Assessing Users' Satisfaction through Perception of Usefulness and Ease of Use in the Daily Interaction with a Hospital Information System

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The present study deals with the assessment of the subjective perception of the clinical core of the hospital information system (HIS) we are building. This HIS is not in use on a voluntary basis, but physicians and nurses use it for all the aspects of their inpatient care that have been informatized.
Two questionnaires, aimed at the assessment of users' perceived usefulness and ease of use of information technology, were utilized to:
- *obtain feedback of the actual users' satisfaction as a predictive factor for the future life of the system*
- *assess the real influence of the often-mentioned problems of age and unfamiliarity with computers of potential users*
- *learn about the aspects which would enhance users' acceptance.*

The analysis of answers to the questionnaires has indicated a substantially positive perception of the system in terms of both usefulness and ease of use. This constitutes a good reason to keep on investing in the project. Even though this study has the intrinsic limit of the small dimension of the inquired population (53 users, equivalent to 98% of the personnel of the assessed clinical units), our data confirm the inconsistency of the relationship between perception of usefulness and age, and show "unfamiliarity with computers" as commonplace. On the other hand, it seems that the keystone for usefulness perception is the knowledge the users have of the system. An effort by the technical personnel in establishing a broader collaboration with the users, and in providing more exhaustive training and support may well be worthwhile.

INTRODUCTION

Typically, people who project and develop a HIS have a broad view of the system itself, know the flows of the involved information, and consequently the potential benefits it can provide. On the other hand, a single user's knowledge of the system is usually limited to the aspects he or she is concerned with, and, in many cases, the long-term benefits are not personally perceived. The user is perfectly conscious of the ratio between effort and gain as regards his or her usage of the system, for each single activity.

The daily utilization of the system by all the potential users, each for his or her professional role, is essential to the full realization of the benefits of a HIS, and hence to the success of the operation.

An objective assessment of the benefits - for example in terms of cost reductions, global time savings, and the opportunity to perform activities otherwise impossible - is necessary and of great impact, but very time and resource consuming. Moreover, it gives indications about the global cost-effectiveness of a HIS, that is only indirectly tied to the single user's satisfaction.

The aim of the present study is the assessment of the subjective perception of the clinical core of the HIS we have been building for three years, in order to:
- obtain a feedback of the actual users' satisfaction as a predictive factor for the future life of the system as it is at present.
- assess the real influence of the often-mentioned problems of age and unfamiliarity with computers of the potential users.
- learn about the aspects to which we have to pay more attention in order to enhance users' satisfaction.

SETTING

The HIS we are building[1,2] integrates administrative and clinical data for a small (177 beds, 5 clinical units) medical centre.

The system, operating in the Windows environment with its standard graphic user interface, consists of a set of modules providing, at present, for:
- collection of demographic data
- entry and retrieval of encounter clinical data
- management of laboratory, radiology and nuclear medicine data, from the generation of requisitions (typically handled by nurses on physicians' indication) to the reporting and review of results
- creation of composite time-oriented view of data
- consultation of indexes of all the events belonging to a patient
- printing of document

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- selection of patients matching user-defined conditions.

For each informatized clinical unit (at present nephrology, dialysis, internal medicine and oncology), the patient-record is personalized in terms of content, complexity, and, to some extent, appearance, although a common basic structure is present.

Data are captured either indirectly through the use of a paper encounter form, or directly through provider interaction with a PC, but always in a patient-specific way.

METHODS

Since the system is not in use on a voluntary basis, but physicians and nurses use it to take care of all the patients in the clinical unit for all the aspects that have been informatized, the quantification of the logons doesn't give sufficient insight about personal satisfaction.

In order to assess the acceptance of the HIS by the users (physicians and nurses), we have developed two questionnaires in Italian, starting from those (fig.1,2) developed by Davis[3], aimed to the inspection of the constructs of perceived usefulness (PU) and ease of use (PEU) of information technology.

From Davis study [3], reliability was tested through Cronbach alfa (.98 and .94 per PU and PEU respectively), and the factorial validity of PU and PEU was confirmed by factor analysis.

The original questionnaires are domain and technology independent, and have been used across industries, health care included, for commercially available software[4].

