Faculteit der Economische Wetenschappen en Econometrie

, Serie Research Memoranda

The relation between user information satisfaction, usage of management support systems and performance

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Research Memorandum 1997-43

August 1997

vrije Universiteit amsterdam

Research note:

The relation between user information satisfaction, usage of management support systems and performance

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August 12, 1997

Abstract

This study investigates the validity of two commonly used measures for the success of management support systems (MSS): usage and user information satisfaction (UIS). The results of a questionnaire survey among Dutch managers are used to assess the mutual relation between both measures and performance. The results indicate that UIS is significantly related to performance (r = 0.42). The relation between usage and performance is not significant. A partial correlation after correction for UIS is not significant either. This study provides new empirical evidence for the popular assumption that UIS is the most appropriate measure for MSS success available.

1 Introduction

The explanation of management support systems (MSS[1]) success has been called one of the main goals of IS research [5]. Unfortunately, however, one of the main prerequisites for such an explanation, measurement of MSS success, has been subject to much controversy [8, 15, 18, 20, 22, 27]. It has been rightly claimed that the measurement of MSS success has been high on the research agenda for well over 15 years [20, 27]. During those years a development from theoretical discussions and relatively rough measurement of MSS success (see e.g., [32] for a survey and discussion of measurement issues in MIS research), towards the development and empirical validation of measurement instruments [2, 11, 24, 25] has taken place. Within this development a tendency towards the application of more advanced psychometric methods can be recognized. Reliability analysis using Cronbach's α and

***Comments are welcome. Before quoting this paper,** please contact the author to obtain **a more recent version. This study has been carried out as part of my PhD-research. I wish to thank the members of my reading committee: Gary** Bamossy, **Tom Groot,** Cees van Halem, David Otley, Edu Spoor, and Berend Wierenga

[1] In this paper the term MSS will be used for both management information systems, executive information systems and decision support systems put to managerial use.

exploratory factor analysis have gradualiy been replaced by the estimation of confirmatory factor models [6, 10, 12].

In parallel with this development a shift in the success measures employed can be observed. Laboratory research typically applied (and applies) measures in which the contribution of MSS to performance of the subject is determined. A similar approach, in which the contribution of MSS to organizational performance is assessed, has been proposed for real world studies [1, 9] and indeed attempts have been made to apply such measures in empirical research. Gallagher [17] tried to determine the value of MSS in monetary terms, but his results were disappointing. Two dissertations at Ohio State University tried to assess the influence of MSS implementation on financial performance. However, '[t]he influence of noncontrollable variables prevented their reaching a conclusion' [17, p. 47]. Apparently it is difficult to assess the contribution of MSS to performance in a real world situation: a large portion of the costs and benefits of MSS will be qualitative or intangible [4, 23, 24], the assessment of the value of unstructured or ad hoc decision making may be nearly impossible and organizations typically will not record these costs and benefits of an MSS (23,241.

Partially as a consequence of the perceived difficulty with direct measurement of contribution of MSS to organizational performance, with the shift in emphasis from laboratory to real world studies two alternative success measures gained terrain: usage and user information satisfaction ('the extent to which users believe the information system available to them meets their information requirements' [24, p. 785]). Both are supposed to be proxies for the contribution of MSS to organizational performance. The validity of research findings in which those measures are used to operationalize MSS success ultimately depends on these measures' validity. Consequently, the development of theoretical and empirical foundations for their application deserves a high place on the research agenda.

2 Usage and user information satisfaction as success measures

A very rudimentary rationale for the application of usage as a success measure is the idea that an MSS cannot contribute to performance if it is not used (and that it will automatically contribute to performance when used). An alternative rationale states that users are able to assess the value of the MSS and will use a system if they conclude that the benefits (rewards) of using it will outweigh the costs (efforts) [26, 30]. On similar grounds Ein-Dor and Segev assume that usage is highly correlated with other criteria for success (like profitability, application to major problems of the organization, quality of decisions or performance and user satisfaction) as 'a manager will use a system intensively only if it meets at least some of [these] criteria' [13, p. 1065]. Unless usage is treated as a dichotomy (that is, a system is either used or not used), both rationales assume that more usage is always better, which *is* not necessarily the case. Furthermore, application of usage as a success measure may suffer from the fact that a system will be used if managers perceive it to facilitate their *own* goals. Thus, both perfect knowledge and goal-congruence between manager and organization are assumed. On another level, it is unclear what amount usage of an MSS is *exactly.* Furthermore, subjective measurement of usage may be influenced by

