Measures for Cloud Computing Effectiveness Assessment

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ABSTRACT

For the Cloud Computing Effectiveness Assessment Model (CCEAM) that was recently proposed, a set of operationally and objectively defined measures are presented. The model incorporating these measures is validated by case studies carried out in five companies from four different categories of involvement with cloud computing. It is shown in the context of the case studies that CCEAM is applicable for assessing cloud computing strengths and weaknesses of organizations.

Keywords: Case Studies, CCEAM, Cloud Computing, Effectiveness Assessment, Measures

INTRODUCTION

The Cloud Computing Effectiveness Assessment Model (CCEAM) that was proposed recently (Yarlikas & Bilgen, 2013b) consists of 42 variables and a total of 142 generic measures categorized in the technical, economical, organizational and external dimensions. The intermediate stages of the qualitative research that led to the final model have been documented in (Yarlikas & Bilgen, 2013a). Findings and interview transcripts of four exploratory case studies carried out in 10 companies to finalize the model are available in (Yarlikas & Bilgen, 2013c). A major shortcoming of the study was that the measures used to evaluate the variables were subjectively defined and interpreted in a case-specific fashion in the exploratory studies.

In the present study, to significantly enhance applicability of CCEAM, we present operational and objective definitions for all measures. This set of measures is still generic in the sense that individual measures for any variable can be re-defined and/or selected as necessary and appropriate in a case-specific fashion. In fact as shown in the confirmatory case studies, only the relevant ones for any specific organization have been used for assessment. The method applied to develop and validate these measures is again qualitative, starting from an extensive literature review (Yarlikas & Bilgen, 2013a), continuing with exploratory case studies reported in (Yarlikas & Bilgen, 2013b; Yarlikas & Bilgen, 2013c), and culminating in the application of the derived definitions of all measures in confirmatory case studies.

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studies. Interviews conducted in the studied organizations have shown that with the present set of measures, CCEAM is applicable and provides a meaningful and useful assessment of the cloud computing effectiveness of firms, whether they are service providers, or clients, or position themselves in an intermediate functionality.

The rest of this paper consists of four sections. First the operational definitions and normalization process of measures are presented. Explicit references to the relevant literature are provided in the table in which each measure is defined and justified. After that, the confirmatory case studies conducted in four different categories of companies are reported. The paper is concluded with a summary of the major results, perceived limitations of the study and suggestions for future work.

OBJECTIVE OPERATIONAL DEFINITIONS OF MEASURES

CCEAM consists of 24 technical, 7 organizational, 9 economical and 2 external variables, to be evaluated in terms of 80, 31, 29 and 2 measures, in the four dimensions, respectively. Table 1 presents a list of all variables and their abbreviations. In Tables 2 through 8, the measures to be used for assessing variables are presented, together with their abbreviated denotations to be used in the footprint diagrams. These denotations are constructed to indicate the variable with which each measure is directly associated. E.g. Cla2 in Table 2 indicates the second measure for variable “Cloud Applications” (Cla) in Table 1.

These seven tables are arranged according to the similarities of Likert scale assignment rules or ratio formulations. In Table 2, 46 measures are defined as ratios. Tables 3, Table 4, Table 5, Table 6, Table 7, and Table 8 present measures with 3- or 5-point Likert scales and specific assignment rules. In all tables, references are provided to bibliography on measures and their relationships to cloud computing effectiveness. No reference has been provided for operational definitions obtained through exploratory case studies directly.

We present assessment results in the form of footprint diagrams (Kandogan, 2001), appropriate especially for comparative and improvement studies. A normalization process is applied for the values of measures.

Since, according to the results of exploratory case studies, 5-point Likert scale definitions have been determined to be appropriate for some of the measures and 3-point definitions for some others, a common Likert scale was not constructed, but 3-Values have been mapped into the 5-point scale for normalization.

To evaluate all of the measures on a common basis, the following normalization process has to be followed:

**Step 1:** 3-point Likert scores are mapped to 5-point scores via the mapping:

\[ Y = x^3 - 6x^2 + 13x - 7 \quad 1 \leq x \leq 3 \quad 1 \leq Y \leq 5 \]

where x and Y denote the 3- and 5-point Likert values, respectively. This ensures that when only a single respondent has evaluated a certain variable according to the 3-point scale, the possible values of 1, 2 and 3 are mapped directly to 1, 3 and 5, respectively. In case of multiple responses, a 3-point average is mapped to the 5-point range.

**Step 2:** Each measure is normalized with respect to its maximum possible value.

Normalized values of measures obtained in the case studies are presented in footprint diagrams (Figure 1, Figure 2, Figure 3, Figure 4, and Figure 5).

CONFIRMATORY CASE STUDIES

In Table 9, measures, four model dimensions, and associated company categories, namely, (i) cloud service providers (CSP), (ii) companies that provide as well as receive cloud computing...
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