# Policy Making for End-user Systems: A Model and Empirical Evidence

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**ABSTRACT**

End-user computing is entrenched in organization life, consuming more resources than traditional systems development. It lacks, however, management and control policies. This study proposes a framework for understanding the objectives of the various stakeholders - end-users, top management and DP/MIS management — and analyzes how these objectives influence the policy-making process for end-user computing. Additionally, it measures the effects of these same objectives on specific end-user computing policies for hardware and software acquisition, application /systems development, data base access, security/copyright protection and training.

## INTRODUCTION

The objective of this work is to study the effect of end-user systems management, systems development, and strategic impact of information technology (IT) on the end-user computing policy-making process.

End-user computing has increasingly received attention in literature in terms of: (a) end-users taxonomy [18], (b) end-user systems taxonomy [1], (c) information center concepts and functions [5,21,22], and (d) end-user systems management [13,15]. Moreover, end-user computing is recognized as one of the critical issues of information systems management [12].

The movement toward end-user systems development started as a Management Information Systems (MIS) alternative to in-house systems development. IBM Canada's classic study [10] developed the "information center" concept in order to deal with existing systems development bottlenecks [6,14].

The movement gained momentum as an end-user action for control and increased productivity in computer use — this, facilitated by the advent of personal computers and easy-to-use software.

Finally, the movement matured as a top management strategy of obtaining business competitive advantages through information technology [2,8,17, 20]. (Figure 1 shows end-user, top management and DP/MIS management objectives for end-user computing.)

An end-user's key objective is obtaining effective use and timely results from efforts applied to computers (effectiveness and turnaround time); a secondary objective being that of obtaining control and the cost efficiency of computing activities (efficiency and control) [3,5,21].

Top management expects that by applying corporate resources to end-user systems, they will gain competitive advantages and improve corporate performances (strategic use of information technology) [2,17]. In addition, they also expect higher levels of output from professionals and managers (productivity increase) with end-user systems.

DP/MIS managers' intentions are to decrease the "systems development bottleneck" [13] by transferring development of small and unique applications to end-users (systems design alternative), as well as improving communications and relations with end-users by providing them with easier and more direct access to computing (increase user satisfaction) [5,21,22].

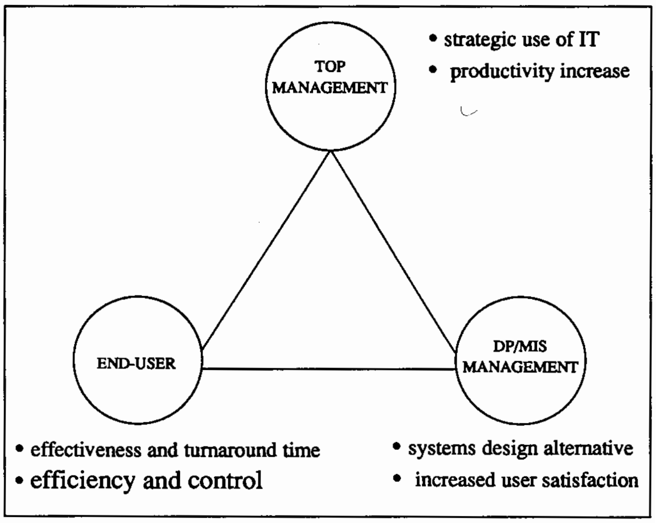


Figure 1: End-user computing objectives

Understandably, the objectives of these three groups may be inconsistent; some complimentary, others conflicting. The end-user objective of effectiveness and turnaround time is probably consistent with top management's objective of obtaining strategic use of IT, and with DP/MIS management's objective of increasing user satisfaction and providing systems design alternatives.

The end-user objective of efficiency and control is probably also consistent with top management's objective of increasing professional and managerial productivity, and DP/MIS management's objective of increasing user satisfaction.

