User Developed Applications: Evaluation of Success from the DP Department Perspective

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Abstract

User development of computer-based applications (UDA) is a new phenomenon in organizations, and can provide benefits for both users and data processing departments. The benefits of UDA for DP departments are considered in this article. The UDA literature suggests that DP departments can expect to receive two major types of benefits: a decrease in the backlog of DP application development projects and in the proportion of DP resources spent on application maintenance. However, this study, which was carried out in ten large Canadian business firms, found that in no instances were these factors cited by senior DP managers as primary success considerations.

Introduction

User development of computer-based applications (UDA) is a relatively new phenomenon that is occurring in many organizations today. Two major factors have contributed to the rapid growth of UDA. First, the extensive and ongoing decrease in computer hardware prices has made it possible for organizations of all sizes to place serious computing facilities in the hands of numerous non-data processing staff. The second factor has been the advent of "user-friendly" software, that is, software packages intended for the use of individuals with little or no knowledge of computing or data processing techniques. Much of this software consists of general-purpose tools that let users create their own applications [16]. This combination of inexpensive hardware and easy-to-use software has led to a rapid increase in the number of personal computers installed in firms [26], and in the number of data processing departments which have chosen to provide their users with mainframe access [25].

The "conventional wisdom," as reported in the UDA literature, suggests that the two primary benefits of UDA for DP departments are reduction of the application project backlogs, and reduction of the application maintenance load. However, the results of the research reported here show that these are not, in fact, the benefits of importance to the organizations studied.

This article will provide some background on the UDA phenomenon, including the "conventional wisdom" regarding UDA success from the DP management perspective. The research methodology used is presented, followed by a discussion of the study's major findings. A framework for UDA evaluation is proposed and illustrated in the contexts of the firms studied and the role of the DP department in the UDA evaluation process is discussed.

Background

There are two key "players" in the UDA movement: (1) the user community, which wants access to computing resources in order to carry out certain application development activities; and (2) DP management, which usually wants to facilitate and yet maintain control over UDA

Table 1. Some Characteristics of The Ten Firms Studied

	A	B	C	D
INDUSTRY	FINANCIAL	INSURANCE	UTILITY	MANUFACTURING
ASSETS	> $50 Billion	> $4 Billion	$1.3 Billion	$2.8 Billion
SALES	NOT APPLICABLE	> $4 Billion	$1.1 Billion	> $8 Billion
NUMBER OF EMPLOYEES	23,000	4,500	2,700	39,000
MONTHLY HARDWARE & COMMUNICATIONS RENTAL EQUIVALENT	> $2.5 Million	> $200,000	$225,000	$800,000
HOW IS UDA FACILITATED?	INFORMATION CENTER	INFORMATION CENTER	PRODUCT COORDINATORS	INFORMATION CENTER
LENGTH OF TIME THAT UDA HAS BEEN FACILITATED AS AT PRESENT	3½ YEARS	1½ YEARS	8 YEARS	2 YEARS

activities. To each player, UDA offers certain advantages.

To users, most of the advantages of UDA are related to the ultimate involvement of the user in the development process. Since users do not have to translate and communicate their information needs to outsiders, the problems inherent in determining information requirements are reduced or eliminated. UDA also has the potential of making application development a more flexible process, so users can readily adapt their applications when the need arises. These and other advantages, such as improved timeliness with which applications are developed and greater independence of users from the DP department, have been suggested in the UDA literature [5, 16, 18].

It has been argued that users cannot reap these benefits without active, ongoing support from the DP department in the form of user-oriented software tools, access to computing facilities, access to data, and training and support [16, 18]. Such DP contributions serve a control, as well as a facilitating function. In companies where DP units have attempted to inhibit UDA, user departments have often turned to locally purchased microcomputers or outside timesharing services. In such situations, dysfunctional effects are likely to

follow, such as "fragmented departmental data, poorly written user programs, and hardware that cannot be connected to a company's data network" [19, p. 5]. Moreover, the DP group's loss of control may lead to higher company data processing costs [24].

