An Instrument to Classify End-Users Based On the User Cube

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Abstract

End-user computing (EUC) has led to increased end-user productivity and satisfaction. In order to reduce the risks inherent to EUC, organizations should better manage EUC. As a first step different groups of end-users must be identified. Existing classification schemes have weaknesses and fail to capture the different roles contemporary end users play. Cotterman and Kumar (1989) proposed a user cube based on the three main dimensions of EUC – development, operation, and control. Even though this is rational approach to end user classification, it has been largely ignored by researchers. This may be due to the lack of an instrument to implement the cube. Hence, in this paper, a 10-item instrument is presented and data collected from 292 end users show that the instrument has strong construct validity. Practitioners can find this instrument very useful in determining the characteristics of EUC in their firms which in turn would be beneficial to devise strategies for EUC management.

Keywords: End-user computing, EUC Support, End-user Types, Instrument for Classification

Introduction

End-user computing (EUC) has been in existence since the advent of personal computers. Armed with adequate computing resources, possible due to the low cost of software and hardware, end users began developing applications (on their own and/or with the help of others) to aid their decision-making. This in turn has reduced end user dependence on centralized information technology (IT) group for computing needs. Also, organizations started providing EUC support through mechanisms such as helpdesks. This has led to increased end-user productivity and satisfaction. However, since end users are not trained professionals in application development, many risks are associated with EUC. These risks range from lack of documentation to threats to data integrity and security (Alavi and Weiss, 1986). Although organizations have wrestled with EUC to reduce risks and to increase benefits by providing different support mechanisms such as online support, helpdesks, and localized MIS staff support, a first step would be to understand the end users in terms of who they are, what they do, and what differences exist among different groups of end users. This is the main motivation for this study. To begin to answer these questions, end users should be classified into different groups based on meaningful criteria. A classification scheme developed by Rockart and Flannery (1983) in the early eighties is still used by researchers. While this classification was useful in identifying different user groups when EUC was in its infancy, it does not reflect the different characteristics of contemporary end users. Cotterman and Kumar (1989) presented a user cube and classified users into eight distinct types based on three dimensions represented by users – developer, operator, and controller. This is a quantitative approach to end user classification and has been largely ignored by researchers. This may be due to the lack of an instrument to classify users based on the cube. In this paper, a 10-item instrument is presented and

data collected from 292 end users show that the instrument has strong construct validity. This short instrument can be very useful in identifying the status of end-user computing within firms in terms of identifying different groups of end-users and the predominant dimension of EUC. Armed with such information, firms can develop appropriate strategies to manage EUC. With the aid of this tool, researchers can better explore end-user dynamics.

End-User Classification

Research has provided different end-user typologies. McLean (1979) divided users into two main categories. ***Data Processing Professionals*** (DPP) and ***Data Processing Users*** (DPU). DPP writes code for use by others and hence refer to information technology personnel. DPU are end users who are further divided by McLean into *DP amateurs* (DPA) and *non-DP trained users* (NTU). The DPA writes code for his or her own use while the NTU uses code written by others. Rockart and Flannery (1983) presented a fine-grained classification of end users that is widely accepted and used by MIS researchers. The different end-user groups identified by them are:

a. ***Nonprogramming end-users*** neither program nor use report generators. Access to computerized data is through a limited, menu-driven environment or a strictly followed set of procedures.

b. ***Command level users*** perform simple inquiries, often with a few simple calculations such as summation, and generate unique reports for their own purpose.

c. ***End-user programmers*** utilize both command and procedural languages directly for their own personal information needs. They develop their own applications, some of which are used by other end users.

d. ***Functional support personne*****l** are sophisticated programmers supporting other end users within their particular functional areas. These are individuals who, by virtue of their prowess in EUC languages, have become informal centers of systems design and programming expertise within their functional areas.

e. ***End-user computing support personnel*** are most often located in a central support organization such as an "Information Center."

f. ***DP programmers*** are similar to traditional COBOL shop programmers except that they program in end-user computing languages.

Since the last two types refer to information technology professionals such as programmers and helpdesk personnel, they can be ignored.