1	Using [Technology X] allows me to accomplish tasks more quickly
2	Using [Technology X] improves my job performance
3	Using [Technology X] increases my productivity
4	Using [Technology X] enhances my effectiveness in the job
5	Using [Technology X] makes it easier to do my job
6	Overall, I find [Technology X] useful in my job

fig. 1 Items of the Perceived Usefulness Scale

Each item was measured on a seven-point Likert scale, ranging from "Strongly disagree" (value -3), to "Strongly agree" (value +3), through the indifference (value 0).

1	Learning to operate [Technology X] would be easy for me
2	I would find it easy to get [Technology X] to do what I wont it to do
3	My interaction with [Technology X] would be clear and understandable
4	I would find [Technology X] to be flexible to interact with
5	It would be easy for me to become skilful at using [Technology X]
6	I would find [Technology X] easy to use

fig. 2 Items of the Ease of Use Scale

The usefulness score (SCU) and the ease of use score (SCE) are the equally weighted sum of the six individual items for each scale.

Confidential pen and paper questionnaires were distributed to all the personnel of the clinical units where the HIS was available, explaining in the cover letter the aim of the study and the use we would have done of the results. Each person had to compile a sheet of general data, including age, clinical unit, professional status, previous experience in use of computers (either for hobby and/or job), how long his/her unit has the HIS installed, and a self-reported assessment of the personal frequency of use of the system.

Fifty-four questionnaires were distributed to the personnel of the dialysis, nephrology and internal medicine units.

RESULTS AND DISCUSSION

General consideration

Collaboration was excellent, since only one user did not return the questionnaires (a physician in chief, who hasn't ever personally used the system), and, with few exceptions, the answers came back without delay on the scheduled date.

The study refers to a sample of 17 physicians and 36 nurses, sample that is small in absolute, but representing the 98% of the personnel of the inspected clinical units.

Reliability was verified through Cronbach alpha, obtaining 0.87 and 0.89 respectively for perceived usefulness and for perceived ease of use.

Here we have considered a positive result also in case of answers or scores of indifference (value=0), since the perception of a system at least not as an

impediment to one's job is a good result. Moreover a null-cost activity can produce benefits for others.
Actual users' satisfaction, relation with age, previous experience, frequency of use, are explored in the following:

1. Actual users' satisfaction

Synthesis: good results about perceived usefulness (but with significative difference for physicians who have or have not actively participated in the analysis phase of the project), and ease of use.
Since physicians and nurses use different modules of the system, results are presented separately.
Tab. 1 and 4 include, for each scale, the percent frequencies of non-negative values for the computed score (SCU and SCE) and for the sixth items (6PU and 6PEU) that can be considered a sort of conclusive question.
In tab. 2, 3, 5, and 6 the percent frequencies of each answer value on the Likert scale are shown, for all the items in the two questionnaires.

1.1 Physicians

SCU values were not as high as 6PU for physicians, whose use of the system is intensive,. We think that they perceive other benefits than those included in the questionnaire, or they had difficulties in including these benefits in the categories proposed by the questionnaire. Inspecting negative SCU, they are numerous, with a range between -8 and -1 (being the minimum possible value for SCU -18), and with a median of -4.
Considering the group of physicians (40%) who have actively participate to the analysis phase of the project, all SCUs are positive (range 3 to 16, median 9). Comparisons between participant and not participant physicians of the answers to each item of PU scale confirm the differences, in particular as regards item 3 "using the system increases my productivity", and 5 "using the system makes it easier to do my job" (Mann-Whitney test $p < 0.005$ for both items), explaining also the low values in tab 2. It has to be noted also that some physicians had to their disposal other software products, or had well organized paper-based system to manage information.
All the physicians gave positive answers to item 2, about the improvement of their job performance; 76% of the answers are positive for item 4 (enhanced effectiveness); 47% and 23% of the clinicians think respectively to save time and not to be overburdened by the system (item 1).
For the perceived ease of use scale, the percentage of positive SCE (tab. 1) is high, and similar to 6PEU. Looking at tab.3 the worst results (59% of negative answers) refer to item 2 (getting the system to do what the physician wants it to do).