DP departments have taken a variety of approaches to support and control UDA. Some firms have designated "product coordinators" — individuals usually reporting to the DP unit who monitor and support end users in their use of a particular software tool. Another popular approach is the Information Center. In 1975, IBM established a user support group, and physically situated them in a central location together with open terminals, manuals, training aids, etc., in their Canadian headquarters. This group/location was referred to as the Information Center. IBM Canada experimented extensively with the Information Center concept and developed guides and other documentation based on their findings [8]. IBM and other companies are continuing to strongly market the Information Center concept to their customers [25]. Recent surveys indicated that over 40% of major IBM customers have an Information Center underway [21], and a considerably larger number of companies expect to implement one or more in the future [17].

E	F	G	H	I	J
FORESTRY	UTILITY	FINANCIAL	MANUFACTURING	COMMUNICATIONS	MANUFACTURING
$1.05 Billion	$1 Billion	>$60 Billion	$1.7 Billion	$2.3 Billion	$900 Million
NOT PROVIDED	$800 Million	NOT APPLICABLE	$1.4 Billion	$900 Million	$800 Million
7,000	2,400	28,000	11,500	14,400	5,000
$32,000	$200,000	$5 Million	$250,000	$460,000	$200,000
PRODUCT COORDINATORS	INFORMATION CENTER	USER COMPUTING FACILITIES	TIMESHARING SUPPORT GROUP	INFORMATION CENTER	PRODUCT COORDINATORS
10 YEARS	9 MONTHS	2 YEARS	11 MONTHS	4 YEARS	10 YEARS

A third form of DP support has entailed providing advice and assistance to users in the acquisition of microcomputers. This type of support is becoming increasingly important as more and more companies decide to incorporate microcomputers into their MIS strategy [9].

The implementation of DP department support for UDA involves substantial investment in software, computing capacity, terminals, support staff, and so on. Much of this investment must be borne and administered by the DP department. An important question then, concerns the benefits that the DP unit might expect for its efforts. The UDA literature suggests that DP departments can expect to receive two types of benefits: a decrease in the backlog of application development projects and a reduction of DP resources spent on application maintenance [8, 16, 18, 24].

Research Approach

At the time this study was conducted very little empirical research had been done on UDA. The authors of the existing UDA literature mainly reported opinions and beliefs based on their own or other's direct experience with UDA [4, 24], or based on their knowledge of the broader MIS field [5, 18]. An exception to this is Rockart and Flannery's case study of end user computing in a large company [23].

A clinical research approach was adopted in this study to investigate the UDA phenomenon and UDA success from the perspective of the DP department. The study was conducted in 10 of the 100 largest Canadian business firms. Table 1 provides some background information on the participating firms. The main criterion for choosing these organizations was the number of years experience they had had with UDA. Four firms (A, B, D, I) had substantial experience with UDA (two to three years) using the Information Center approach. Three companies (C, E, J) had extensive experience with UDA itself (six to twelve years), but did not have an Information Center. The remaining three organizations (F, G, H) were in an intermediate situation: UDA had existed in those three firms for several years, but an Information Center type of user support group was just being implemented.

The research findings presented here are primarily based on in-depth interviews, conducted with DP executives and other DP professionals

responsible for providing end user support services (Information Center managers, Information Center staff, product coordinators, etc.). Secondary sources of data used in the study include: (1) a DP profile questionnaire (from [6]), (2) internal documents made available by DP departments, and (3) direct observation [22].

Initial Definition of UDA Success

Drawing on the available literature, UDA success from the DP perspective consisted of two components:

1. decrease in the DP application project backlog; and

2. decrease in the DP maintenance load.