On the other hand, the end-user efficiency and control objective may conflict with top management's objective of strategic use of IT while also conflicting with DP/MIS management's objective of securing system design alternatives (for example, some transaction processing applications are developed in the end-user area and not in DP/MIS).

The top management strategic use of IT objectives may conflict with the DP/MIS objective of finding systems design alternatives when top management does not approve DP/MIS acquisitions of query languages and report generators (thus facilitating access to data bases by end-users, and decreasing programming jobs).

Therefore, the management of end-user systems is a complex activity.... not only for the need of managing a rapidly changing area in information technology, but also for the need of balancing and coordinating the objectives of all interested parties — end-users, top management and DP/MIS management. The present study empirically measures the effect of these interested parties on the policy-making process for end-user computing.

## RESEARCH VARIABLES AND HYPOTHESES

The overall aim of this study is to contribute answers to the research question: "What are the effects, if any, of end-users, top management and DP/MIS management interests and objectives on end-user computing policies?"

This broad area of inquiry is seeing pioneer works [7,16,18,23] that are leading toward a better understanding of managing and controlling enduser computing. In this study we take a concerted view of the problem representing each of the interested parties end-user, top management and DP/MIS management — by their major interests and objectives on enduser computing.

Four variables were created to measure the research question: (a) the end-user computing stage, (b) the systems development stage, (c) the strategic impact type, and (d) the end-user computing policy level. The first three variables are surrogates, respectively, for the influence of end-users, DP/MIS management, and top management on the end-user computing policy-making process.

### End-User Computing Stage

The end-user computing (EUC) level was measured using the framework shown in Table 1 derived from Gerrity and Rockart [13] and Henderson and Treacy [15]. The dimensions of objectives and control mechanisms were used to define the three EUC stages:

(a) INITIATION - EUC is introduced as a way to support end-user needs without a special organizational control mechanism, and with or without MIS management support the so-called "PC revolution."

(b) CONTROL - there is explicit recognition of a need to control expenditures and to provide standards for EUC. Additionally, while needing to support legitimate end-user applications development, basic control mechanisms are implemented, such as micro-managers, PCs and 4th GL technical support groups.

(c) MANAGEMENT - EUC is integrated into the IT management strategy as an alternative to traditional, in-house, systems development. More elaborate, formal control mechanisms (information centers) are implemented to provide training, consulting, planning and control, and to promote end-user systems development.

**TABLE 1**
**END-USER COMPUTING STAGES**

| | Initiation (1) | Control (2) | Management (3) |
|---|---|---|---|
| Objectives | end-user needs | end-user and control needs | alternative to systems development |
| Control Mechanisms | none | micro-manager and support groups | information center |

### Systems Development Level

The systems development level was measured using the taxonomy shown in Table 2 which reflects the extensive literature on the subject [6,9,11].

**TABLE 2**
**SYSTEMS DEVELOPMENT LEVEL**

| Level | Description |
|---|---|
| Program (1) | Program rather than systems development |
| Informal (2) | Systems development, but no standard methodology adopted |
| Formal (3) | Systems development with standard methodology and procedures adopted |
| Automated (4) | Systems development with standard methodology and automated tools adopted |

### Strategic Impact of IT

Strategic impact of IT was measured using the Cash, McFarlan, McKenney [8] framework, as shown in Table 3. Organizations with applications portfolios classified as:

(a) SUPPORT - neither operationally, nor strategically dependent on Information Technology (IT).

(b) FACTORY - heavily dependent on cost effective operational systems, but not strategically dependent on IT.

(c) TURNAROUND - not substantially dependent on cost effective operational systems, but strategically dependent on IT.

(d) STRATEGIC - operationally and strategically dependent on IT.

