Evaluating
Health Information Systems

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Version 2

Contents

1. Before you start

1.1 Prerequisites

This chapter assumes that you have the following knowledge and skills:

1. **Knowledge of information systems** - "Types of Health information systems" at http://www.robin-beaumont.co.uk/virtualclassroom/chap12/s2/systems1.pdf
2. **Knowledge of systems development methods** - "Information systems development methods" at http://www.robin-beaumont.co.uk/virtualclassroom/chap12/s3/view.html
3. **Knowledge of Obtaining requirements - Engineering (Quantitative) perspective** at: http://www.robin-beaumont.co.uk/virtualclassroom/chap5/s5/requirements_quant/view.html
4. **Knowledge of Obtaining requirements - Qualitative perspective at:** http://www.robin-beaumont.co.uk/virtualclassroom/chap5/s5/requirements_qual/view.html
5. **Knowledge of Getting Clinicians / Users Involved in developing Information Systems** at: http://www.robin-beaumont.co.uk/virtualclassroom/chap12/s4/view.html

2. Learning outcomes

This chapter aims to provide you with the following skills and information. After you have completed it you should come back to these points, ticking off those with which you feel happy.

Learning outcome	Tick box
Be able to discuss the historical context of Information Systems Evaluation	❑
Be able to list the five categories of failure suggested by Flowers 1996	❑
Be able to discuss the various times when evaluation might occur in different Systems development Lifecycles	❑
Be able to discuss the arguable difference between 'research' and evaluation.	❑
Be able to discuss the distinction between philosophical, methodological and techniques used in Qualitative and Quantitative research	❑
Be able to suggest what key factors to consider when evaluating an Information System.	❑
Be able to mention various validated questionnaires such as Bailey's 1990 User Satisfaction one.	❑
Be able to discuss Shakel's(1990) components of Usability	❑
Be able to discuss the 'toolbag' approach to Information systems evaluation	❑
Be able to discuss Evaluation planning activity, including questionnaire development /analysis	❑
Be able to discuss Evaluation planning activity, including questionnaire development /analysis	❑
Be able to discuss the similarities and differences that exist between evaluation and the process of obtaining requirements in Information Systems development methods.	❑

3. Why evaluate - The History of failure

There is a clear paradox when it comes to considering Information systems evaluation; this is best described by considering two questions. Firstly one may ask the simple question, should one evaluate computer systems? To which most people would answer yes, however, if you were to change this to; Should one evaluate *your* computer system? Most would say no as most people tend to have some type of loyalty towards their system.

This is the problem: **Most computer systems fail**

Much empirical research backs up this statement, here are a few facts:

- Hospitals use less than one quarter of the abilities built into their computer systems. Gardner 1990 Survey of 620 Hospitals.
- 45% of randomly selected hospitals (n=40) had failed information systems because of user resistance and staff interference despite the fact that they were technologically sound. Dowling 1980. (Anderson, Aydin and Jay 1994, p6).
- 50% of Information systems fail possibly due to technical problems , data content and format, user problems related to skills, competence and motivation; and organisational problems. Lyytinen (1988) and Lyytinen & Hirschheim (1987). (Anderson, Aydin and Jay 1994, p6).
- Empirical study using path analysis demonstrated that user involvement in the development of information systems will enhance both user satisfaction and produce greater usage. (Baroudi, Olson & Ives 1986). But user involvement is rarely considered.

There is also a steady stream of books about this topic:

A plotted history of books about Information Systems failure

2006 - Gauld R, Goldfinch S. Dangerous Enthusiasms: E-Government, Computer Failure and Information Systems Development Otago University Press

2005 - Friedman C P Wyatt J C. (2Rev Ed) Evaluation Methods in Biomedical Informatics (Health Informatics). Springer-Verlag

2003 - Ewusi-Mensah K. Software Development Failures. The MIT Press

2002 - Evan W M, Manion M. Minding the Machines: Preventing Technological Disasters. Prentice Hall

1998 - McDaniel H. Computer Snafus: Crashes, Erros, Failures, Foul-Up, Goofs, Glitches, and Other Malfunctions That Cause Computers to Go Awry. Chicora Publishing

1998 - Glass R A. Computing Calamities: Lessons Learned From Products, Projects, and Companies that Failed. Prentice Hall

1997 - Glass R A. Software Runaways: Lessons Learned from Massive Software Project Failures. Prentice Hall

1997 - Friedman C P Wyatt J C Evaluation Methods in Medical Informatics. Springer

1996 - Flowers S. Software Failure: Management Failure: Amazing Stories and Cautionary Tales: Management Failure: John Wiley & Sons

1993 - Sauer C. Why Informations Systems fail: A case study Approach.

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1975 - Lucas C H. Why Information Systems fail. Columbia University Press.

Pergamon

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0268-4012/97 $17 00 + 0 00

Reviews

Software Failure: Management Failure. Amazing Stories and Cautionary Tales
S. Flowers
Wiley, Chichester, New York, (1996)
197 pp £19.99 ISBN 0 171-95113-7

As long ago as 1975 Henry Lucas wrote a book called, *Why Information Systems Fail*[1] but it seems that it takes a long time for us to learn the lessons, hence this book, which looks at specific cases of information systems failure, mainly in the UK.