Difficulties in measuring these constructs were recognized at the start. Two specific problems with respect to measuring the application project backlog were foreseen. First, most organizations develop a number of different types of applications, and UDA would not reduce the backlog of all types equally. McLean, for example, has suggested that computer applications can be categorized as three types: personal applications, departmental applications, and corporate applications [18]. Personal applications are designed to serve the needs of an individual. "They draw upon capabilities, facilities and data that are already in place" [18, p. 42]. Departmental applications "provide the reports, both routine and special, the queries, the analyses, and the many other items of computer-based data that form the backbone of a department's management information system" [18, p. 43]. Corporate applications involve data from several departments and are generally large systems ". . . designed to meet external, as well as internal requirements" [18, p. 43].

The literature suggests that applications developed by users will usually be of the personal or departmental type [8, 18]. Consequently, what is important in studying the impact of UDA on the DP applications backlog is not so much the absolute backlog, but rather the *composition* of the backlog. Rosenberger, for instance, suggests that UDA would tend to "skim off the top" of the DP backlog those ill-defined, "one-shot" types of applications (usually of the personal and departmental type), while leaving the larger "production" projects untouched [24].

The second problem in measuring the change in the backlog is that other events, apart from UDA, may have taken place in an organization during the period in which change is measured. For instance, the DP department may have hired more programmers or analysts, or may have implemented some "modern programming techniques" [11] in order to increase the DP professionals' productivity. The backlog may also have appeared to decrease because users became so dissatisfied with the service provided by DP that they gave up requesting applications [1]. Consequently, when measuring change in backlog, it is necessary to take such factors into account.

Problems in measuring the decrease in the DP maintenance load were also foreseen. As in the case of application backlogs, attention must be paid to the *type* of maintenance being examined. Lientz, *et. al.*, [15] defined three types of maintenance: (1) corrective maintenance, which consists of emergency fixes and routine debugging, (2) adaptive maintenance, which pertains to "the accommodation of changes to data inputs and files and to hardware and system software" [15, p. 468], and (3) perfective maintenance, which encompasses changes due to user requests for enhancements, improved documentation, and recoding for computational efficiency. The literature suggests that UDA is most likely to impact perfective maintenance [18]. Thus, as with the impact of UDA on the DP application backlog, the key variable would be the *composition* of the maintenance load, rather than the overall load.

Research Findings Regarding UDA Success

As noted above, the initial definition of UDA success from the DP departments' perspective centered on the decrease in the application backlog plus the decrease in the maintenance load. As the field investigation progressed, this definition of success changed dramatically.

Table 2. DP Definition of UDA Success

COMPANY	PRIMARY DEFINITION	SECONDARY DEFINITION
A	Assurance that users use computer resources in a manner which is profitable to the firm	User satisfaction with IC services
B	Improvement in user productivity and in decision making outcomes due to UDA	User satisfaction with IC services
C	User satisfaction	—
D	User satisfaction	Assurance that users use computer resources in a manner which is profitable to the firm
E	Improved user productivity	—
F	Improved user productivity	—
G	User satisfaction	Decreased outside timesharing usage Assurance that users use computer resources in a manner which is profitable to the firm
H	Decreased outside timesharing usage	User satisfaction Assurance that users use the computer in a manner which is profitable to the firm
I	Assurance that users use the computer resources in a manner which is profitable to the firm	Decreased outside timesharing usage
J	UDA should be profitable for the firm (low cost, high user benefits)	Reduction of the number of small one-shot requests

In none of the ten firms studied was the decrease of application backlogs or maintenance load identified as being a primary aspect of success. Table 2 lists the primary and secondary definitions of UDA success for these 10 organizations, as provided by the DP managers. "User satisfaction" is identified by three of the ten DP managers interviewed as the primary indicator of UDA success. "User satisfaction" was taken by the DP managers to mean satisfaction with the services provided by the DP department, as evidenced by "no complaints." In the other seven firms, the DP managers indicated that "tangible benefits to the user community" were the primary measures of UDA success. Tangible benefits include such factors as improved user productivity, assurance that users apply the computing resources in a manner that is profitable to the firm, and decreased outside timesharing usage. Table 3 summarizes the results regarding UDA success, as viewed by the DP departments in the firms studied.