**TABLE 3**
**STRATEGIC IMPACT**

| Existing Systems \ Development Portfolio | Low | High |
|---|---|---|
| Low | Support (1) | Turnaround (3) |
| High | Factory (2) | Strategic (4) |

### End-User Computing Policies

The type of end-user computing policies were measured using the framework shown in Table 4. Policies related to hardware and software acquisition, corporate DB access, and security/copyright protection were seen as providing EUC with MIS hygienics [18]. Policies related to end-user application/systems development and training were considered to provide EUC with MIS support. The dimensions of MIS hygienics and support were used to define four types of EUC policies:

(a) NO OR LIMITED POLICIES - all policies in regard to hardware and software acquisition, corporate DB access, security/copyright protection, end-user systems development and training are informal, if existent.

**TABLE 4**
**END-USER COMPUTING POLICIES**

| MIS Hygienics \ MIS Support | Low | High |
|---|---|---|
| Low | Limited (1) | Support (2) |
| High | Hygienic (3) | Comprehensive (4) |

(b) SUPPORT POLICIES - policies in regard to end-user systems development and training are reasonably well defined, while policies to assure MIS hygienics are informal, if existent.

(c) HYGIENICS POLICIES - policies in regard to hardware and software acquisition, corporate DB access, and security/copyright protection are reasonably well defined, while policies to assure MIS support are informal, if existent.

(d) COMPREHENSIVE POLICIES - policies in regard to MIS hygienics and support are reasonably well defined.

### Control Variables

Organization size and industry type were used in this study as control variables as shown in Table 5.

**TABLE 5**
**CONTROL VARIABLES**

| Variables | Description |
|---|---|
| Organization size | The total number of employees working in the organization |
| Industry | The organization's SIC code, later recoded in a one-to-eight scale based on the more frequent types of industries represented in the sample |

### Hypotheses

The main hypothesis of the study is that the objectives of various stakeholders affect levels of end-user computing policies in organizations. The end-user computing stage, the strategic impact of IT, and the systems development level are used as surrogates respectively of end-users, top management and DP/MIS management objectives. Therefore, the main hypothesis is operationalized as follows:

Hl: The higher the end-user computing stage, the strategic impact of IT, and the systems development level, the higher the end-user computing policy level should be within an organization (when controlled for industry type and size of the organizaton).

The secondary hypothesis of the study is that the objectives of various stakeholders affect differently each specific type of end-user computing policy —hardware and software acquisitions, DB access, application/systems development, etc. The objectives of various stakeholders are related to some policies and not others. For example, strategic impact of IT should be related to applications/systems development, but not to hardware acquisition standards.

Specifically, it is hypothesized that the higher the end-user computing stage, the strategic impact of IT, and the systems development level, the higher the levels of:

H2: end-user application/systems development policies

H3: end-user training policies

Also, it is hypothesized that the higher the end-user computing stage and the systems development level, the higher the levels of:

H4: end-user DB access policies
H5: end-user hardware acquisition policies
H6: end-user software acquisition policies
H7: end-user security/copyright protection policies

## RESEARCH METHODOLOGY

The present study, the first in a series of studies on end-user computing, is therefore exploratory in nature. The study was conducted as a survey research using as target population, the 60 Fortune 500 companies located in New England.

Data on industry type, number of employees and operating income was obtained from Fortune Magazine [19]. Data on all other variables was obtained using a survey instrument in printed and/or diskette format.

Twenty-six questionnaires were returned of which 22 were usable, this corresponding to a 36.6 percent sample of organizations within the population.

The sample, although only representative of the target population, has enough variety to allow effective controls with respect to the two most common variables used in available literature industry size and organization size.

The New England region was selected as a target area because it contains the administrative headquarters of a variety of industry (construction, high tech, insurance, education, health care) within a close proximity of physical and cultural settings. The sample is a diversified cross industry panel, as shown in Table 6.