Flowers has embarked upon a task similar to that which Lucas set himself, but with the advantage of many more years in which systems failed, failed at enormous expense, and failed, in some cases, catastrophically. Readers in the UK will be familiar with such disasters as the London Ambulance Service's computerized despatch system, which after a week of intermittent use:

> . . slowed down and then locked up altogether. Attempts to reboot the system failed to correct the problem and, when the backup system failed to cut-in, the control room staff had no alternative but to revert to a fully manual paper-based system. (p 4)

and with the case of the Wessex Regional Information Systems Plan, which failed after spending at least £43 million and which became a national scandal that has probably put back the development of effective information systems in the National Health Service for a decade, since everyone is now terrified of becoming 'another Wessex'.

However, entertaining though these stories of failure may be, Flowers's purpose is more serious: it is to derive from the failures some general understanding of why information systems fail. In the final chapter he develops the concept of critical failure factors and shows, quite conclusively, that there is more to failure than systems failure: indeed, that the causes of failure lie as much with failures of management and project direction as with the software.

His categorization of factors can be set out simply:

- The organizational context
  hostile culture
  poor reporting structures
- The management of the project
  over-commitment; i.e. becoming committed to the success of the project to the extent that it is impossible for a manager to remain impartial to the outcome
- Throwing good money after bad
- Political pressures
  influential outsiders
  internal power struggles
  external power struggles
- Conduct of the project
  initiation phase: technology-focused developments; the lure of the leading edge; and underestimating complexity;
  analysis and design phase: poor consultation; design by committee; technical 'fix' for a management problem; and poor procurement;
  development phase: staff turnover; competency, and split sites
  implementation phase: receding deadlines, and testing and training.

There is nothing here that the designers of systems have not been aware of for decades, and yet the mistakes continue to be made. Why? A number of factors appear to interact in allowing failure to recur:

(1) senior management's lack of understanding not only of the technology but also of the general systemic nature of their organizations — the lesson that technological change means organizational change and cultural change is difficult to learn;
(2) the pressure of time, particularly in public sector organizations, where spending the money before the end of the financial year can result in too little attention to project definition and control;
(3) a failure to begin the process of systems definition with an organization-wide participative process of defining the needs, identifying the existing systems and their problems, and preparing staff (and management) for change;
(4) a failure to invest in planning the project within the organization, and buying a 'solution' instead.

I have been working recently with two public sector organizations that are trying to overcome these problems and, at the very least, the methods employed, training workshops, participative needs definition, for example, can reveal the complexity of the issues to senior management and encourage a cautious approach to systems development. Cautious means slow, but better a slow and successful implementation than a quick fix that fails.

Professor Tom Wilson
University of Sheffield
UK

[1] LUCAS, H C *Why Information Systems Fail.* Columbia University Press New York, 1975

Exercise 1. IMPORTANT

1. Looking at the above abstract consider what the reviewer lists as the factors that cause failure, do you think any of them have been responsible for Information Systems failures in your organisation (particularly the NHS).
2. Visit the EFMI Working Group for Assessment of Health Information Systems at http://iig.umit.at/efmi/ and look at a few of the cases on the *Bad Health Informatics Can Kill* page and also investigate some of the links.

4. When to Evaluate?

This is related to the particular information system development method chosen discussed in a previous chapter, listed in the prerequisites section.

For example the traditional waterfall approach might end with a post implementation review (**PIR**) which could be considered to be a type of small scale evaluation. In contrast when using a iterative prototyping approach evaluation, in the form of a review, would occur at the end of each cycle. Finally with Agile development techniques the relationship becomes more complex as it relies upon which flavour of Agile development you are using. So for eXtreme programming you would have user(s) one site with the developers/ programmers and they would literally be sitting beside them reviewing literally every line of code. Alternatively if the Crystal approach were adopted **reflective meetings** and **user viewings** would be used.

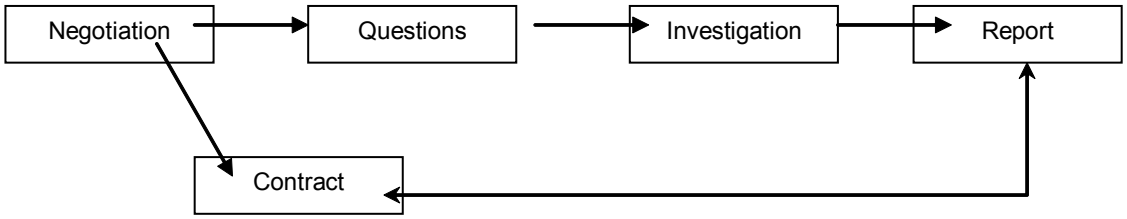
5. Is Evaluation different from Research?

Some consider it different from pure 'scientific inquiry' (Anderson, Aydin and Jay 1994, p8):

"Although both use the same logic of inquiry and research procedures, scientific studies focus primarily on meeting specific research standards. Although scientific rigor is important in evaluation studies as well, evaluation research must also recognise the interests of organisational stakeholders and be conducted in a way that is most useful to decision makers. Although evaluation studies may strive to meet the criteria for scientific rigor, the primary purpose of evaluation research is to provide information to organisation stakeholders and decision makers (Rossi & Freeman 1985)". (p8).

Friedman & Wyatt 1997 p20 provide several definitions of evaluation along with an evaluation lifecycle:

Evaluation Process Friedman & Wyatt 1997 p20



5.1 Qualitative Research

I should state at the beginning that I have a great affinity towards the quantitative approach, so the following may be somewhat biased.

The commonly held division between qualitative (subjectivist/Interpretist approach to reality) and quantitative (objectivist/realist approach to reality) research is problematic. Most research involves elements from both approaches. Qualitative research can involve the use of numbers (Robson 1993 chapter 12 although this approach is questionable see Macnaughton 1996) and quantitative research may involve a preliminary qualitative phase to inform the data collection process, provide information concerning operationalisation of concepts and get a feeling for the research area.