With regard to the original success indicators, "decrease in application backlog" and "decrease in maintenance load," the DP executives interviewed were asked to what extent they believed UDA would impact these factors. In most cases,

Table 3. Summary of DP Departments' Definitions of UDA Success

	Tangible Benefits to User Community	User Satisfaction
Primary Definition	7	3
Secondary Definition	2	3
TOTAL	9	6

these managers felt that UDA might have some effect on the amount of DP resources devoted to perfective maintenance or on the portion of the backlog which consists of smaller, "one-shot" applications. However, in *no* instances had the DP managers attempted to measure these factors. More importantly, the decrease of the applications backlog and the decrease of the maintenance load were *not* perceived by the DP executives as being important components of UDA success. Thus, the initial definition of UDA success as derived from the UDA literature was found to be inappropriate. The authors began to focus on the broader issue of overall *evaluation* of the UDA effort in an organization. In the next section, this issue is elaborated further, and a framework is proposed.

The Evaluation Issue

While the change that took place in the definition of UDA success from the DP department point of view is an important finding of the study, the research results suggest that the related *evaluation* issue is more critical. That is, in most cases DP executives accompanied their definition of UDA success with statements indicating that the DP department was responsible for demonstrating to top management that users indeed derived tangible benefits from the applications they developed. Furthermore, it appears that the DP executives were not always successful in demonstrating this. The following quotes from DP managers illustrate these points.

> "Unless we can demonstrate that the applications users develop are profitable to the company, we won't be able to assert that UDA is successful. And for the

> time being, we cannot perform such a demonstration."

> "The president comes from Finance. What he wants to see as a result of our efforts (to facilitate UDA) is a good ROI."

> "How do I define success? User satisfaction... However, we have to have "hard" numbers in order to assure top management that UDA is cost effective. It would be most embarassing for us to go to the steering committee with a demand for a $6 million increase (in computer capacity) to accomodate UDA if we cannot demonstrate that what users do is profitable for the company."

As indicated in Table 4, in seven of the participating firms, DP was responsible for demonstrating to top management that there were tangible benefits provided by the applications users developed. Interestingly, those seven firms were also the ones where an Information Center support group had been implemented. Although the available data do not allow conclusive testing of the question, this observation can perhaps be explained by the fact that establishment of an Information Center (IC) or similar group usually entails a significant expenditure for facilities and staff. Management perceives the IC as a type of data processing capital investment, and thus holds the DP department responsible for return on that investment.

Considering the experiences of DP departments that were successful in demonstrating the tangible benefits achieved through the applications users developed, and of departments which were less successful, the following views of evaluation seem to be most relevant to UDA:

Evaluation is a set of planned . . . activities undertaken to provide those responsible for the management of the change with a satisfactory assessment of the effects and/or progress of the change effort . . . (one) key word in this definition is planned. *Evaluation is often glossed over and viewed as an add-on or extracurricular activity of a change effort.* [2, p. 86].

Evaluation is part of the wider process of implementation and begins before the system is designed. [12, p. 19].

In his discussion of the implementation of decision support systems, Keen stresses the importance of a negotiated contract between the consultant (system designer) and client (user, top management). Also important is the fact that this negotiation should occur "well before the system is even designed" [12, p. 13]. Keen suggests the following as an "ideal agenda for negotiation":

1. define "success";

2. allocate resources and responsibilities;

3. develop methods and criteria for evaluation, including a consensus as to what "key indicator" may be used to test the status or accomplishment of the aim of the system [12, p. 23].