**TABLE 6**
**INDUSTRY TYPE**

| Code | Description | SIC | N | % |
|---|---|---|---|---|
| 01 | General Manufacturing | 16, 20, 26, 32 | 4 | 18.2 |
| 02 | Chemicals | 28 | 2 | 9.1 |
| 03 | Metal Products | 34,35 | 2 | 9.1 |
| 04 | Electric & Electronic | 36 | 2 | 9.1 |
| 05 | Transportation Equipment | 37 | 2 | 9.1 |
| 06 | Scientific and Photographic | 38 | 3 | 13.6 |
| 07 | Transportation and Public Untilities | 42, 49 | 2 | 9.1 |
| 08 | Finance & Insurance | 63 | 5 | 22.7 |

The organization sizes vary substantially in the sample as shown in Table 7 although all are large-sized organizations.

**TABLE 7**
**ORGANIZATION SIZE**

| Number of employees | % |
|---|---|
| less than 3,000 | 13.6 |
| 3,000 to 6,000 | 13.6 |
| 6,000 to 9,000 | 22.7 |
| 10,000 to 19,000 | 13.6 |
| 20,000 to 49,000 | 18.2 |
| 50,000 to 99,000 | 9.1 |
| more than 100,000 | 9.1 |

The research instrument was pre-tested and refined to provide internal validity. A weak external validity post-questionnaire interview test was conducted, with five out of the 22 usable (and self-identified) respondents, to evaluate how much the questionnaire captured of the ideal types defined by the research variables.

The variables used in the study were operationalized using items in the questionnaire as described in the next paragraphs.

### End-User Computing Stage

The end-user computing stage was measured using descriptions of hypothesized objectives and control mechanisms. The three alternative descriptions for objectives shown in Table 1 were presented for the CIOs to choose from. Likewise, alternative descriptions for control mechanisms were also presented. A combination of three choices was used to define the EUC stage. (Figure 2 shows the frequency distribution found in the sample.)

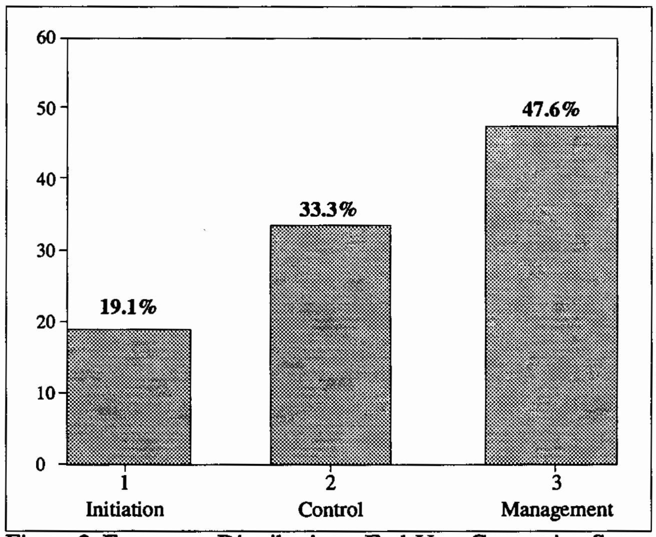


Figure 2: Frequency Distribution – End-User Computing Stage

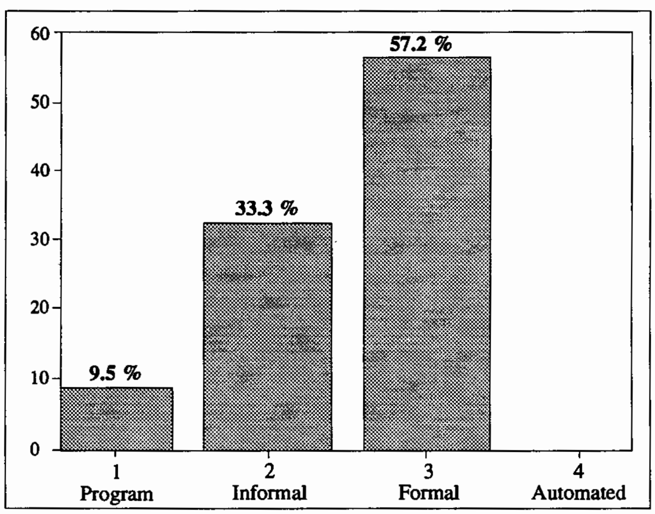


Figure 3: Frequency Distribution – Systems Development Level

**Systems Development Level**

The systems development level was measured using descriptions of the four levels shown in Table 2. The frequency distribution is shown in Figure 3.