	SCU	SCE	6 PU	6PEU
>=0	58.8	82	94.4	88.2

tab. 1 Each scale score and 6 item answers

N.	-3	-2	-1	0	1	2	3
1	0	23.5	5.8	23.5	23.5	11.7	11.7
2	0	0	0	29.4	35.3	29.4	5.88
3	11.7	23.5	17.6	29.4	0	11.7	5.9
4	0	11.7	11.7	29.4	17.6	29.4	0
5	0	41.2	0	11.7	23.5	11.7	11.7
6	0	5.9	0	11.7	41.2	23.5	17.6

tab. 2 Physicians - Perceived usefulness

N.	-3	-2	-1	0	1	2	3
1	0	5.9	5.9	0	23.5	58.8	5.9
2	5.9	41.2	11.8	0	23.5	17.6	0
3	0	11.8	17.6	5.9	17.6	41.2	5.9
4	0	5.9	5.9	0	58.8	23.5	5.9
5	0	5.9	11.8	0	35.3	35.3	11.8
6	0	0	11.8	11.8	23.5	47.1	5.9

tab. 3 Physicians - Perceived ease of use

Again, such negative answers come from people who had not directly participated to the project and had less knowledge of the system itself.
There were no problems with learning to operate the system (item 1, 88% of positive answers), and with becoming skilful (item 4, 88% of positive answers).

1.2 Nurses

Tab. 4 also shows a discrepancy for nurses (even if much less evident) between the percentage of positive SCU (80%) and the percentage of positive answers to item 6 of perceived usefulness scale (91.7%).
The general consideration made for physicians are valid also for nurses.
Referring to tab. 5, like physicians, the worst results are concerned with item 3 "using the system increases my productivity", where only 69% of the answers are non-negative, with a maximum (33.3%) on the indifference value. Maybe the use of the word "productivity" is intimidating.
All the other items of theperceived usefulness scale have percentages of positive answers over 77%, with lower values on the indifference column, if compared with the physicians.
Moreover, answers are spread over all the seven value scale. This is related to the different frequencies of use of the system reported by the nurses, and also due

to organizational choices, as discussed in a following section.
As regards perceived ease of use (tab. 4), the scale score and item 6 agree.

	SCU	SCE	6 PU	6PEU
>=0	80	83	91.7	86.2

tab. 4 - Each scale score and 6 item answers

	-3	-2	-1	0	1	2	3
1	5.5	5.5	0	11.1	16.6	55.5	5.5
2	5.5	0	8.3	11.1	27.7	41.6	5.5
3	8.3	11.1	11.1	33.3	16.6	13.8	5.5
4	2.7	11.1	8.3	11.1	16.6	38.8	11.1
5	8.3	8.3	0	5.5	44.4	16.6	16.6
6	0	8.3	0	0	38.8	36.1	16.6

tab. 5 Nurses - Perceived usefulness

	-3	-2	-1	0	1	2	3
1	0	2.7	8.3	2.7	11.1	63.9	11.1
2	13.8	11.1	5.5	5.5	25.0	38.8	0
3	0	11.1	8.3	0	25.0	50.0	5.5
4	8.3	16.6	2.7	2.7	22.2	47.2	0
5	0	2.7	11.1	5.5	22.2	52.8	5.5
6	2.7	11.1	0	2.7	19.4	52.8	11.1

tab. 6 Nurses - Perceived ease of use

The worst results, like in the case of physicians, are related to item 2 (69% of positive answers), but the maximum is on the answer value of +2. All the other items have percentage of positive answers over 70%. In particular item 1 (learning effort) and item 5 (achieving skill) have positive answer percentages of 88% and 86% respectively.

2. Relationship with age
Synthesis: no relationship with age

Our population has a mean age of 36.06 ± 7.8 (range between 21 and 61 years).
As regards SCU and SCE, a linear relationship with users' age has been tested.
Considering all the users as a whole, no relation was found. For physicians, SCU shows a positive trend (r-square=0.279) if regressed on age. For nurses only, SCE shows a negative trend (r-square=0.136). Nevertheless, for both the last two cases, age doesn't explain the most part of variance in SCU and SCE.
The relationship is weak, in accordance with [4,5] other authors.