While some would argue that evaluation of IS's should be more qualitative (Klein & Lyytinen 1985) who also provide a detailed argument against quantitative research others suggest that both qualitative and quantitative methods should be used in an evaluation (Kaplan 1988, Anderson, Aydin & Jay 1994).

Kaplan 1988 argues that qualitative research allows the collection of contextual information quoting Cook & Campbell's seminal book on behavioural research methods, "Field experimentation should always include qualitative research to describe and illuminate the context and conditions under which research is conducted" (Cook & Campbell 1979 p93). The qualitative faction argues that their aim is to provide deeper understanding on an individual (i.e. case study) basis. Often the outcome of a qualitative study is a new interesting area of research that requires further (i.e. quantitative) study to ascertain its prevalence, generality and reproducibility etc.

Others argue that the deliberate lack of generalisability in qualitative research means that results from such research are inappropriate for formulating policy. This is because the qualitative methodology deliberately does not use a framework which would allow valid hypothesis testing and inference from a sample to a population.

That is the techniques associated with quantitative research (i.e. randomisation, sampling, blinding, data analysis techniques etc) focus on making the understanding gained from the research applicable to other similar samples. Whereas In the qualitative paradigm the understanding gained is "more akin to the understanding gained from an art, rather than from science. This does not mean that it is an inferior kind of understanding, but it does mean that it is different: it requires active participation from the reader to identify with the situation and relate the findings to his own situation" (Macnaughton 1996)

There is often confusion between a research **technique** / **tool** such as a questionnaire, interview, diary etc and a research **philosophical approach** (qualitative / quantitative). Most techniques can be adapted so they may be used in both philosophical approaches. For example, an interview (a research tool) can range from being very structured using pre-defined questions, such as in the general household survey (quantitative), to being unstructured attempting to "discover the interviewee's own framework of meanings." [where] "The researcher needs to remain open to the possibility that the concepts and variables that emerge may be very different from those that might have been predicted at the outset." (Britton 1995). Unstructured interviews being one of the most common qualitative techniques used.

Many people argue that the qualitative approach to research is not used because of the prevalent scientific paradigm which diminishes the value of it (Klein & Lyytinen 1985). However it must be remembered that the scientific paradigm was the driving force behind the 'enlightenment' and few people would be happy to revert back to times past. Neither can the qualitative approach be considered to offer an alternative to the quantitative, for, by qualitative practitioners own admission, offers no strategy for generalisability. Qualitative research therefore should be seen as an adjunct / supplemental activity where, if at all possible, the results of which should be verified using quantitative techniques.

Frequently the qualitative approach is taken for ease. For example there might be insufficient subjects in the sample for a quantitative approach, or the researcher believes that a qualitative approach will produce more appropriate data if a few subjects are interviewed 'in depth'. I however, would argue that a structured interview using a properly constructed / validated questionnaire - possibly partly based upon the findings from some exploratory interviews, would produce more 'in depth' useful information and offer the possibility of generalisability and hence useful for informing policy.

Unfortunately for qualitative research it is often carried out by people who know little of research methods of any type, ending up with a real hotchpotch. A common scenario is a researcher carrying out a number of in depth interviews and then deciding afterwards to convert the information obtained into a more quantitative format. They discover particular themes (which are now statistics) and decide to make generalisations (a concept antagonistic to the qualitative paradigm) or suggest that if the sample had been larger generalisation (irrelevant in the qualitative paradigm) would have been possible. This demonstrates very clearly how little people frequently understand when carrying out research. Examples of this type of mis-directed research abound. One concerned with nurses attitudes towards the use of computers is (Reeve & Wheeler 1995).

There is also excellent qualitative research which provides deep, and often moving insight into complex issues, a classic in this field, is the book, Asylums by Irving Gofman which describes the process of institutionalisation.

For more information about the differences and misunderstandings that exist between qualitative and quantitative research see: http://www.robin-beaumont.co.uk/virtualclassroom/chap5/s5/comm_theories/view.html

The rest of this handout will focus on Quantitative methods.

6. What to Evaluate in Information Systems?

"Although evaluation studies may not specify an explicit paradigm or theoretical framework, underlying and often unconscious assumptions about models of change may influence both the questions selected for study and the accompanying research strategies (Kaplan 1991). Different assumptions will lead researchers to ask different questions and focus on different outcomes to the computer implementation process. Thus it is important that evaluation researchers also recognise the influence of their own and the organisation stakeholders' underlying assumptions about change in selecting specific questions for investigation." (Anderson, Aydin & Jay, p9)

You can evaluate any or all of the following (Anderson, Aydin & Jay, p7):

- External environment of the organisation
- Internal environment of the organisation
- Information System Users
- Systems development environment and staff
- Management and operational environment of the system
- The nature of the system including the information processed
- Patterns of utilisation
- Organisational Impacts (direct or indirect, intended or unintended)
- Social Impacts (direct or indirect, intended or unintended)

(Ives, Hamilton and Davis 1980, Kreamer and Dutton 1991)

More recent papers investigates each of these aspects further. Such as an attempt is to develop a conceptual framework based on organisational tensions, for NHS systems evaluation by Connell & Young, 2007. For the analysis of healthcare specific evaluation problems as well as the use of 'constructive' evaluation which can be used as part of the systems development process see Brender, 2006. also with the development of networked systems these are also being evaluated (Nykänen & Karimaa, 2006). EHealth systems are also being evaluated (see: http://www.ehealth-impact.org/) although this will not be discussed further in this chapter.