The experiences of the firms studied, taken in light of Keen's arguments, suggest that the evaluation process must begin before UDA is introduced. Moreover, it is critical that DP and top management negotiate a "contract," and that they both respect the terms of this contract. The following section proposes a framework for

evaluation of UDA, which borrows heavily from Keen's "ideal agenda for negotiation."

A UDA Evaluation Framework

The UDA evaluation framework illustrated in Figure 1 indicates that successful management of the UDA evaluation process should include four critical steps. While those steps are presented here in a linear fashion, it is likely that they overlap and that iterations will take place. The four steps are to; (1) define UDA success, (2) develop criteria, methods, and procedures for evaluation, (3) reach an agreement with top management with regard to (1),(2) and (3), and (4) implement the evaluation methods and procedures. In the discussion which follows, experiences of companies B and H are used to illustrate situations where the DP group successfully managed the UDA evaluation process. The experiences of companies A and D are presented to illustrate a case where the evaluation process was not as successfully managed.

Define UDA Success. From the DP department perspective, the definition of UDA success is closely related to the types of pressures for introduction of UDA being exerted upon it. In the cases of firms B and H, these pressures were clearly identified, and UDA success was readily defined. At H, the costs of outside timesharing had been doubling every year for a number of years. Both top management and DP management were concerned with the increasing costs. The DP department decided to introduce an in-house Timesharing Service, and defined UDA success as the "slow-down of the growth of outside timesharing, and eventual 'repatriation' of all outside timesharing usage."

Table 4. DP Departments' Roles in UDA Evaluation

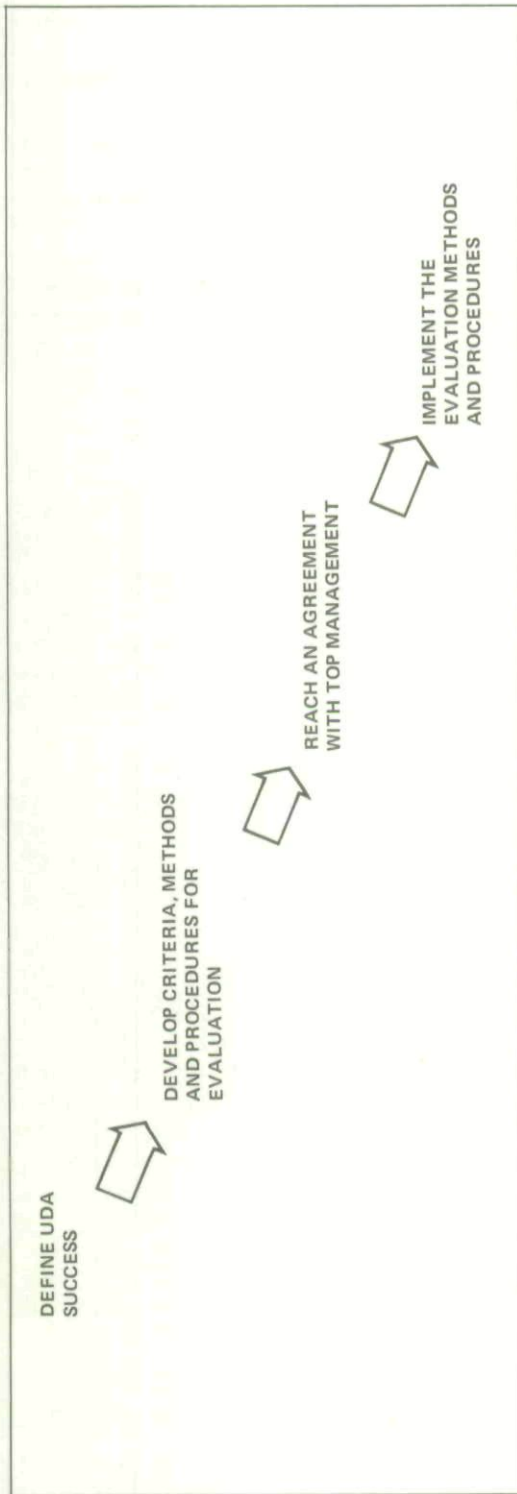|	A	B	C	D	E	F	G	H	I	J
Are users charged for UDA?	No	Yes	Yes	Yes	Yes	No	Yes	No	No	Yes
Is DP responsible for evaluation?	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes	No
How is UDA supported?	Information Center	IC	Product Coordinator	IC	PC	IC	IC	IC	IC	PC