3. Relation with previous experience
Synthesis: no relation with previous experience

Experience in using computers is another general and often mentioned problem or obstacle to the acceptance of IT.
In the personal data sheet distributed together with the questionnaires, we asked for information about previous experience with computers.
The population is exactly divided between experienced (EXP) and inexperienced (INEXP) users. 76% of physicians and 36% of nurses reported previous usage of personal computers. Age and frequency of use of the system are similarly distributed inside the two groups.
The low value of SCU for the experienced group (tab. 7) is due to a high presence of physicians, for whom SCU is perhaps less representative than 6PU.
We were interested particularly to the ease of use scale: Mann-Whitney test, when used on SCE, doesn't identify a significant difference, while being a larger number of scores under the total median for the INEXP group. Moreover, comparisons of the answers to each item of the PEU questionnaire were performed. No significant differences were found, neither as regards learning nor becoming skillful between EXP and INEXP.

	SCU	SCE	6PU	6PEU
INEXP	81.4	74	96	81.4
EXP	65.3	92	88.4	92

tab. 7 Influence of previous experience

As regards our population, previous experience cannot be considered as a factor influencing the perception of the system in terms of ease of use.

4. Relationship with frequency of use
Synthesis: positive trend between frequency of use and perceived usefulness (fig.3)

Since the system is not in use on a voluntary basis, but everybody uses it, frequency of use depends on organizational rules (particularly for nurses) as regards basic activities, and on personal disposition as regards other data retrieval activities.
A study is on going to assess the different ways in which the users operate.
Self-reported frequency of use has been defined through five levels, from less than once a week (level 1) to many times a day (level 5).
82% of physicians use the system many times a day: daily routine usage has been achieved, but relationship with frequency of use is not investigable.

95% of nurses are equally divided over level 3 (some times a week), level 4 (about once a day) and level 5. Inexperienced and experienced users are present in the same proportion in each group.
As regards perceived usefulness, a significant linear positive trend exists between frequency of use and SCU (r-square=0.14).
Similarly, the answers to all the items of PU questionnaire, with the exception of item 2 and 6, show significant positive trends (r-square between 0.11 and 0.14). No relation between frequency of use and ease of use has been found.

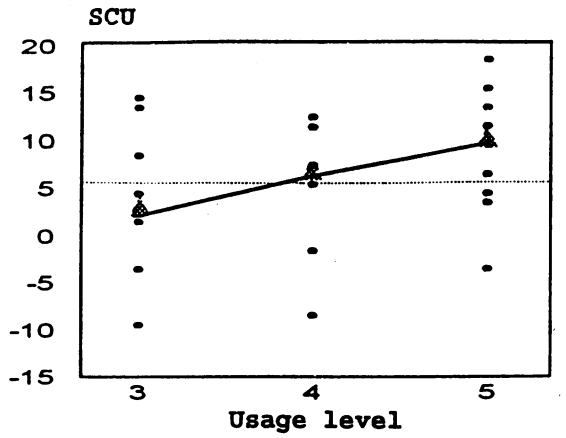

fig. 3 SCU vs. usage level with median values for each level. Dotted line represents the total median value

CONCLUSION

Hospital Information Systems are very important in modern health care. However, user satisfaction is essential for the survival of the information system itself. Because of this, it is important to be able to quantify user satisfaction.
As regards our population, and the specific software under inspection, the adopted instrument to assess users' satisfaction have revealed useful to objectify the intuitions we, as developers, had about the usability of the system in the daily routine, necessary condition to the survival of the system itself.
The substantially positive system perception that was found through the questionnaires constitutes a good reason to keep on investing on the project, also expanding the HIS to other clinical units.
Even though this study has the intrinsic limit of the small dimension of the inquired population, some general insights can be drawn.
In addition to the confirmatory result about the inconsistency of the relationship between perception of usefulness and age, our data dispel another often-mentioned myth that unfamiliarity with computers is one of the main reasons users won't use or appreciate hospital information system.
It seems that the keystone is the knowledge the users have of the system.
Two are the main reasons for a superficial or partial knowledge of the system:
- a lack of participation of the users to the analysis phase or an insufficient attention paid to transferring (sharing) information about the philosophy underlying the system
- a limited usage.

In both cases, an effort in terms of broader collaboration with the users, training and support by the technical personnel may well be worthwhile.
We will carry on a validation of the Italian version of Davis questionnaires (an agreement with the author obtained) on a larger sample of users in health care environment.

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