Other questions related to systems development alternatives and project management were also included in the questionnaire. Unfortunately, the reliability analysis has shown that these other two variables neither form a scale with the systems development level, nor between themselves. The values of Cronbach alpha were all below 0.35.

Strategic Impact of IT

Strategic impact was measured using existing systems and applications development portfolio dimensions, where each one of the dimensions could assume the values of low (1) or high (2) importance. The combination of scores obtained would define the type of strategic impact as shown previously in Table 3. Once more, the frequency distribution found in the sample is shown in Figure 4.

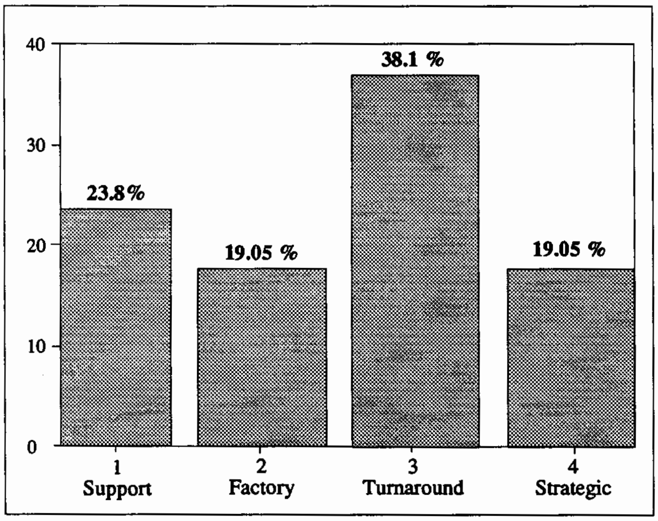


Figure 4: Frequency Distribution – Strategic Impact

The existing system's impact was measured by two variables: shutdown impact and business impact. The shutdown impact was derived from questions asking the CIOs to evaluate the impact on operations during one-hour and two-week shutdowns of the main computer within their organization. The business impact was derived from questions asking the CIOs to evaluate the impact of critical computer processing errors on external exposure, profits, and operations within their organizations.

All of these questions were measured in a Likert-type four-point scale and each individual variable was classified as low (1) or high (2) impact by comparison with their median. The shutdown and business impact variables were obtained by averaging the low-high scores of the questions corresponding to each variable. The Cronbach alpha reliability index for shutdown impact was 0.83 and for business impact 0.68.

The development portfolio impact was measured by six questions asking each CIO what percentage of the development budget was dedicated to research and development, cost displacement productivity applications, maintenance, decision support, IT based product development (for example ATMs), and operational efficiency projects.

All variables except maintenance were classified as high (2) impact if expenditures with each type project fell above the mean; otherwise rated low (1). Maintenance was classified as low (1) impact if expenditures were above the mean (or high (2) otherwise) following the rationale that the more resources applied to maintenance, the less strategic impact the applications portfolio would have. The development portfolio impact was obtained by adding the low-high score of the six questions and comparing the sum obtained with the median for this variable.

Questions used in the questionnaire were inspired by and adapted from Cash, McFarlan and McKenny's [8, pp.220-223] example of how organizations are measuring strategic impact. Comparisons with the median and mean, when appropriate, were used instead of specific limits shown in the examples, thus making the measures used in this work adequate to the sample.

