

# AvI-index: A tool to assess usability

Iordanis Kavathatzopoulos<sup>1</sup>

<sup>1</sup> Uppsala University, Department of IT-HCI, Box 337, 751 05 Uppsala, Sweden,  
[iordanis@it.uu.se](mailto:iordanis@it.uu.se)

**Abstract.** AvI-index is a usability measurement questionnaire to assess IT systems' usability as a factor dependent on efficiency, effectiveness and work environment. It is focused on how personal skills and organizational processes contribute to successful user participation and through that to higher usability, to better work environment, and to higher effectiveness and efficiency. Reliability coefficients and correlations to objective criteria were high confirming the original hypothesis. AvI-index can be used to acquire information about an IT system's usability in an easy and quick way. It can be used to evaluate interventions and changes of IT systems. It is also a suitable method to apply continuously over a longer period of time. Although AvI-index only provides an indicative value, such a diagnosis of usability in an organization's IT infrastructure is valuable as an alert and to determine the extent of further initiatives.

**Keywords:** usability, questionnaire, evaluation, reliability, validity

## 1 Introduction

IT is a ubiquitous tool. It is the tool with the greatest significance on all parts of our life, leisure as well as work. Therefore it is important that it functions well and it helps us achieve our goals. However, as it is well known, this is not always the case. IT systems very often do not function in a fully satisfied way creating efficiency and effectiveness problems as well as bad working conditions and risks for health. It is broadly accepted that user participation during systems development, system function, adaptation to organizational structures and work processes as well as user competence determine the usability of IT systems. AvI-index correlates these parameters of usability to work environment and profit.

There is a great need to be able to evaluate the usability of IT systems in an easy and reliable way. During all phases, planning, development, installation, and running of an IT system, it is important to have access to such an evaluation tool. But what should be the bases of an instrument like this? The most important factor for an IT system's usability is of course its efficiency and effectiveness. We have therefore to focus our instrument on the structure and the use of an IT system, and the way these two are connected to the goals of the user [1]. Resolution of different contradictions that can arise in this connection can be seen as the ground for good usability [2]. In that sense work environment is an important aspect of efficiency and effectiveness. IT

systems usability is dependent on good work environment, not only during the running of a system, but also earlier, during its construction, and later during its further development.

Users' participation is of outmost importance for the construction and use of usable IT systems. One factor that facilitates participation is users' informal responsibility for the system they need as a tool for their work, and the responsibility they feel to find solutions to all possible problems they are confronted with during its use. Spontaneous networks among users come up with the aim to provide support and to transmit knowledge and expertise. Informal cognitive processes in the form spontaneous networks are very effective in solving problems and in promoting learning [3, 4]. Formal support structures and formal education contribute a lot to the good function of IT systems directly and indirectly by supporting networking. However, informal structures and processes among users are necessary; therefore an evaluation instrument has to focus on this. AvI-index connects IT systems efficiency, effectiveness and users' work environment, to informal cognitive support processes.

The main goal of AvI-index is to describe the processes behind usability; user participation, knowledge support, networking for coordination and cooperation etc. AvI-index focuses on whether the preconditions for these processes are there to allow them to arise and to function in a satisfying and fruitful way. For example, user participation during construction of an IT system is necessary to produce knowledge about what would be the most usable technical or interface solution for a certain work task. Informal knowledge support structures contribute mostly to this process as well as to the transmission of knowledge among users. Problems that arise after installation are impossible to foresee, to prescribe in a manual or to train during introductory education. Knowledge how to handle such problems is found by those informal support processes.

## 2 Reliability and validity

AvI-index contains 46 questions divided in six subscales. *Development* subscale: usability is dependent on user participation during system construction. *Use* subscale: how well the system supports work tasks. *Competence* subscale: acquiring knowledge and skills. *Utility* subscale: contributing to efficiency and effectiveness. *Stress* and *Health* subscale: promoting healthy work environment. *Relations* subscale: facilitating cooperation and coordination. AvI-index evaluates an IT system on all these six variables, which are supposed to be different aspects of the same underlying main factor, that is, usability.

Participants in the study were employees in many different organizations. Many different IT support tools were assessed [5, 6, 7, 8]. That allows the investigation of internal reliability as well as the validity of AvI-index.

The results of internal reliability were very positive. In a sample of 466 participants the final version of AvI-index showed very high homogeneity, Cronbach's alpha was 0.99 for the whole questionnaire. For each of the subscales internal reliability the results showed the same high levels except for the Development subscale which showed a relatively lower but still high homogeneity (Table 1).

