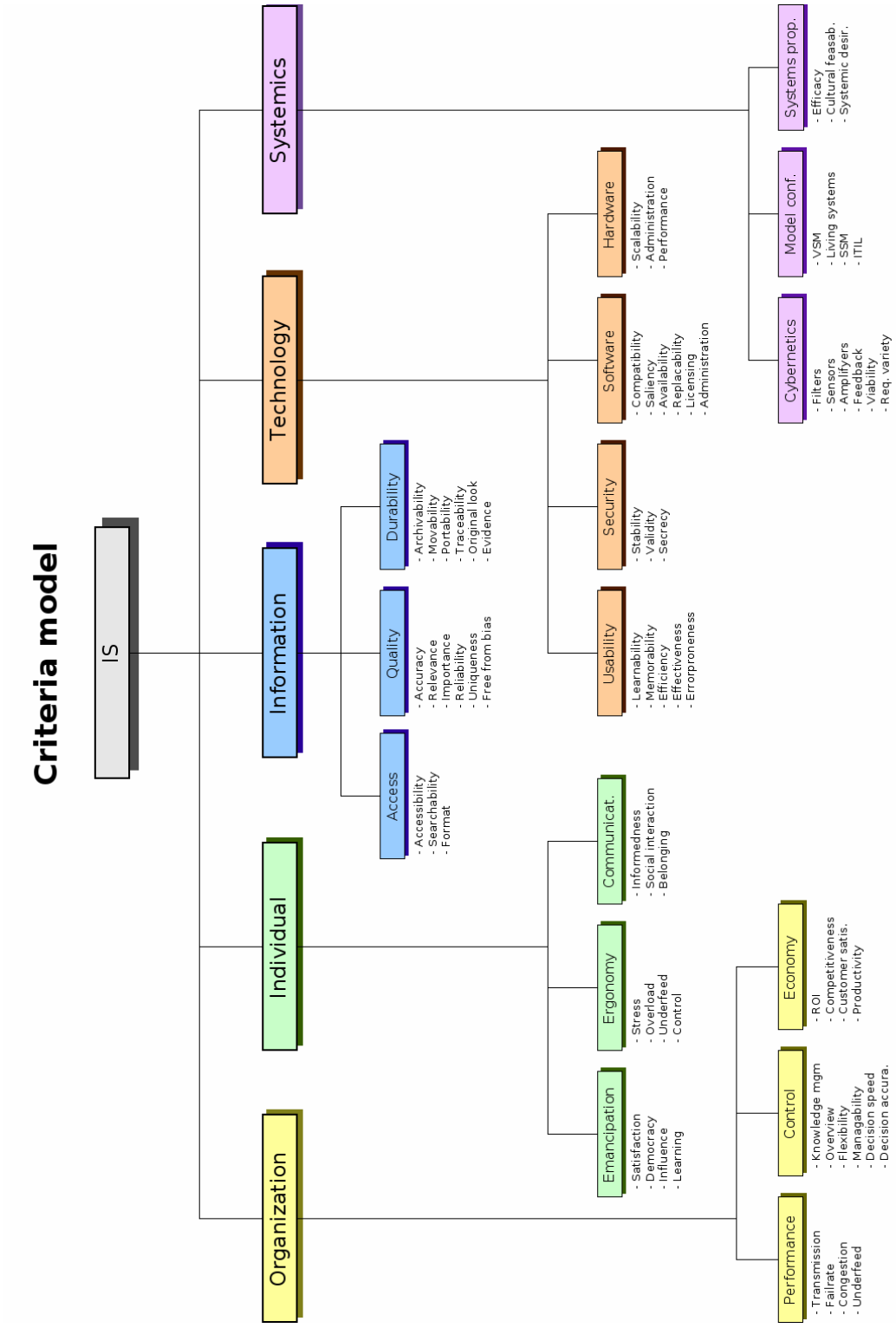
Finally, to return to current time, I have opted to include a contemporary reference framework, The Information Technology Infrastructure Library, ITIL (IT Library 2007). According to its own words, ITIL is a collection of best contemporary practices for managing an IT operation. This collection or library provides a good base for checking model conformance with contemporary practices.

Categorization of criteria from literature

Literature defines many criteria for what characterizes a good information system. Below I have summarized these criteria according to a categorization derived from an organization-individual-technology-policy model, the Syntegrity-4 (Holmberg S, 2001).