social desirability and usage measurement may suffer from time-dependent noise. Finally, and perhaps most importantly, the application of usage as a success measure may lack sensitivity. Usage measurement will only identify the very unsuccessful systems [3] and whether or not managers will use a system mainly will be determined by negative aspects of the system [24]. Provided that the benefits of using the MSS outweigh the costs, each MSS will be used. It is impossible to differentiate between systems each of which is being used, but which may differ considerably in their contribution to organizational performance.

The measurement of user information satisfaction (UIS), on the other hand, will treat the very unsuccessful systems (that are not used at all) as nonexistent, but is better able to differentiate between MSS that are used. UIS measurement assumes that managers know their own information needs-which introduces the necessity of goal-congruence between manager and organization-and are able to compare them with the perceived characteristics of their MSS. Furthermore, it is assumed that improved performance will automatically follow if the system meets management information needs.[2] Another possible shortcoming is noticed by Melone [27] who doubts whether users necessarily hold attitudes about their MSS and, if they do, whether these attitudes are accessible to them, or are only formed when questions about UIS have to be answered, which would at least negatively affect the reliability of the scores obtained. Melone goes one step further and claims that attitudes that are absent or inaccessible to users will not influence their perception, judgement, and behavior [27]. Consequently a relation between UIS and performance would be unlikely. This statement, however, presumes that UIS is assumed to cause performance; this assumption is not required: UIS is a reflection of the extent to which the information needs of the manager have been met and the assumption made in treating UIS as a success measure is that performance of managers will improve if their information requirements are met.

3 Empirical evidence on the validity of user information satisfaction

UIS also shares some shortcomings with usage, UIS may suffer from time-dependent noise [29] and UIS may be influenced by social desirability. Furthermore, the problem of valid UIS measurement is apparent, but as indicated above, during the last couple of years, considerable progress has been made in instrument development and validation by the application of more advanced psychometric methods.

Notwithstanding the apparent shortcomings of UIS as a success measure, the research community seems to be of the opinion that UIS is the best proxy available. UIS is increasingly employed in practice [7, 18] and is the most commonly used dependent variable in MSS research [8, 21, 27, 33]. In a recent meta-analysis [19] 27 studies used some operationalization of UIS as the success measure, 17 employed usage, and 13 some other dependent variable. Furthermore, the findings of this study indicate that effect sizes for usage show a significant, negative relation with the year in which a study had

*This rationale does not imply that satisfaction causes performance. It merely states that the manager's perception of the extent to which his information needs are met by the MSS will be reflected in the UIS-score obtained.

been carried out, which may well be a consequence of this measure's limited sensitivity mentioned above.

Besides isolated application and validation of the individual success measures, some studies apply multiple measures simultaneously, and some attempts have been made to gain insight in the mutual relations between success measures and their relation to organizational performance. Gatian [18] investigated the relation between UIS, 'decision-making performance' and 'efficiency.' Her research population existed of two groups of university and college users of a financial accounting and accounts payable system: department heads and controllers. She finds relatively strong positive relations between satisfaction and both decision performance (assessed for both user groups) and efficiency (only assessed for controllers group). However, her results may be inflated by the fact that the decision performance measure used in this study asks users about their perceptions of the contribution of the system to various, sometimes directly system-related, subdimensions of performance: the decision-performance measure may well be considered to be a UIS measure itself.[3] The efficiency measures assess 'specifically, data processing correctness, report preparation and distribution timeliness' [18, p. 123]; those variables do not seem particularly suited to assess the contribution of MSS to organizational performance.

Iivari and Ervasti [22] investigated 21 different systems in a single municipal organization. For a group of users and a group of user-managers UIS scores were determined using a version of the Bailey and Pearson [2] instrument that was adapted by the authors in order to be able to determine UIS with an individual system.[4] Furthermore, implementability of the system was assessed using a scale developed by the authors, and effectiveness of the organizational unit was determined using the Van de Ven and Ferry [34] organizational assessment framework. Iivari and Ervasti found a positive relation between UIS (and in particular ease of use) and implementability. Further results are somewhat ambiguous, but point at a positive relation between UIS (and in particular ease of use) and unit performance.