Several other aspects such as the importance Mumford placed on what she called job enhancement for the success of Information Systems has been validated and extended, to include specific dimensions such as task productivity, task innovation, customer satisfaction, and management control (Torkzadeh; Koufteros & Doll, 2005)

Other studies have attempted to include financial/operational costs into the evaluation, such as the framework shown below (Byrd & Thrasher et al, 2006).

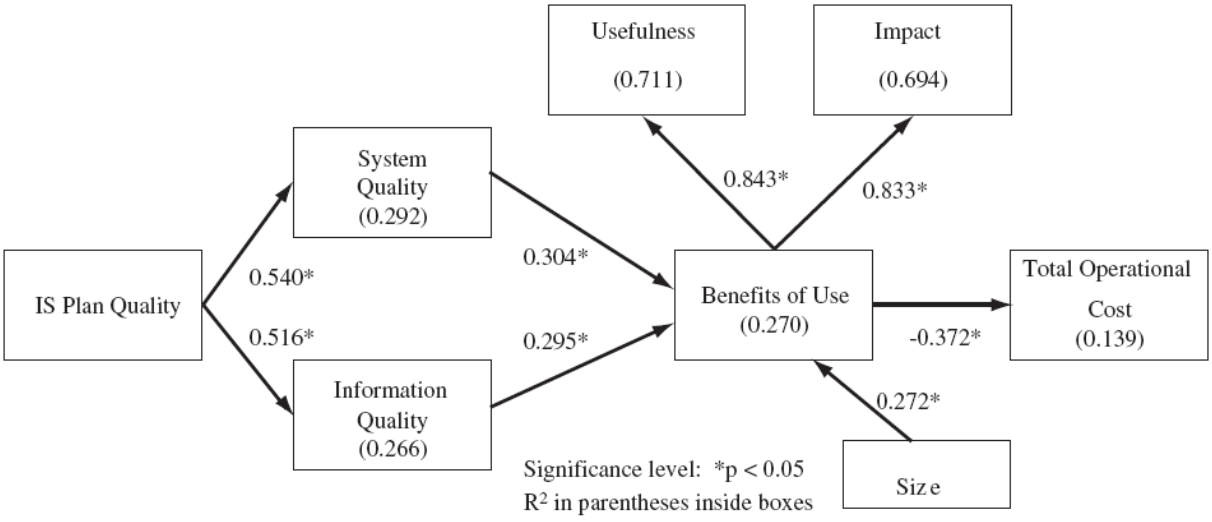
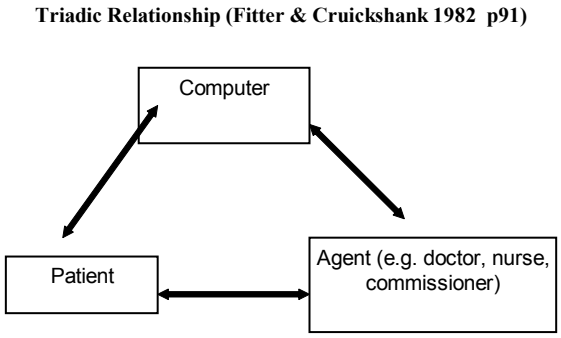


Fig. 2. Process model of information system success.

6.1 Triadic Relationship (Fitter & Cruickshank 1982)

Related to the above list is the idea of carrying out an evaluation from a number of different perspectives. Fitter & Cruickshank 1982 presented a psychological framework for analysing the computer in the consulting room and originated the term 'triadic relationship' (Fitter & Cruickshank 1982 p91) meaning the interaction between the doctor, patient and computer.



Each perspective in turn can then have a number of evaluation techniques applied to it.

Applying these three perspectives to the NHS Prodigy Project (1997) which was concerned with developing a prescribing aid for GPs in the UK:

1. Computer perspective:

- Log files - Each time the Prodigy module was accessed this was recorded automatically by the computer along with various other data such as the nature and outcome of the interaction.
- Laboratory testing - The systems were tested in a laboratory to see that various keystrokes produced the required result and the system performance was acceptable.

2. Patients perspective:

- A selection of patients were interviewed before and after consultations where Prodigy was used.

3. Agents (doctors) perspective:

- Doctors were given a number of questionnaires before /after the system was installed and also after any consultation where a patient was videoed. The questionnaires are available from here.
- Video Analysis (Quantitative) - Several doctors had their consultants videoed to analyse the triadic interaction.
- Focus groups (Qualitative) - allowed GPs to explore issues in more depth.

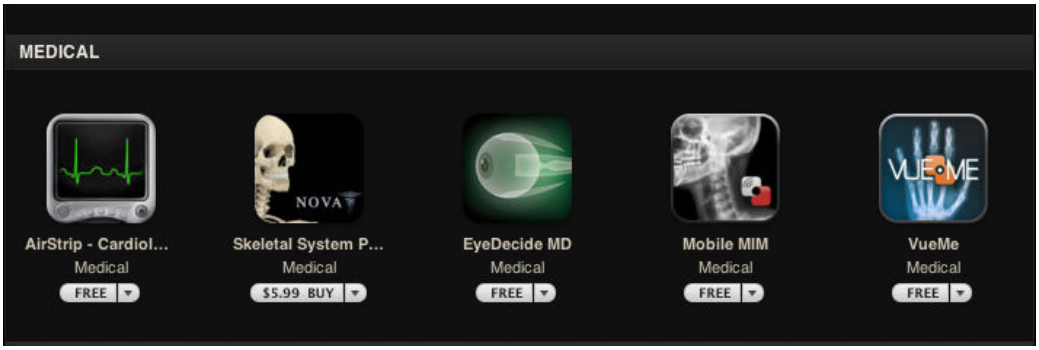
6.2 Complexity and mode of use

Evaluation of Information Systems usually involves assessing different types of users such as the novice and the expert. However with Health Information systems another level of complexity is introduced - the type of use.