A closer look at these types, as well as McLean's reveals that user knowledge of computing is the main criteria for classification. But since computing resources are plentiful within organizations, contemporary end users may also control EUC activities around them. The control dimension is crucial and is evident by definitions of EUC presented by researchers (Cotterman and Kumar, 1989; Davis, 1982; Kasper and Cerveny, 1985). Cotterman and Kumar (1989) state, "*…end users are those who are consumers or producer/consumers of information. Producer/consumers of information are those who operate, develop, or control the computer based information system (CBIS), while at the same time using its output*." This plentiful availability of resources has led to end-user independence from or reduced dependence on the IT departments within firms, thus giving users a sense of control over their computing needs. Contemporary end-users perform one or more of the following: use (operate) applications, develop applications, and control EUC activities. The popular classification schemes fail to capture these dimensions of EUC and hence research using such classification schemes tends to focus only on the knowledge of the end user. Based on these three dimensions of EUC - operations, development, and control – Cotterman and Kumar (1989) classified end users into eight distinct types (user cube): user-consumer, user-operator, user-

developer, user-controller, user-operator/developer, user-developer/controller, user-operator/controller, and user-operator/developer/controller. Figure 1 presents the user cube. Finer classifications are possible if points on the edges and inside the cube are considered (Cotterman and Kumar, 1989). However, for simplicity, this research focuses on the eight user types represented by the eight edges of the cube.

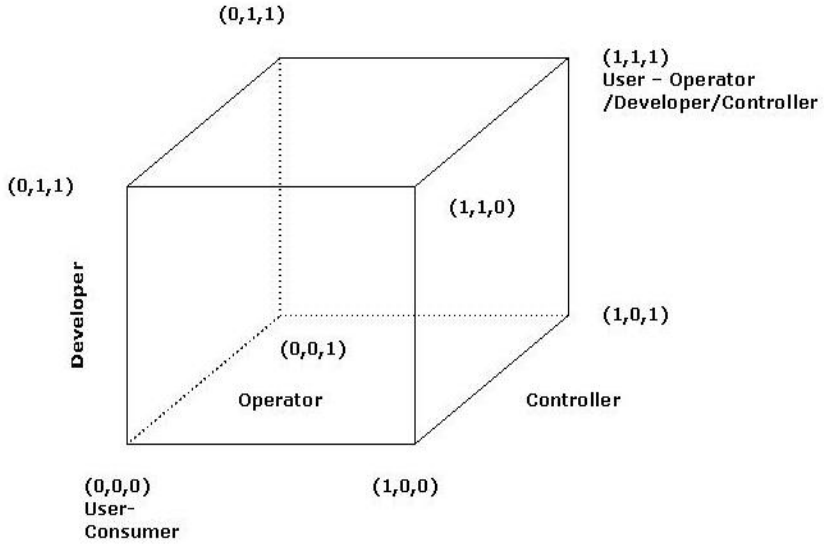

Figure 1. The End-User Cube

Instrument Development

Based on Cotterman and Kumar's definition of the dimensions and review of EUC literature, an eleven-item instrument, as presented in Table 1, was designed. Because of variations in end user knowledge level, applications developed by them range from simple spreadsheets to complex GUI based programs and dynamic Web pages (with database connectivity). To validate the instrument dimensions of development and control, it is important to understand the types and complexity of applications developed by end users and the organizational positions held by them. Respondents were asked to provide the same. Definitions for different levels of applications were provided to the respondents. They are given below:

Level-1 Application: Development of simple applications including presentations (using, for example PowerPoint presentations, Harvard Graphics, etc.) and/or creation of static WebPages using MS Word or other editors. These are simple applications.

Level-2 Application: Medium sized applications which include development of one or more of the following: spreadsheet applications using financial or statistical formulas, use of macros in spreadsheets / statistical package such as SAS/SPSS, creation of database applications that uses SQL type queries, dynamic WebPages using Java/Perl/VB scripts/CGI/Applets etc. Examples are simple programs using COBOL or GUI based Visual Basic/Visual FoxPro/Visual C++ etc.

Level-3 Application: Development of complex programs that involves extensive use of advanced features of COBOL or GUI languages such as Visual Basic/Visual FoxPro/Visual C++ etc. Number of lines of executable code is a lot more than a Level-2 application. Applications involving CAD/CAM can be included here.