**End-User Computing Policies**

The end-user computing policy's level was measured using MIS hygienics and support dimensions where each one of the dimensions could assume a value of low (1) or high (2) level of formalization. The combination of scores obtained defines the type of EUC policies as shown previously in Table 4. Figure 5 displays the frequency distribution found in the sample.

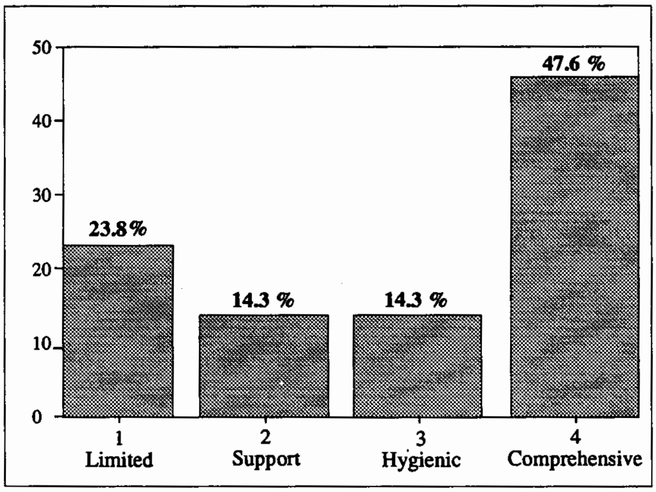


Figure 5: Frequency Distribution – End-user Computing Policies

The MIS hygienics policy's index was measured by four variables: hardware acquisition, software acquisition, corporate DB access, and security/copyright protection policies. These variables were obtained from questions, in a Likert-type four-point scale, asking the CIOs how formally the hygienics policies were defined in their organizations.

An MIS hygienics score was computed adding the answers of the four questions. Each company was then classified with low (1) or high (2) MIS hygienics if their scores were either lower or higher than the median score for all companies.

The MIS support policy's index was measured by two variables: end-user application/systems development and training. These variables were obtained from questions, in a Likert-type four-point scale, asking CIOs how formally the support policies were defined within their organizations.

An MIS support score was computed adding the answers for the two questions. Each company was then classified with low (1) or high (2) MIS support if their scores were either lower or higher than the median score for all companies.

### Statistical Procedures

The reliability procedure of SPSS was used to test for non-additivity and to obtain the coefficients of reliability reported in the operationalization of the variables when this procedure was appropriate.

The non-parametric correlation procedure of SPSS was used to compute the Kendall Tau-c simple correlation coefficients between research variables. All research variables except one, were measured in an ordinal scale or better; industry was measured in a nominal scale.

Partial correlations were computed to test the hypotheses. As shown by Blalock [4], the formulas for computing non-parametric partial correlations are the same as those used for computing the parametric partial correlation coefficients. Therefore, the New Regression procedure from SPSS was used for computing the non-parametric partial correlations by using as input the Tau-c correlation matrix previously obtained. The $R^2$ and F statistics computed by this procedure are meaningless [4] in the case, as well as the significance level for partial correlation coefficients, and will not be reported.

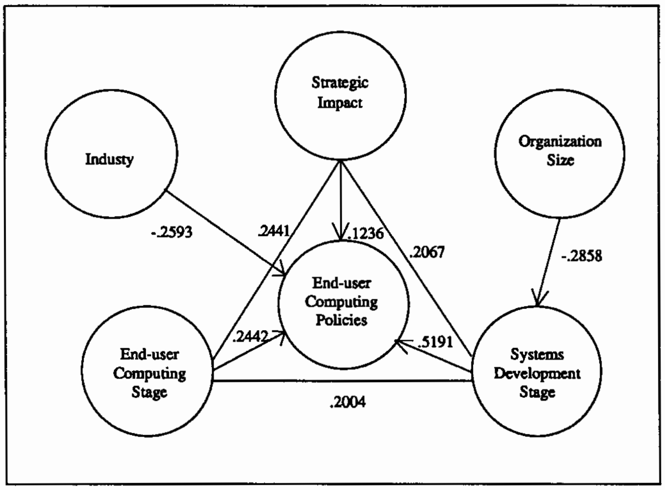


Figure 6: Summary results of effects on policies

## RESULTS AND CONCLUSIONS

The main results of this research are shown in Figure 6. Numbers displayed in the lines are partial correlation coefficients. The original simple correlations were all significant at 0.05 or better.