Most GPs use their systems in a relatively simple way (i.e. patient registration and repeat prescribing) however a few use the computer for more complex 'decision support' activities. Similarly the system may be configured to produce audit reports and facilitate the production of the yearly report.

Other research has shown that doctors use the computer differently in the consultation. This needs to be taken into account when evaluating a Healthcare system as it would be unfair to assess a 'backend' system as if it were meant to work within the consultation. Other healthcare systems have been developed to work in particularly demanding environments such as operating theatres, Cardio-angiography laboratories and other areas where invasive investigations take place.

In recent years the development of personal Hand Held devices (PDA's) and wireless networks has facilitated the use of ambulatory information systems for both patients and clinicians. Since 2005 the development of the smart phone such as the iPhone and android, development of these 'apps' has gained further impetuous.



6.3 Operationalising fussy concepts

The process of operationalisation can be thought of simply as that of converting something that is immeasurable into something that is. For example it is not possible to measure IQ directly but it is possible to operationalise it by measuring, memory, motor co-ordination, comprehension etc.

Similarly it is necessary to quantify various concepts that are frequently used in everyday speech when evaluating Healthcare Information systems such as:

- Usability
- Ease of use
- Clarity
- Complexity
- Satisfaction
- Quality of output taken from Shackel (1990).

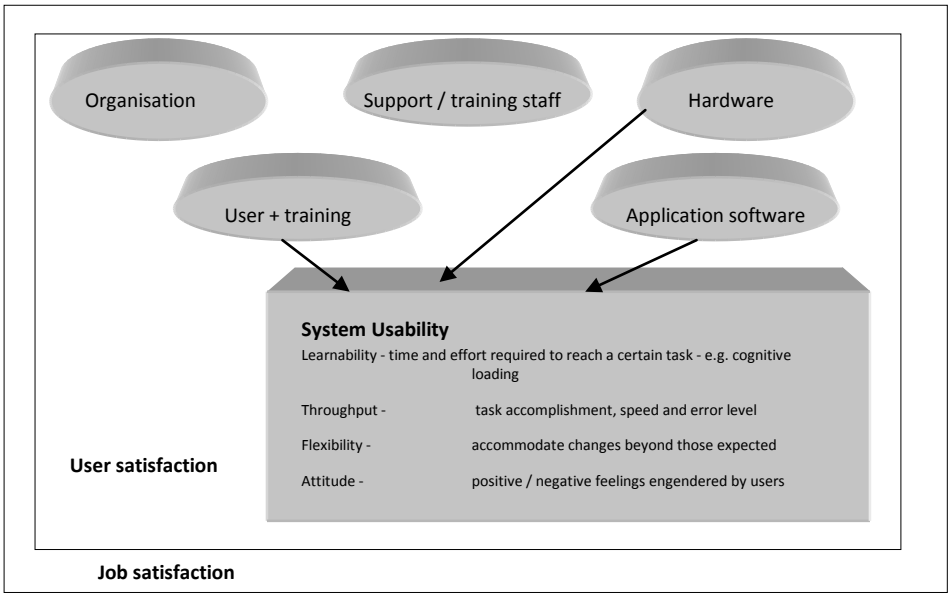
Each of these has been the subject of many investigations. Taking Usability, the various components were identified by Bennett (1984) and then operationalised by Shackel (1990). Details along with references can be found in Preece 1994 p.401. Usability is thought to consist of four aspects:

- Learnability - time and effort required to reach a certain TASK - e.g. cognitive loading
- Throughput - task accomplishment by experienced users speed + error level
- Flexibility - accommodate change beyond that expected
- Attitude - positive feel engendered by users by a system

Exercise 2. usability

1. One of the most prolific and web aware writers on the topic of usability is Jakob Nielsen, visit his usability site at http://www.useit.com/alertbox/20030825.html
2. Another important writer on usability is Ben Shneiderman his book is considered the bible in most university courses on computer usability. He has also developed the concept of **universal usability** - see: http://en.wikipedia.org/wiki/Ben_Shneiderman and http://en.wikipedia.org/wiki/Universal_usability

The diagram below suggests the possible relationship between the various above concepts.



Taken from: Beaumont R 1999 Review of Ergonomic assessment of CRAMS by John Dowell et al 1999 Internal report for the Home Office. Available online: http://www.robin-beaumont.co.uk/probation/assess1.pdf We will revisit this idea of how the various variables are related when we look at the Delone/Mclean model in a few pages.

6.4 User satisfaction

There are numerous Information Systems satisfaction questionnaires around, however few have been developed in any rigorous way or undergone formal evaluation (LaLomia & Sidowski 1991, Anderson, Aydin and Jay 1994 provides a range of such questionnaires). One which is frequently used/cited is that of Bailey 1990.