EUC Dimensions and Items on the questionnaire	Scale
Development	**No Involvement** 1 2 3 4 5 6 7 **Active Involvement**
Please rate	
1. Your involvement in the design of end-user applications	1 2 3 4 5 6 7
2. Your involvement in the specification of end-user application requirements	1 2 3 4 5 6 7
3. Your involvement with respect to actual coding of end-user applications	1 2 3 4 5 6 7
4. Your involvement in the implementation of the applications developed by them and/or by others	1 2 3 4 5 6 7
Operation	**Low Extent** 1 2 3 4 5 6 7 **High Extent**
Please rate the extent of your use of end-user applications	
5. Developed by you	1 2 3 4 5 6 7
6. Developed by others in the department	1 2 3 4 5 6 7
7. Developed by others in the firm	1 2 3 4 5 6 7
Control	**No Authority** 1 2 3 4 5 6 7 **Complete Authority**
Please rate	
8. Your decision-making authority to acquire hardware (hard disks, RAM etc) for the department	1 2 3 4 5 6 7
9. Your decision-making authority to acquire software (MS Office, Corel Suite etc) for the department	1 2 3 4 5 6 7
10. Your authority to initiate, manage, and implement new end-user applications	1 2 3 4 5 6 7
11. Your authority to collect, store, and use data for the end-user applications	1 2 3 4 5 6 7

Table 1 Instrument to classify End Users

Data Collection

To collect data, a structured questionnaire was designed. The questionnaire was then converted to an HTML file and posted on the Internet. The site address was widely advertised in various Usenet groups, list servers, etc. Once a respondent completed the survey, the response was written to an MS Access file using active server page (ASP) technology. To prevent duplicate responses, an algorithm was used to ensure that only one response was received from each respondent.

Results

A total of 292 useful responses were received after eliminating incomplete and duplicate responses. Responses came from a wide variety of industry sectors as shown in Figure 2. A seven-point scale was used to solicit responses for categorizing respondents as developers, operators, controllers or any combination of these (Table 1). If the average score on any of these dimensions for each respondent was above 3.5, he/she was assigned to that category. As mentioned earlier finer classifications are possible. For simplicity, average scores were used to assign respondents to specific dimensions. Figure 3 shows respondent end-user types for each category. It is interesting to note that 22.6% of respondents develop

applications, use them, and control EUC activities in their departments. 17.1% of the respondents are categorized as consumers of information. Consumers do not develop, operate, or have any control over EUC activities. They merely consume information such as use printed reports. About 17% of respondents are developer-controllers. Since end users develop applications mainly for use by themselves or for use by others, it is understandable that pure developers represent only 3.4%. To better understand how each dimension is represented, a Venn diagram approach is used (Figure 4).

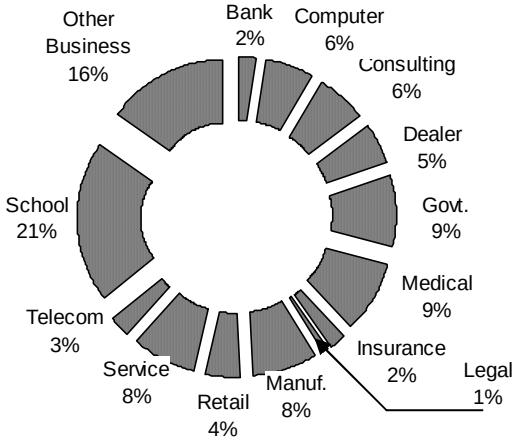

Figure 2. Respondents by Industry Type

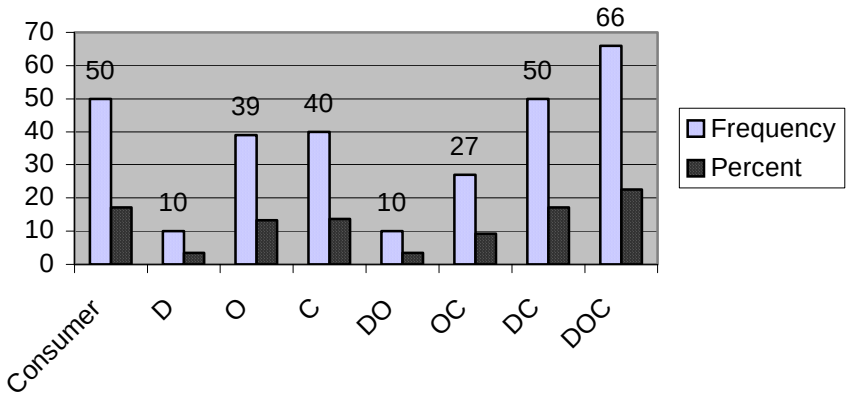

Figure 3. End-User Types (D-Developer, O-Operator, C-Controller)

The Venn diagram clearly shows that approximately 47% of respondents represent the developer dimension, while 49% and 63% of respondents represent the operator and controller dimensions respectively. End-user computing gained momentum as users learnt to develop applications. It is understandable that more respondents represent the operator dimension than the developer dimension since not all users have the knowledge to develop applications. But it is surprising that 63% represent the controller dimension that has not been reported before by academic researchers.