Etezadi-Amoli and Farhoomand [15], investigated the relation between a newly developed UIS instrument (which shows some resemblance to the Bailey and Pearson [2] instrument) and a newly developed performance instrument. Their respondents were employed by 22 different organizations and 38% of them occupied a managerial position. They find a strong relation between the subdimensions of their UIS measure and performance. However, as was the case in the study by Gatian, the nature of the performance measures employed may have inflated the findings: users are asked about the contribution of the software to their performance.

This paper pursues a direction similar to that taken by the last three studies mentioned above. I try to copy the positive features of each study, to avoid potential problems and to extent the analysis. This study will not only assess the relation between UIS and performance, but also the relation

[3] An alternative explanation for the inflated correlation is that respondents will try to answer consistently to the UIS and the 'contribution of MSS to performance' scale: a respondent who first indicates that she is very satisfied with the MSS is unlikely to answer that the system has a negative influence on her performance.

[4] The authors explicitly acknowledge that the Doll and Torkaadeh UIS instrument could have been used to assess the relation between performance and UIS.

with usage, which will be operationalized by both hours and frequency of use. In this way empirical evidence is gained on the presumed problems with the application of usage as a success measure. Unit performance will be assessed using the Van de Ven and Ferry [34] measures and two new questions concerning financial performance (revenues and profit). In this way no spurious relations between UIS and performance are introduced beforehand. The Doll and Torkzadeh [11] instrument will be used to assess UIS. This instrument has been validated extensively (see [6, 11, 12, 14]) and measures satisfaction with an individual application, which eliminates the need for adaptation of the instrument. In order to counter the criticisms of Etezadi-Amoli and Farhoomand [14] about two-item measures the first version of the instrument (before elimination of items deemed superfluous by Doll and Torkzadeh) will be used. A final reason why analysis of the relation between the outcomes of this instrument and other performance measures is particularly interesting is that it has been criticized for not including performance related variables [14, 15].

Although the analysis to be carried out is somewhat exploratory in nature, beforehand some expectations may be formulated. At the most elementary level, it is expected that a positive relation between the MSS success measures and performance will be found. If concerns about the validity of usage as a success measure and the preference of the research community for the application of UIS as a success measure are justified the relation between UIS and performance is expected to be stronger than the relation between usage and performance. However, even for UIS, only a moderate relation is expected, as UIS is a proxy for the contribution of the MSS to organizational performance. This implies that there are two factors that will make the relation less than perfect: first the fact that UIS is a proxy implies that some variance will remain unexplained and second, for reasons mentioned above, the relation between UIS and performance will be assessed instead of the relation between UIS and the contribution of MSS to performance.

4 Research method

In order to gather the data needed to carry out the above mentioned analysis a questionnaire survey was send to 1024 Dutch managers, information managers, and controllers.[5] A seperate answer card was attached to the questionnaire which could be used to obtain a booklet about MSS and the results of the survey. Furthermore, the respondents did receive a postage paid envelop to return the questionnaire and a letter on university stationary, which asked for their cooperation and guaranteed that answer card and questionnaire would be seperated upon receipt. Four weeks after the first mailing, a reminder was send out in which respondents were thanked for their cooperation and in which the cooperation of people who had not yet responded was again solicited.[6] A final gross response rate of 20.7%

[5] Administration of the questionnaire was made possible by financial support of Oasis Nieuwegein, which is gratefully acknowledged.

[6] The original of the intend of the answer card was to be able to keep track of respondents and non-respondents as suggested by Fowler [16]. However, the number of questionnaires received without an answer card and the number of answerd cards received without a questionnaire was quite large, and it was decided to send a reminder/thank letter to all (non-)respondents.

function	%
concern management	**27.1**
division management	**10.2**
business unit management	**5.4**
line management	**12.7**
staff member"	**41.6**
other	**3.0**
total[b]	**100.0**

industrv	%
manufacturing"	**41.9**
government and non-profit	**14.4**
financial services	**11.9**
wholesale	**6.3**
transportation	**5.0**
communication	**5.0**
energy	**5.0**
building	**5.0**
other	**5.7**
total[b]	**100.0**

"Of this group 23.2% indicated that their function was either information manager or controller.
"Due to rounding errors the sum of the individual items does not always equal 100%.
'Including food industry.