Note that some criteria has been reformulated and/or been given new names to fit into the tables. Below each table I will list criteria divided into "literature" (criterion for which there is a direct reference) and "not in literature". For the latter, I want to stress that I am reasonably certain it in fact exists in literature, but that I have not yet decided upon a good reference.

The diagram on the following page summarizes the criteria framework. In the following, the major divisions will be described shortly. Tables with more detailed descriptions of the individual criteria, and literature references, have been moved to appendix A for readability reasons.


Criteria model
IS
Organization
Individual
Information
Technology
Systemics
Performance
- Transmission
- Failrate
- Congestion
- Underfeed
Control
- Knowledge mgm
- Overview
- Flexibility
- Managability
- Decision speed
- Decision accura.
Economy
- ROI
- Competitiveness
- Customer satis.
- Productivity
Emancipation
- Satisfaction
- Democracy
- Influence
- Learning
Ergonomy
- Stress
- Overload
- Underfeed
- Control
Communicat.
- Informedness
- Social interaction
- Belonging
Access
- Accessibility
- Searchability
- Format
Quality
- Accuracy
- Relevance
- Importance
- Reliability
- Uniqueness
- Free from bias
Durability
- Archivability
- Movability
- Portability
- Traceability
- Original look
- Evidence
Usability
- Learnability
- Memorability
- Efficiency
- Effectiveness
- Errorproneness
Security
- Stability
- Validity
- Secrecy
Software
- Compatibility
- Saliency
- Availability
- Replacability
- Licensing
- Administration
Hardware
- Scalability
- Administration
- Performance
Cybernetics
- Filters
- Sensors
- Amplifyers
- Feedback
- Viability
- Req. variety
Model conf.
- VSM
- Living systems
- SSM
- ITIL
Systems prop.
- Efficacy
- Cultural feasab.
- Systemic desir.

Organization

The organization criteria are the criteria that will be found to be interesting from the point of view of the management and the sales department. These criteria describe how well the IS support organization's performance (as opposed to how well the technology or a specific individual performs).

The criteria in the organization category are divided into the topics "Performance" (Table I), "Control" (Table II) and "Economy" (Table III).

Individual

The individual criteria relate to the performance and satisfaction of individuals within the information system. The criteria within the individual category are divided into the topics "Emancipation" (Table IV), "Ergonomy" (Table V) and "Communication" (Table VI).

Information

The information category of criteria relate to the quality and access of information. It is divided into the topics "Access" (Table VII), "Quality" (Table VIII) and "Durability" (Table IX).

Technology

The technology criteria are all those criteria that relate to tangible artifacts that participate in distributing and managing information. Sometimes paired with use, this is what most literature will call “information system” or “information technology”. The technology category is divided into the topics "Usability" (Table X), "Security" (Table XI), "Software" (Table XII) and "Hardware" (Table XIII).

Systemics

The systemics criteria are related to a systems' point of view of the IS. These criteria study how well the IS conform to what can be said to be a good general system. The systemics category is divided into the topics "Cybernetics" (Table XIV), "Model conformance" (Table XV) and "Systems properties" (Table XVI).

Operationalization, implementation and usage

It is beyond the scope of this article to explicitly define how the criteria can be measured in practice. However, some general guidelines can be provided with the warning that they come from a theoretical discussion, and will most likely be changed in a later stage of the research process.

Formulation and measurement of criteria

The criteria listed in the tables are formulated in a generic manner. In most cases it is not obvious how they will be measured in practice. In future work, it is my intention to operationalize each criterion. To fulfill this, each criterion must in the end fulfill these qualities:

- Measurability
- Explicit definition
- Quantification
- Possible to validate

Measurability: The purpose with all the above is to be able to measure and compare information systems. Thus the criteria themselves will need to be measurable. The mode of the measurement is another discussion, but in the end it must be possible to assign a value to a criterion.

Explicit definition: In order to do so, the criteria must be defined and broken down into points of observation, where it is stated clearly what entity or phenomenon the observation points actually concern.

Quantification: While not strictly necessary, it is my belief that it is a good design goal to formulate the measurements of the points of observation in a quantitative manner.

Possible to validate: With the above three points, it should also be possible to evaluate how well a specific contribute to the overall quality of an information system. Criteria which can be shown to have no impact should be removed.