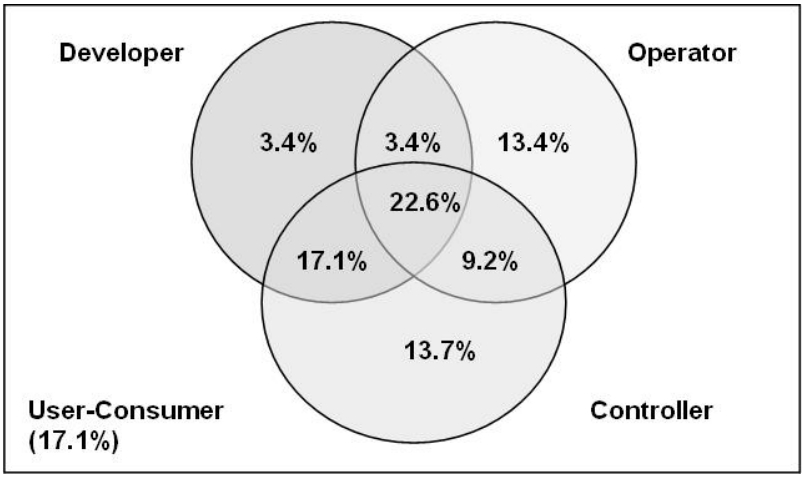

Figure 4. Venn Diagram of EUC Dimensions

Understanding how dimension is represented is crucial to effectively manage end users. Under representation of the developer dimension means that EUC is at its infancy. To enhance user productivity, suitable training programs can be designed to educate end users on development. If development and control dimensions are predominant, it may mean that EUC is at an advanced level. In such a scenario, EUC management is crucial to have appropriate policies regarding access rights to corporate data. For MIS researchers, a thorough understanding of the various groups of end users provides a clear direction to model end-user behavior and dynamics.

Instrument Validation

The eleven-item instrument, when subjected to factor analysis, produced three factors. Because of low factor loadings one item of the developer construct, item 5 in Table 1, was dropped. The results of the final factor analysis are presented in Table 2.

Items	Factor 1	Factor 2	Factor 3
Developer1	.221	**.883**	-.002
Developer2	.366	**.796**	.093
Developer3	.120	**.849**	-.075
Developer4	.338	**.753**	.133
Operator1	.009	.090	**.898**
Operator2	.016	-.031	**.905**
Control1	**.912**	.185	-.055
Control2	**.913**	.181	-.043
Control3	**.855**	.362	.052
Control4	**.796**	.314	.123

(Varimax rotation converged in 5 iterations)

Table 2 Results of Factor Analysis

High values for Cronbach's alpha are an indicator of instrument reliability. Also, high inter-item correlations are a measure for instrument reliability. The inter-item correlations were high with the lowest value at 0.67. The alpha values are presented in Table 3. High reliability clearly shows the careful selection of items for the construct. If the instrument measured the constructs accurately, then more respondents fitting the control dimension would hold higher management positions than the non-controller respondents. Similarly, more respondents who fit the developer profile would have developed more complex applications than the non-developer respondents. Tables 4 and 5 present these results.

Construct/Items	**Alpha (N)**
Development/4	.887 (N=292)
Operation/2	.777 (N=288)
Control/4	.932 (N=292)

Table 3. Instrument Reliability

Designation	**Controller (%) (N = 183)**	**Non-Controller (%) (N = 109)**
Operator/Technician	13.10	10.10
Clerical Staff	3.80	16.50
Supervisor	4.90	5.50
Middle-level Manager	21.90	10.10
Upper-level Manager	14.80	2.80
CEO/CIO level Administrator	10.90	0.00

Table 4 Positions held by Controllers and Non-Controllers

From Table 4, it is clear that controllers mainly come from middle or upper level management. This is expected as they have more authority and responsibility than users from lower management levels. It is surprising that 13% of respondents at lowest-levels of management have control over end-user computing activities. While this is not necessarily bad, the risks arising out of this may be higher. Among non-controllers, about 10% of middle-level managers and 3% of upper-level managers who responded to the survey seem to have minimal or no control over end-user computing activities in their department(s). Again, this is not encouraging since they are accountable for the activities and performance of their department(s). Such findings are possible only if the user cube approach is used. Control is a critical dimension of EUC and it should be exercised with care mainly by the middle to upper levels of management. This would help curtail the risks arising out of end-user applications such as redundancy, threats to data integrity and security and to maximize benefits such as increased productivity, employee satisfaction and morale. Table 4 also validates the accuracy of the instrument in classifying end users.