Table **1: Descriptive statistics (n = 170).**

(n = 212) was obtained. The net response rate was 16.6%, as 42 responses could not be used for analysis.[7]

The age of the respondents varies from 23 to 65 years, with an average of 44.9 years. On average respondents have worked 6.1 years in their current function and 11.2 years with their current employer. A large majority of the respondents (94.7%)is male. Of the respondents 84% has at least a polytechnic, university, CPA or CMA degree.[8] An MSS was available to 64.5% of the respondents, 26.7% uses the system only through an intermediary and 11.4% does not use it at all. Some other descriptive statistics of the respondents are provided in Table 1.

As indicated above, in order to measure UIS, the original Doll and Torkzadeh [11] instrument was used. In this way, the concern of Etezadi-Amoli and Farhoomand [14] about the application of two-item measures, is solved for all subscales of UIS, with the exception of the timeliness scale. Two new indicators were added to this latter scale: 'Are the data in the system updated often enough?' and 'Are the data in the system updated ***quickly*** enough?'. Both confirmatory factor analysis (CFA) and an expert panel were used to validate the resulting measurement instrument. This resulted in the elimination of the fourth and fifth item of the content scale, the first newly added item of the timeliness scale and the third item of the ease of use scale.[9] An extension of the CFA in which a measurement model in which all non-zero factor loading were set equal to 1 was compared with

[7] **A large number of those refusals consisted of a letter indicating a company policy of non-cooperation in survey research and a not-filled out questionnaire.**

[8] **The subjects were Dutch managers, the original questions concerned HBO, WO, RA and RC, respectively.**

[9] **This latter elimination reintroduces concerns that the number of indicators per construct is too low. However, the inclusion of only two items in the measure, was preferred about the inclusion of a faulty item. The elimination of this third item did result in an *increase* in Cronbach's α. A possible explanation it that the formulation of this item ('Is the system efficient?') is ambiguous. Future research could consider to use 'Can the system be used efficiently?' as an alternative.**

a traditional measurement model in which the non-zero factor loadings are left free. The difference in χ^2 between both models ($\chi^2_{11} = 5.07$) is not significant, which indicates that in further analyses the sum of the individual item scores can be used. Finally, the reliability coefficients presented on the diagonal of Table 2 all are quite satisfactory.

The second success measure, usage, has been assessed in four different ways. The respondents were asked how many hours a week they used their MSS, and how many times a week they used their MSS. Both measures were also obtained for indirect usage: the respondents were asked how many hours and times a week they used their MSS via an assistent.

To assess performance, the Van de Ven and Ferry [34] measure was used. This instrument is extensively tested and well established in the literature (275 hits in SSCI from the moment of appearance until 1995, for the 1980 book alone) and modifications were not deemed desirable. Using the same format as employed for the Van de Ven and Ferry measures scores for a newly developed second performance measure were obtained for profitability and development of revenues. Although this latter measure has the disadvantage that it will not be applicable to the situation of every respondent, it provides a more direct linkage to bottom-line performance measures. The reliability estimates on the diagonal of Table 2 indicate that the reliabilities of the Van de Ven and Ferry measure are reasonably high. Although α for the new measure is somewhat below average, it still is acceptable [28].

5 Results

The results of the analysis are presented in Table 2. All relations are presented in the form of correlation coefficients. In addition, the number of observations and the 2-tailed significance level are presented.

As expected, the relations between UIS and organizational performance are all significant. Noteworthy is the fact that all six correlations between UIS and the Van de Ven and Ferry performance measure are stronger than the relation with the newly developed bottom-line performance measure. Partly, this is a consequence of the lower reliability of the latter measure. A re-estimation of the correlation matrix using LISREL (in order to allow for the incorporation of unreliable measurement) slightly increases the correlations found,[10] but shows the same pattern. A possible explanation is that financial performance is to a larger extent determined by factors (e.g., general economic conditions) that cannot be influenced by the respondent (and her MSS) than the Van de Ven and Ferry measures, which focus on more autonomously determined aspects of performance like efficiency, quality and innovativeness.