It is likely that each criterion will be broken down into a number of points of measurement which together will serve as the operationalization for the criterion.

Technological support for evaluation

One of the inspirations of this work has been prior work with simulations of information systems, see for example (Palmius J, 2005a) and (Palmius J, Egonsdotter G, Asproth V 2003). One of the previous problems was the lack of definite operationalizations of key variables for basing the simulation on. In the future, a functional set of criteria should be possible to reformulate into variables

for use in simulations. This is one intended technological implementation of the criteria model.

Another intended implementation is a software for registering and analyzing measurements. The intention is that this should mechanically be able to identify weaknesses based on registered observations of an information system, or a model of an information system.

Design and the temporal space for the evaluation

The criteria for evaluating an information system are formulated from the basis that there is an information system to evaluate. This implies that the evaluation is done post-hoc. However, if there is a good model of an intended information system, the evaluation could also be done pre-hoc.

It is my assumption that when the criteria are used, most of the evaluations in practice will be carried out on models of information systems anyhow, with some validation done through feedback from the participants in the information system.

Since a design of IS is usually conducted through model construction, one immediate use of the criteria list is that it can be used as a checklist during the design of a system. The designer, the customer and the users and compare sketches of the information system with the criteria model to see if there is something obvious missing.

Priority of criteria

The listed criteria are not ordered according to priority or weight. In final usage they must be, so that a person comparing two systems can have a good basis for choosing which criteria to include. Adding this priority now is beyond the scope of the article.

Discussion

The long term goal with the contents of the above article is to provide a basis for a quantitative model, a tool for measuring, comparing and possibly simulating information systems. Obviously, there is a lot left to be done before such a tool can be finished. First and foremost, the theories here presented must be put against empirics.

At this point in time, the set of criteria here are a theoretical construct which has not been tested against practice. This is a common problem with criteria-based models for evaluations of information systems. Even the most tested model, the DMSM, has been criticized for being largely untested empirically more than a decade after its conception (Iivari J, 2005). Still, the empirical tests that have been conducted have indicated usefulness rather than hinting against it.

My extended set of criteria does of course need to be put against an empirical reality. Until this is done, they can at the most be accepted as an inspiration or a list of things to consider when investigating information systems.

One critique which has been raised against the research in this article is that even DMSM is bloated and too large to be practically useful. Thus, writing a list of criteria more than twice as large is the wrong way to go. I can sympathize with this critique. However, in order to build a functional tool, I still feel that the right way to go is through finding all the criteria one can find, and then reduce them. The criteria list presented above is not a finished tool; rather it is intended as a step towards such a tool.

Somewhat related to the previous critique is the comment that to undertake a project to build a model such as this is very, very ambitious. Probably too ambitious. This completely true, and I do not claim that this model could easily be finished. In the following years, what I can address myself will be the model as such, and validation of sections of it. There is no way that I can myself complete this whole model, operationalize it and test it against empirics. I invite other people to join in on the discussion and expand and test the parts of the model they find interesting.

Another valid critique is that no heed has been taken to interdependencies between criteria. A factor analysis of a case scenario would likely show that several criteria really are indicators of the same hidden variable. Again, I sympathize with this critique, and again I will say that it is too early to make such an analysis. Before having done an initial sorting based on empirical results, it would be overkill to gather enough data to do a factor analysis.

Further critique says that no heed has been taken to the fact that the criteria are not equal. They are not equally important, and describe so different things that they, so to say, describe "apples and pears". The first part of this critique I agree with, with the second I do not. It is true that some criteria describe mission critical qualities while others describe peripheral details. I do not claim otherwise. I do however claim that the prioritizing of criteria must be done on a later stage and on a case-by-case basis. The model will eventually have to be amended with a support for how to do conduct such a prioritizing. For the apples-and-pears critique I simply do not agree it is a problem. An information system is a complex thing. The measurements for describing it cannot be expected to be uniform, and it is not desirable that they be.

Finally, it has been asked if this whole discussion cannot be broken down to what was specified as requirements for a system, and whether the end system fulfilled those requirements. This may be so. However, in order to write the specification, one needs criteria for the evaluation of the information system. The specification must come from somewhere: The criteria model comes before the specification.