Type of Applications	**Developer (%) (N = 136)**				**Non-Developer (%) (N = 156)**			
No. of Applications	< 2	2-5	6-10	>10	< 2	2-5	6-10	>10
Level-1 Applications	14.0	27.2	15.4	37.5	42.3	22.4	14.1	16.0
Level-2 Applications	25.0	25.7	16.2	25.0	64.7	18.6	4.5	6.4
Level-3 Applications	58.1	9.6	14.7	6.6	84.0	6.4	1.3	0.6

Table 5. Number of applications developed by Developers and Non-developers

Table 5 shows that more developers designed and created more end-user applications than the non-developers lending credibility to the accuracy of the instrument. The numbers indicate that more developers created level 2 and level 3 applications than non-developers. Data shows that 64.7% and 84% of the non-developers created less than two level-1 and level-2 applications. This should be interpreted carefully since less than two applications also mean that they did not develop any application. The numbers for developers under columns 2, 3, and 4 are consistently higher than the numbers under the same columns for non-developers. Although it may be surprising to see respondents classified as non-developers have developed applications, this is attributed to the classification scheme followed. The scores on developer dimension for the non-developers were less than the threshold (3.5) and not a zero. Nevertheless, these numbers give a clear indication of the high-level of development activity among the respondents. Practitioners should find this instrument very useful to ascertain the level of development activity in their organizations.

Conclusions

The instrument presented here appears to remain strong in its validity and reliability. A word of caution is in order. Since the respondents were Internet users, they may not be a true representative sample of the population. However, since the data was used only to test the instrument and not actually to classify respondents, it is not a serious concern. Such an instrument could be beneficial to practitioners to understand the extent of EUC in their respective firms. A recent study (Govindarajulu, 2002) showed that end users use helpdesk support minimally. Hence, understanding different user groups will help organizations to provide better end-user support and to reap the benefits of EUC. For researchers, understanding different groups of users is crucial to understand end-user characteristics and to model end-user behavior. Future EUC researchers should consider all the dimensions of EUC in their models to give an accurate picture of EUC dynamics.

References

Alavi, M., and Weiss, I.R. (1985-86) Managing the Risks Associated with End-User Computing. *Journal of Management Information Systems*, 2(3), pp. 5-20.

Cotterman, W.W. and Kumar, K. (1989) User Cube: A Taxonomy of End Users, *Communications of the ACM*, 32(11), pp. 1313-1320.

Davis, G. B. Caution: User Developed Systems can be Dangerous to Your Organization. *MISRC-WP-82-04*, MIS Research

Govindarajulu, C. (2002) The Status of Helpdesk Support: A Survey, *Communications of the ACM*, 45(1), pp. 97-100.

Kasper, G.M. and Cerveny, P.C. (1985) A Laboratory Study of User Characteristics and Decision-Making Performance in End-User Computing. *Information & Management*, 9, pp. 87-96.

McLean, E.R. (1979) End Users as Application Developers. *MIS Quarterly*, 3(4), pp.37-46.

Rockart, J.F. and Flannery, L.S. (1983) The Management of end-user Computing, *Communications of the ACM*, 26(10), 1983, pp. 776-784.

Biography

Chittibabu Govindarajulu, Ph.D. is an Assistant Professor of Management Information Systems in Bennett S. Lebow College of Business at Drexel University in Philadelphia. He received his Bachelors of Mechanical Engineering from Anna University and MBA from Bharathiar University in India. His Ph.D. in Information Systems from University of Mississippi focused on End-User Computing support. His teaching interests are in the areas of e-commerce systems development, programming and technology. His current research focuses on end-user computing management, e-commerce, and business intelligence. He has published over 20 articles in popular MIS journals such as *Communications of the ACM*, *Information and Management*, *Journal of End-User Computing*, and *Journal of Database Management*. Dr. Govindarajulu is also currently co-authoring a book on Microsoft's latest VisualBasic.NET technology for Prentice Hall.