Even more noteworthy is the observation that all correlations between the usage measures and performance are insignificant.[11] The concerns about

[10] This is always the case, unreliability of measurement will attenuate the correlation coefficient. A correction for attenuation can be made by $r'_{xy} = \frac{r_{xy}}{\sqrt{r_{xx}}\sqrt{r_{yy}}}$ in which r' is the corrected correlation coefficient, and r_{xx} (r_{yy}) is the reliability of variable x (y) [28, 31]. Remember that Cronbach's α is a lower limit of (statistical) reliability and substitution of reliability by α will result in an overestimate of the effect size.

[11] Partial correlations between the usage measures and performance after correction for UIS have been estimated as well. All partial correlations turned out to be lower than

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. content	0.90 (103) n/a												
2. accuracy	.68 (103) .000	0.97 (103) n/a											
3. format	.70 (103) .000	.59 (103) .000	0.94 (103) n/a										
4. timeliness	.59 (103) .000	.76 (103) .000	.56 (103) .000	0.91 (103) n/a									
5. ease of use	.58 (103) .000	.57 (103) .000	.73 (103) .000	.56 (103) .000	0.96 (103) n/a								
6. UIS (1 + 2 + 3+ 4 + 5)	.84 (103) .000	.87 (103) .000	.87 (103) .000	.82 (103) .000	.79 (103) .000	0.96 (103)							
7. hours of direct usage	.14 (100) .169	.14 (100) .157	.11 (100) .266	.24 (100) .018	.22 (100) .032	.19 (100) .056	n/a (103) n/a						
8. hours of indirect usage	.14 (93) .169	.16 (93) .133	-.01 (93) .906	.16 (93) .116	.04 (93) .724	.11 (93) .275	.36 (95) .000	n/a (96) n/a					
9. frequency of direct usage	.19 (101) .051	.14 (101) .175	.19 (101) .055	.23 (101) .021	.29 (101) .004	.24 (101) .017	.53 (103) .000	.08 (95) .428	n/a (104) n/a				
10. frequency of indirect usage	.15 (98) .147	.21 (98) .041	-.05 (98) .608	.19 (98) .058	.02 (98) .821	.12 (98) .239	.14 (99) .159	.76 (96) .000	.12 (100) .240	n/a (101) n/a			
11. performance (Van de Ven and Ferry)	.36 (100) .000	.35 (100) .000	.41 (100) .000	.36 (100) .000	.35 (100) .000	.44 (100) .000	.11 (100) .294	.04 (94) .699	.15 (101) .124	.06 (98) .582	0.85 (162) n/a		
12. performance (new)	.26 (92) .011	.27 (92) .009	.30 (92) .004	.29 (92) .005	.26 (92) .013	.33 (92) .001	-.06 (92) .572	-.08 (88) .479	.07 (93) .535	-.01 (91) .914	.45 (143) .000	0.79 (146) n/a	
13. performance (11 + 12)	.38 (91) .000	.36 (91) .000	.42 (91) .000	.38 (91) .000	.37 (91) .000	.46 (91) .000	.09 (91) .383	.01 (87) .908	.17 (92) .101	.04 (90) 707	.95 (143) .000	.70 (143) .000	0.84 (143)

Table 2: Pearson product moment correlations of MSS success measures with organizational performance. Underneath each correlation coefficient the number of cased it is based on and the significance are presented. Reliability coefficients (Cronbach's α) for multiple item measures are presented on the diagonal of the matrix.

the validity of usage and the preference for UIS in empirical research seem well justified. The reader should keep in mind that usage in this case is defined as the amount or frequency of usage. A dichotomous usage measure may still be a valid operationalization of MSS success, but provided the system is used, the usage criterium fails to show a significant relation with performance. Due to the limited number of non-users in the sample-it is not unlikely that an interaction with response did occur-only a tentative test of the relation between this dichotomous usage measure and performance could be made. An ANOVA was carried out to find out whether users and non-users differed significantly on the performance measures. Although performance is lower for non-users, the difference is not significant ($F_{1,101}$ = 2.74; p = 0.10, $F_{1,93}$ = 0.79; p = 0.37, and $F_{1,92}$ = *2.24; p* = 0.14 for the three performance measures, respectively).[12]

On a more detailed level some additional observations concerning the relation between usage and UIS may be made. Of the relations between the subdimensions of UIS, ease of use and timeliness show the highest correlation with both hours and frequency of direct usage of the system. Intuitively, it makes sense that systems that are more easy to use are used longer and more frequently. This finding is related to the relation between ease of use and implementability of a system observed by Iivari and Ervasti [22]. It also makes sense to assume that users who are more satisfied with timeliness of the information provided by their MSS—which probably indicates that the information is updated more regularly-will use it more frequently.