Summary and conclusions

Several criteria models for evaluating information systems exist today. However, they all share the problem of being focusing at a subset of the information system. Further, most share the problem of having had very little exposure to real-world testing.

By combining criteria from several publicly available sources, it is possible to make a more general and holistic criteria model. These sources may not always have been intended to focus on IS evaluations, but through minor reformulations they can be made to fit.

At this stage, the criteria model exists, but is empirically untested. Further work will have to determine the validity of the respective criteria, and aspects such as criteria interdependencies.

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Appendix A - Criteria Tables

Organization

Table I: Organization / Performance

Performance	
Transmission	How efficient (as in speed) the information distribution is within the organization
Failrate	How often a failure (lost information, corruption..) occurs
Congestion	How often information heaps up in one place (information overflow, overfeed)
Underfeed	How often segments of the organization has to be idle due to lack of information

Literature: Transmission (Shannon C, 1948), Failrate (Shannon C, 1948), Congestion (Palmius J, 2005), Underfeed (Palmius J, 2005). (note that Shannon used the terms channel and noise, and that the reformulations might not exactly fit the original meaning).

Table II: Organization / Control

Control	
Knowledge mgmt	How well the information is stored in the organization rather than dependent on specific individuals
Overview	How salient the information channels are
Flexibility	How easy it is to modify the system to upcoming needs
Managability	How well the system supports management of the organization (order propagation)
Dec. Speed	How quickly decisions can be taken
Dec. accuracy	How often decisions are wrong or inaccurate

Literature: Flexibility (Irani Z, 2002), Managability (Torkzadeh G, Doll W, 1999), Decision speed (DeLone W, McLean E, 1992), Decision Accuracy (DeLone W, McLean E, 1992)

Not in literature: Knowledge management (rather, I have not picked any specific reference for this, it is a large field), Overview.

Table III: Organization / Economy

Economy	
ROI	Return on investment
Competitiveness	Does the information system make the organization more able to compete with the environment
Cust. satisfaction	Are external customers happy?
Productivity	Does the system support production in a satisfactory fashion?

Literature: ROI (DeLone W, McLean E, 1992), Competitiveness (Irani Z, 2002), customer satisfaction (Torkzadeh G, Doll W, 1999), productivity (Torkzadeh G, Doll W, 1999)

Individual

Table IV: Individual / Emancipation

Emancipation	
Satisfaction	Is the individual satisfied with the information system
Democracy	Can the individual make his voice heard publicly
Influence	Can the individual influence his own situation through the system
Learning	Is the individual given the opportunity to develop skills and understanding through the system

Literature: Learning (DeLone W, McLean E, 1992)

Not in literature: Satisfaction, democracy, influence

Table V: Individual / Ergonomy

Ergonomy	
Stress	Does the IS contribute to stressing the individual (for example through being difficult to manage)
Overload	How often does the IS provide too much information
Underfeed	How often does the IS provide too little information
Control	Can the individual configure his role and the technology in the IS to fit his own needs

Literature: Overload (Palmius J, 2005b), Underfeed (Palmius J, 2005b)

Not in literature: Stress, control

Table VI: Individual / Communication

Communication	
Informedness	Is the individual informed about the things he needs to know about in the organization
Social interaction	Does the IS provide support for the individual's need for interacting with other people
Social belonging	Does the IS support a sense of belonging

Literature: informedness (DeLone W, McLean E, 1992)

Not in literature: social interaction, social belonging

Information

Table VII: Information / Access

Access	
Accessibility	Is the information within the IS easy to reach?
Searchability	Is it easy to find a specific desired piece of information?
Format	Is the information within the IS available in an appropriate format

Literature: Accessibility (Borglund E, 2005), Searchability (Borglund E, 2005), format (DeLone W, McLean E, 1992)

Table VIII: Information / Quality

Quality	
Accuracy	How accurate is the information within the IS
Relevance	How relevant is the information within the IS
Importance	How important is the information within the IS
Reliability	How reliable (repeatable, stable) is the information within the IS
Uniqueness	How often does redundant information flow in the IS
Free from bias	How objective is the information (ie, how often has it passed through interpretations)

Literature: accuracy (DeLone W, McLean E, 1992), Relevance (DeLone W, McLean E, 1992), Importance (DeLone W, McLean E, 1992), Reliability (DeLone W, McLean E, 1992), uniqueness (DeLone W, McLean E, 1992), free from bias (DeLone W, McLean E, 1992)