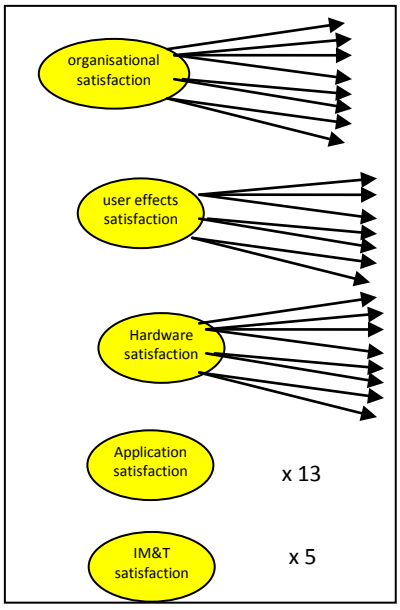
Bailey developed the questionnaire from previous research and developed a 40 variables model and then grouped then together into five areas of **satisfaction** (Organisational, Hardware, Application software, User effects and Information Systems staff):

Organisational satisfaction:

- HIS policies in hospital
- Administrative involvement
- Your control over system
- Goal congruence with HIS
- Rerun policy
- Power of HIS in hospital
- Payment policy for HIS
- Competition with HIS

Hardware system satisfaction:

- Flexibility of system
- Time - to - process changes
- Integration of system
- Capabilities of system
- Ease of introduction of system
- Vendor support
- Documentation
- Security of data



Application software satisfaction:

- Ease of use . . . .- Usability - See discussion above
- Timeliness of output
- Completeness of output
- Accuracy of output
- Form of output
- Relevancy of output
- Reliability of output
- Volume of output
- Convenience of output
- Procedure of input / output (the above output factors are often considered to represent 'data quality'
- Currency of data
- Value of output
- Terminal response time

User effects satisfaction:

- Your training with system
- Effects on your job
- Your participation in Hospital Information System (HIS)
- Computer saves you time
- Need for the system
- Confidence in system
- Understanding of system

Information Management & Training (IM&T) staff satisfaction (with them):

- Relationship to HIS staff
- Personal skills of HIS staff
- Technical skills of HIS staff
- Attitude of HIS staff
- Healthcare knowledge of HIS staff

6.4.1 Factor analysis

This is a statistical technique which is classed as a 'data reduction' technique which means that you basically start off with a large number of variables which after the procedure is often reduced removing those variables that are merely double counting (i.e. have a correlation above a certain level).

The technique also has a second purpose it also suggests how the original variables (or a subset of them) can be organised into various categories, often in psychological research each of these categories is called a **construct** or **factor** and each of the original variables is called a manifest variable**.** [Unfortunately in the older literature such **as** Bailey 1990 the term factor is used to refer to the manifest variables as well].

So in the above example we can say that the **user effects satisfaction construct** is measured by **seven** manifest variables.

6.5 The Delone/Mclean model

The above research attempted to described a set of 'constructs' by measuring a number of variables using a questionnaire and the relationship between these variables was considered to be fairly simple, see the diagram on the previous page. However, in contrast Delone and Mclean (Seddon & Kiew, 1996; Petter & McLean, 2009) suggested a complex interplay between several variables, such a model is called a structural model and we have come across it before in the chapter "getting the users involved" in the stakeholders and users section. Below is both the original model and how Delone & McLean updated it some years later. The important thing to realise is that while the various associations depicted by the arrow representing statistically significant correlations, they are often interpreted as causal paths, which is a very different thing.

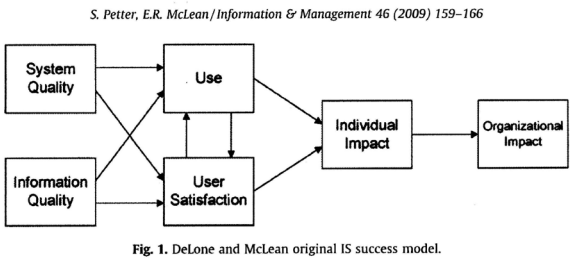


Fig. 1. DeLone and McLean original IS success model.

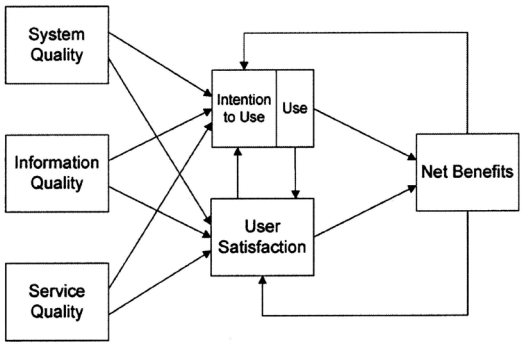


Fig. 2. DeLone and McLean updated IS success model.

Petter & McLean, 2009 carried out a meta-analysis of various papers that had evaluated the above models aggregating the results of 52 empirical studies, they considered each of the various pathways in terms and produced a series of tables indicating which were found to have strong/moderate or weak associations in reality, one such table is given below.

Table 5 taken from Petter & McLean 2009 p164
Magnitude of relationships.

Relationship strength	Meta-analysis	Total *N*	*K*	*p*
Strong	H8: User Satisfaction and Intention to Use	2245	9	0.74
	H11: Net Benefits and Intention to Use	3335	14	0.63
	H2:System Quality and User Satisfaction	3653	17	0.60
	H10: User Satisfaction and Net Benefits	6030	31	0.58
	H4:Information Quality and User Satisfaction	2136	10	0.58
	H3:Information Quality and Intention to Use	1312	5	0.56
	H1: System Quality and Intention to Use	2864	12	0.54
Moderate	H13: Information Quality and Use	897	7	0.49
	H9: Use and Individual Impact	4416	26	0.39
	H12:System Quality and Use	2408	15	0.34
Weak	H7: Use and User Satisfaction	5231	26	0.28
Not significant	H6:Service Quality and User Satisfaction	366	3	0.24
	H14:Service Quality and Use	448	4	0.09
Not tested	HI2e:Service Quality and Intention to Use		na	

Total *N*- total sample size for the given meta-analysis; *K*- number of studies included in the meta-analysis; *p*-effect size corrected for reliability.