On the other hand, the relation between both indirect usage measures and the UIS-subdimensions format of the information provided by the system and ease of use almost equals zero. This makes some intuitive sense, as in indirect usage situations ease of use will be less relevant and the format of the information provided will be filtered by the assistent. However, this observation may also reflect the fact that managers who use their MSS mainly indirectly, may not be able to provide adequate estimates of the format and ease of use dimension.

Finally, the correlations between the subscales of the UIS instrument and the total UIS-score, can be interpreted as traditional item to total correlations and hence as indicators of the true reliability of those five dimensions. Of those five correlations, which are quite satisfactory, the relation of UIS with the ease of use scale is the lowest one. This may reflect a minor problem with construct validity of this latter scale, which is hidden by the fact that this scale has only two items.

6 Conclusions and discussion

Overall, the results presented in this paper increase the confidence in the application of UIS as a criterion for MSS success. The results of this study indicate that, in particular if the large version of the MSS instrument is employed, UIS can be measured with sufficient reliability. Furthermore,

the correlations presented in Table 2 and were insignificant.

[12] ANOVA requires that variance is equal across groups. This assumption was not met for this analysis. In order to investigate whether this problem had any consequences, a non-parametric test (Mann-Whitney's U) for the significance of the difference in performance between users and non-users was made as well. All three U's are insignificant ($U_{12,91}$ = 454.5; p = 0.40. $U_{12,83}$ = 433; p = 0.46, $U_{12,82}$ = 420; p = 0.41).

the strong and consistent correlation with the performance measure indicates that the claim that UIS is an adequate proxy for the contribution of MSS to organizational performance can be maintained. However, the UIS-instrument still needs some improvement. The ease-of-use component of the instrument consist of only two items and is relatively unreliable. Furthermore, reliabilities of the instrument may have been overestimated as a consequence of the tendency of respondents to give consistent answers to, e.g., all questions concerning satisfaction with the content of information provided. In this respect, the correlations between the subdimensions of UIS and the total urs-score presented in Table 2 are better estimates of reliability than the Q'S presented on the diagonal of the same table. Those item to total correlations are satisfactory as well.

The correlations between UIS and performance presented in this paper may be inflated by two artifacts of the research design. First, self-reports of performance were used. Future research can look for ways in which objective estimates of performance (or even better: estimates of the change of performance due to the introduction or presence of the MSS) can be related to UIS. Second, the correlations found may have been inflated by the fact that this study focussed on MSS only; organizations that build better MSS are likely to perform better in other areas, too. All those areas contribute to organizational performance. As only MSS success is assessed, the relation between MSS success and organizational performance found, will partially reflect the contribution to performance of the other areas in which the organization performs better.

It should also be acknowledged that UIS is less suited to assess the success of an MSS that is used indirectly. This is not surprising as the Doll and Torkzadeh instrument was developed to assess *end user* computer satisfaction. However, this feature of the instrument may introduce practical problems in some research projects. In survey research it may not be known beforehand whether a manager is an end-user of the MSS or uses it only indirectly.

Finally, the low and insignificant correlations between the usage measures and the performance measures adds weight to the doubts that already exist about the validity of usage as a success criterion. The fact that partial correlation between usage and performance after correction for UIS were lower than the total correlations indicate that the measurement of usage in addition to UIS does not provide additional information. It should be emphasized, however, that this paper concerns the measurement of MSS success. The results of this study should not be generalized to other kinds of systems. For some systems (e.g., Internet sites or other information systems aimed at a general public) usage may remain the most appropriate and most easily assessed success measure; for MSS, UIS measurement is more appropriate.

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