**Table 1.** Internal homogeneity for all subscales of AvI-index.

<b>Subscales</b>	<b>Cronbach's alpha</b>	<b><i>n</i></b>
Development	0.83	46
Use	0.99	365
Utility	0.99	387
Competence	0.99	358
Stress and Health	0.99	393
Relations	0.99	368

AvI-index contains six subscales which focus on different aspects of usability. Data analyses on the same sample showed that the different subscales were strongly correlated to each other. All correlations were significant at 5% level. Development subscale showed lower correlations to the other subscales but still sufficiently high to be significant. One explanation for the lower correlations can depend on the number of participants. Since most of them did not participate in the development process they did not answer the questions in this subscale.

Correlations varied between 0.37 and 0.92. There was a strong relationship among all parts of the questionnaire indicating that usability is a common factor for all subscales and questions (Table 2).

**Table 2.** Correlations between subscales of AvI-index.

<b>Subscales</b>	<b>Use</b>	<b>Utility</b>	<b>Competence</b>	<b>Stress &amp; Health</b>	<b>Relations</b>
Development	0.38	0.37	0.41	0.34	0.43
Use	-	0.92	0.89	0.88	0.86
Utility		-	0.88	0.89	0.87
Competence			-	0.85	0.86
Stress & Health				-	0.86

*Note: N=466,  $p < 0.05$*

The validity of the questionnaire is supported by these results, which clearly showed that the instrument could assess differences in usability as an effect of system changes and development [6, 8]. Since the IT tools evaluated by AvI-index were developed between the two assessment occasions it was expected that the usability score would be higher in the final test. Indeed the results showed a higher overall usability score, 3.0 in a scale from 0 to 5, compared to 2.6 in the previous test that were conducted before the changes in the system took place. The same tendency can

be found for each subscale too, except for Development subscale where the focus was on user participation. This result has been stable on a significantly low level, 1.3, both after the first and the second assessment. But this was expected since there was extremely low user participation in all change and development processes.

Furthermore, AvI-index could differentiate the usability level of the use of IT systems between two organizations [6]. These two organizations were different in their attitudes toward usability and control. The more flexible and open organization scored higher in AvI-index, as it was expected.

In a final test it was shown that AvI-index correlates strongly with other methods evaluating the usability of the same IT system in the same organization [9]. Independent interviews and observations scored similarly as AvI-index.

Correlation to objective criteria has been missing regarding the validity of usability evaluation methods [10]. However, the above study [9] showed that AvI-index correlated to objective data connected to efficiency, effectiveness and health.

### 3 Conclusion

AvI-index is a valid instrument and it can be used for easy and reliable usability evaluations of IT systems. Although AvI-index only provides an indicative value, such a diagnosis of usability in an organization's IT infrastructure is valuable as an alert and to determine the extent of further initiatives.

### References

1. Nardi, B. (ed.): Context and consciousness: Activity theory and human-computer interaction. MIT Press, Cambridge, MA (1996)
2. Engeström, Y.: Learning by expanding. Orienta-Konsultit, Helsinki (1987)
3. Vygotsky, L. S.: Thought and language. MIT Press, Cambridge, MA (1962)
4. Vygotsky, L. S.: Mind in society. Harvard Press, Cambridge, MA (1978)
5. Kavathatzopoulos, I.: AvI-enkäten: Ett verktyg för att mäta användbarhet, stress och nytta av IT-stöd (Tekn. Rap. Nr. 2006-50). Uppsala universitet, Institutionen för informationsteknologi, Uppsala (2006)
6. Kavathatzopoulos, I.: Usability Index. In: Toomingas, A., Lantz A. and Berns T. (eds.), Work with computing systems, p. 160. Royal Institute of Technology and National Institute of Working Life, Stockholm (2007)
7. Kavathatzopoulos, I.: Ett förbättrat verktyg för mätning av användbarhet, stress och nytta (Tekn. Rap. Nr. 2008-003). Uppsala universitet, Institutionen för informationsteknologi, Uppsala (2008)
8. Gulliksen, J., Cajander, Å., Sandblad, B., Eriksson, E. and Kavathatzopoulos, I. User-centred systems design as organizational change: A longitudinal action research project to improve usability and the computerized work environment in a public authority. *International Journal of Technology and Human Interaction* 5(3), 13--53 2009.
9. Åhlman, M.: Värdehemtagningsplan Ekonomi - Uppsala Kommun, Uppsala (in press)
10. Hornbæk, K. and Lai-Chong Law, E.: Meta-analysis of correlations among usability measures. In: CHI 2007 Proceedings, Empirical Models, pp. 617--626. ACM, San Jose, CA (2007)