Exercise 3. Relationships between Delone & McLean variables

Considering both the updated IS success model and also the table of correlations on the previous page redraw the diagram using red for strong relationships, green for moderate ones and yellow for weak ones, remove all others.

Please not that the '*p*' value provided in the last column of the table on the previous page is not the same as a P value it is basically a correlation value that have been adjusted for sample size. the relationship between the two can be seem in table (p.163) of Petter & Mclean 2009

Do you think that this diagram makes more sense than the original one?

Consider the diagram on page 8 giving information from the Byrd & Thrasher et al, 2006 paper how different is this from your final model?

7. How to Evaluate

It is also possible to consider evaluation as a tool bag with a set of qualitative and quantitative techniques:

Quantitative Techniques	Qualitative Techniques
Questionnaires: **Users (may be multiple groups)** **Patients**	Focus Groups ('Co-operative evaluation' Preece p.662)
Computer activity logs	Storyboarding ('participative evaluation' Preece p.663)
Laboratory testing	Diaries
Cognitive Walk-throughs	Histories / biographies
	Case studies
	Video
	Ethnography - 'Intensive observation, participation in cultural activities, watching learning. Immersion in the field situation including belief system, ritual etc.etc
	Critical Incident analysis

As I said before I believe that the focus of any evaluation should be on Quantitative techniques to give it validity and provide findings robust enough to provide the basis for decision making and questionnaires are by far the most common technique however there are others who disagree with this approach and advice a more pluralistic approach such as Kaplan, 2001b.

The previous sections have described the various aspects of evaluation and how they might be measured describing authors of various validated questionnaires. Additionally you can find several questionnaires at: http://www.ucalgary.ca/~newsted/constructs.htm also the chapter *Getting users involved* section 13.2.1 Contract negotiation and standards setting has relevant information http://www.robin-beaumont.co.uk/virtualclassroom/chap12/s4/view.html

Berry & Hart 1990 provide a clear article discussing the evaluation of system usability in terms of expert systems and Kaplan 2001 a more recent review of clinical decision support system evaluations.

For an example of an activity log report see http://www.robin-beaumont.co.uk/virtualclassroom/chap13/default.htm

7.1 Planning

Obviously any formal evaluation needs to be planned using standard project management techniques, also if specific logs are to be generated from the software these need to be specified, written into the software and tested. Similarly if questionnaires are to be used, even though it is desirable to use validated invariably the questionnaires they will need piloting and adapting to local needs.

For a description of the questionnaire development process including the development of appropriately worded questions, see section 14 at the main site: http://www.robin-beaumont.co.uk/virtualclassroom/contents.html.

Exercise 4.

Consider the department / area in which you work and draw up an evaluation plan for one of the Information Systems.

8. Evaluation meets requirements Elucidation

Possibly you will have realised by now that actually evaluation is a process which is similar in several ways to requirements elucidation. Scan, once again, through the following three chapters and I think you will be convinced:

Obtaining requirements - Engineering (Quantitative) perspective

Knowledge of Obtaining requirements - Qualitative perspective

Getting Clinicians / Users Involved in developing Information Systems

Exercise 5.

I would like you to develop table to compare the activities that you can undertake when obtaining requirements and also when evaluating a system. Give the table three headings; activity/tool, how used in requirements, how used in evaluation. Fill in the table, adapting it as necessary.

9. Do health information systems actually offer any benefits?

It may be assumed that the answer to this question must be an affirmative yes, however various evaluations when taking into account the 'costs' incurred as well have found the results much more questionable. Quoting Ludwick & Doucette J 2009 concerning the implementation of GP systems in seven countries:

The review showed that quality of care, patient safety and provider/patient relations were not, positively or negatively, affected by systems implementation. The fact that no articles were found reviewing the benefits or drawbacks of health information systems accruing to patients should be concern to adopters, payers and jurisdictions.

Concerning hospital systems there is even more controversy, for example quoting Jha, DesRoches & Campbell et al 2009 who surveyed hospitals in the USA

On the basis of responses from 63.1% of hospitals surveyed, only 1.5% of U.S. hospitals have a comprehensive electronic-records system (i.e., present in all clinical units), and an additional 7.6% have a basic system (i.e., present in at least one clinical unit). Computerized provider-order entry for medications has been implemented in only 17% of hospitals.