It seems that the systems development stage (a surrogate for DP/MIS) influences the most policy-making processes for end-user computing, followed by the end-user computing stage (a surrogate for users), and by the strategic impact type (a surrogate for top management). The industry type affects EUC policies, while organization size affects the systems development stage.

The three main explanatory variables (end-user computing stage, systems development stage, and strategic impact type) also are correlated, but no single variable can explain much of the variance of the others. Therefore, it seems that these three variables represent reasonably independent phenomena, as hypothesized.

Additionally, it also seems that the end-user computing policy-making process is affected differently by the same explanatory variables in regard to each specific policy, as shown in Table 8.

The end-user computing stage is the variable more closely associated with the determination of end-user hardware, software acquisition, and training policies, followed significantly by the systems development stage. Training policies also are influenced by the strategic impact type.

The systems development stage is the only variable found significantly associated with corporate data base access policies. Finally, it seems that end-user applications/systems development and security/copyright protection policies are more closely related to the systems development stage, followed significantly by the strategic impact type.

**TABLE 8**
**Effect on Policies**

| End-User Policy | EUC state | Systems Dev. state | Strategic Impact |
|---|---|---|---|
| Hardware acquisition | 0.5021 | 0.4969 | 0.1311* |
| Software acquisition | 0.4897 | 0.2646 | 0.0346* |
| Data base acess | 0.0819* | 0.3223 | 0.0442 |
| Application/systems dev. | 0.0883* | 0.4480 | 0.2696 |
| Security/copyright prot. | 0.1277* | 0.3169 | 0.3280 |
| Training | 0.4615* | 0.2632 | 0.2699 |

* Non-significant at 0.05

The above results lend support to the proposed framework of end-user computing policy-making process resulting from the influence of three different audiences: end-users, top management and DP/MIS management. The recognition of these independent and sometimes conflicting perspectives is fundamental to the adequate management of end-user computing.

It was somewhat surprising to find that just over half of the organizations in the sample (see Figure 3) had formalized systems development procedures, and none had yet adopted Computer-aided Software Engineering (CASE) technologies. Yet, the sample includes leading high-tech (such as computer and communication manufacturers) and main service companies (such as finance and insurance companies).

Similar situations also were found in regard to end-user computing stages (with less than half actually managing EUC) and policies (with less than half having comprehensive policies), as shown previously in Figures 2 and 5. As was illustrated, these situations are correlated.

The above results therefore suggest that policies for the management of end-user computing should not be considered independently. End-user computing policies seem to reflect the overall policies for management information resources in organizations.

**About the Author**

Al Bento is Professor and Chair of the Department of Accounting and MIS at California State University, Northridge. He is the Editor of JIRMS and an Officer of the Human Resources Management and Organization Behavior Association (HRMOB). His primary research interests are information resources management, user-analyst interaction in systems development, and end-user computing. Professor Bento received his Ph.D. in Computers and Information Systems from the Graduate School of Management, UCLA, and also holds a B.S.B.A. and an M.S. in Computer Science and Systems Engineering. He was previously on the faculty of California State University-Stanislaus, Bentley College, Boston University School of Management, and Federal University of Rio de Janeiro. Dr. Bento has worked as systems engineer and financial planning manager for IBM, and as MIS consultant for public and private organizations since 1968. He has more than thirty articles and research papers published and is a member of SIM, TIMS, DSI, HRMOB and AAA.

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