Table IX: Information / Durability

Durability	
Archivability	How well information in the IS is fit to be stored in an archive
Movability	How easy it is to move archived information
Portability	How easy it is to transfer archived information to another system
Traceability	How well the archived information supports tracing its origins and context
Original look	How close to the original look the archived information has (ie was it changed significantly when archived?)
Evidence	How well does the archived information support proving that something has happened

Literature: Archivability (Borglund E, 2005), Archivability (Borglund E, 2005), Movability (Borglund E, 2005), Portability (Borglund E, 2005), Traceability (Borglund E, 2005), Original look (Borglund E, 2005), Evidence (Borglund E, Öberg LM, 2006).

Technology

Table X: Technology / Usability

Usability	
Learnability	How easy is it for a new user to understand how to act in the system
Memorability	How easy is it for an experienced user to remember how to act in the system
Efficiency	How much energy does a user need to put into the system to produce a desired result
Effectiveness	How well does the system support solving the problems of a user
Errorproneness	How often does confusion within the system cause user error

Literature: Learnability (Nielssen J, 1993), Memorability (Nielssen J, 1993), Efficiency (Nielssen J, 1993), Effectiveness (Nielssen J, 1993), Errorproneness (Nielssen J, 1993)

Table XI: Technology / Security

Security	
Stability	How stable is the system in the sense of in what rate it breaks down and becomes inaccessible or loses data
Validity	To what extend does the system ensure that information within it is correct (for example not tampered with)
Secrecy	How well does the system protect information from being seen by outsiders

Literature: Stability (Irani Z, 2002), validity (Finne A, 2005)

Not in literature: Secrecy

Table XII: Technology / Software

Software	
Compatibility	How easy it is to move information between different parts of the system
Saliency	How easy it is to understand the software structure (for an administrator)
Availability	How easy it is to acquire the software (and its upgrades)
Replacability	How easy it is to replace parts of the system with new parts (for example other software products)
Licensing	To what extent licensing issues hinders the administrator from doing what he wants with the system
Administration	How easy it is for an administrator to manage the system

Literature: Compatibility (Finne A, 2005), replacability (Finne A, 2005)

Not in literature: Saliency, availability, licensing, administration

Table XIII: Technology / Hardware

Hardware	
Scalability	How well the hardware can be thought to support future needs
Administration	How easy it is to manage the hardware
Performance	How well the hardware supports the current needs of the system

Not in literature: Scalability, administration, performance

Systemics

Table XIV: Systemics / Cybernetics

Cybernetics	
Filters	How well divisions between parts of the IS works (forwards relevant information and only that)
Sensors	How well the IS is able to collect information about itself and the environment
Amplifiers	How well parts of the IS is able to stress important information so it gets noted
Feedback	How easy it is to see the effect of an output so that further output can be adjusted.
Viability	How well the IS supports the survival of the host system
Requisite variety	How well the IS is able to manage incoming inputs from the host system and the environment.

Literature: Filters (Flood R, Carson E, 1993), sensors (Flood R, Carson E, 1993), amplifiers (Flood R, Carson E, 1993), feedback (Flood R, Carson E, 1993), viability (Flood R, Carson E, 1993), requisite variety (Flood R, Carson E, 1993)

Table XV: Systemics / Model conformance

Performance	
VSM	How well does the IS fit the idea of how VSM thinks a system should look
Living systems	How well does the IS fit the idea of how living systems thinks a system should look
SSM	How well does the IS fit the idea of how SSM thinks a system should look
ITIL	How well does the IS fit the idea of how ITIL thinks a system should look

Literature: VSM (Espejo R, Harnden R, 1996), Living Systems (Miller JG, 1978), SSM (Checkland P, Scholes J, 1997), ITIL (IT Library, 2007)

Table XVI: Systems / System properties

Systems prop.	
Efficacy	Does the IS actually solve the problem it was intended to solve
Cult. Feasibility	Does the current setup of the IS fit how persons in the organization think how things should be
Syst. Desirability	From an expert point of view, is the system constructed in what is usually thought a good manner?

Literature: Cultural feasibility (Checkland P, Scholes J, 1997), systemic desirability (Checkland P, Scholes J, 1997)

Not in literature: efficacy