And concerning paediatrics in the USA:

The response rate was 58%. Overall, 21.3% of respondents had an electronic health record in their practice. The likelihood of having an electronic health record increased with practice size. Those in a practice network were more likely to have an electronic health record than those in other settings. Smaller and independent practices were less likely to be considering implementing an electronic health record. Although most electronic health records include some pediatric-specific functionality such as the ability to record immunizations, many do not offer decision support; only approximately one third included immunization prompts or alerts for abnormal laboratory results. Cost was a barrier for nearly all of those without an electronic

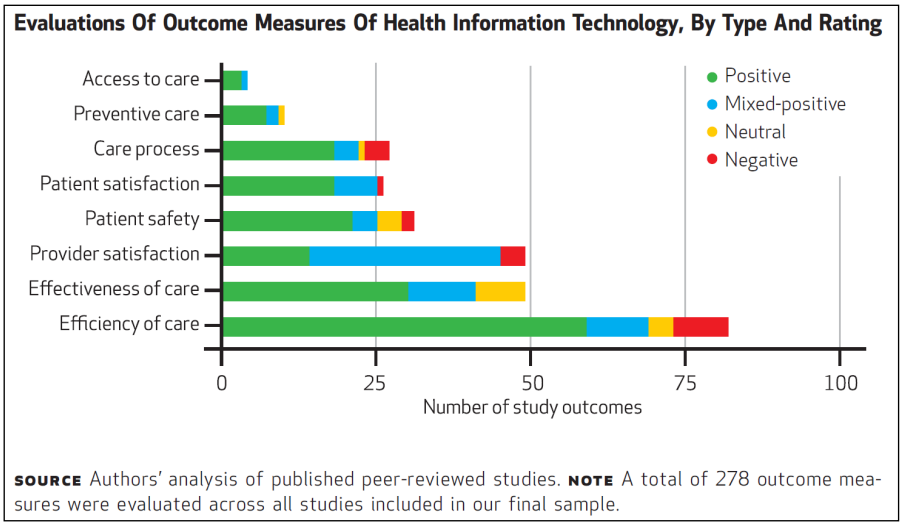
health record; ***half of the respondents questioned whether electronic health records lead to improvement in quality of care****, and many could not identify an electronic health record that would meet their practice requirements. (Kemper, Uren & Clark 2006)*

Shekelle, Morton & Keeler (2006) reviewed 256 articles concerning Costs and benefits of health information technology (HIT) and discovered:

RESULTS: Of the 256 studies, 156 concerned decision support, 84 assessed the electronic medical record, and 30 were about computerized physician order entry (categories are not mutually exclusive). One hundred twenty four of the studies assessed the effect of the HIT system in the outpatient or ambulatory setting; 82 assessed its use in the hospital or inpatient setting. Ninety-seven studies used a randomized design. There were 11 other controlled clinical trials, 33 studies using a pre-post design, and 20 studies using a time series. Another 17 were case studies with a concurrent control. Of the 211 hypothesis-testing studies, 82 contained at least some cost data. We identified no study or collection of studies, outside of those from a handful of HIT leaders, that would allow a reader to make a determination about the generalizable knowledge of the study's reported benefit. Beside these studies from HIT leaders, no other research assessed HIT systems that had comprehensive functionality and included data on costs, relevant information on organizational context and process change, and data on implementation. A small body of literature supports a role for HIT in improving the quality of pediatric care. Insufficient data were available on the costs or cost-effectiveness of implementing such systems. The ability of Electronic Health Records (EHRs) to improve the quality of care in ambulatory care settings was demonstrated in a small series of studies conducted at four sites (three U.S. medical centers and one in the Netherlands). The studies demonstrated improvements in provider performance when clinical information management and decision support tools were made available within an EHR system, particularly when the EHRs had the capacity to store data with high fidelity, to make those data readily accessible, and to help translate them into context-specific information that can empower providers in their work. Despite the heterogeneity in the analytic methods used, all cost-benefit analyses predicted substantial savings from EHR (and health care information exchange and interoperability) implementation: The quantifiable ***benefits are projected to outweigh the investment costs****. However, the predicted time needed to break even* ***varied from three to as many as 13 years****.*

CONCLUSIONS: HIT has the potential to enable a dramatic transformation in the delivery of health care, making it safer, more effective, and more efficient. Some organizations have already realized major gains through the implementation of multifunctional, interoperable HIT systems built around an EHR. However, widespread implementation of HIT has been limited by a lack of generalizable knowledge about what types of HIT and implementation methods will improve care and manage costs for specific health organizations. The reporting of HIT development and implementation requires fuller descriptions of both the intervention and the organizational/economic environment in which it is implemented.

A more controversial (right wing) article by Herrick, Gorman & Goodman 2010 suggests that there is no real value at the moment, in contrast a recent article by Buntin, Burke & Hoaglin et al 2011 entitled The Benefits Of Health Information Technology: A Review of The Recent Literature Shows Predominantly Positive Results. suggests that the picture is more positive and present a nice graphic (below) .



It is important to remember that possibly these 'evaluations' might be influences even more than those developed by the pharmacuetical companies there are big bucks to be made in supplying and maintaining HIT systems. Also review articles are frequently carried out by institutions who might have policy connections with implementation strategies etc. For example Buntin is director of the Office of Economic Analysis, Evaluation, and Modeling, Office of the National Coordinator for Health Information Technology(ONC), Department of Health and Human Services, in Washington, D.C. Could this be in any way linked to the Obama administration?

10. Summary

In this very short introduction to Evaluation in Health Information Systems we have looked at why, how, when and what to evaluate. I would suggest to anyone who wishes to take this large subject area further to first look at the book by Anderson, Aydin and Jay 1994 (or the new edition) then the Friedman & Wyatt 2005 book. Concerning articles Berry & Hart 1990 provide a good overview, and for specific questionnaire development, visit the website mentioned earlier along with the Bailey 1990 article is still one of the most detailed I have come across. Obviously there are a large number of more recent academic articles and a quick search using the older articles provided in this chapter soon demonstrates that they are still the foundation for the most recent developments in user satisfaction assessment, for example see the open access article Byrd L W, Byrd T A, 2012. or Aggelidis & Chatzoglou 2009.

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