At firm B, the DP group had received a mandate from top management to participate fully in the corporate effort to increase productivity. Providing users with UDA tools and support was identified by the DP manager as an appropriate way of increasing user productivity. The DP department defined UDA success as "the increase in user productivity and improvement in decision making outcomes."

Develop Criteria, Methods, and Procedures for Evaluation. For the DP unit at firm H, the procedures for evaluation of UDA success were rather straightforward. The outside timesharing expenses of user departments were monitored, particularly the expenses of two or three "heavy" outside timesharing user departments. The DP department directed much of its effort toward "repatriating" those heavy users.

At firm B, the DP group developed a document entitled "Information Center Guidelines for User Business Cases." Those guidelines, based on pilot studies conducted in the firm and on the experiences of other firms, assisted users in calculating the value of productivity improvements and the value of improved decision making capabilities that result from the applications they developed. Moreover, users were charged for the services they received from the Information Center, as well as for their use of computer resources. Finally, the manager in charge of the Information Center met with user management on a regular basis in order to assess, in "hard numbers," the cost effectiveness of UDA.

Reach an Agreement with Top Management. For both firms B and H, a consensus was reached with top management on the definition of UDA success and on the methods and procedures of evaluation. However, reaching such a consensus required strong arguments on the part of DP management. At firm B for instance, DP staff conducted pilot studies in order to demonstrate productivity improvements which could be obtained from the introduction of UDA. At company H, DP staff made several presentations to the firm's DP steering committee in order to make clear how the in-house Timesharing Service would "attack" the problem of outside timesharing use.

Implement the Evaluation Methods and Procedures. This step of the evaluation process comes after the UDA tools and support have been

Figure 1. A UDA Evaluation Framework

DEFINE UDA SUCCESS

DEVELOP CRITERIA, METHODS AND PROCEDURES FOR EVALUATION

REACH AN AGREEMENT WITH TOP MANAGEMENT

IMPLEMENT THE EVALUATION METHODS AND PROCEDURES

introduced. The responsibility of the DP group at this stage is to ensure that the evaluation procedures are appropriate and that they work well. In the case of firm B, for instance, the task of assessing the cost effectiveness of UDA required the manager in charge of the Information Center to obtain the collaboration of users. While this seemed to work well at company B, it was found to be more difficult to achieve in some of the other firms (company D for instance).

In contrast to these examples of successful management of the UDA evaluation process, two firms experienced significant difficulties. At company A, DP management defined UDA success as the assurance that the applications users developed were profitable for the firm. However, evaluation methods and procedures were not well developed. When the Information Center was introduced at firm A, it was decided that users should not be charged so that they would be encouraged to use the Information Center services and tools. Since they did not have to pay for the services, users were not motivated to determine the cost effectiveness of the applications they developed, and no mechanism existed to formally require users to assess the cost effectiveness of their applications.

The latter is a difficulty that company D also had to face. While users at D were charged for their use of the computer resources, there was no formal mechanism requiring them to assess the "profitability" of the applications they developed. In this case, DP management, together with the Information Center staff, bore the burden of proof but lacked the authority to require users to assess the value of their applications.

The proper role of the DP department in UDA evaluation

The foregoing framework is useful in examining why some DP departments are more successful than others in demonstrating to top management that tangible benefits are derived from the applications users develop. However, the framework takes for granted that DP will play a central role in the evaluation process. Whether, in fact, a DP department *ought* to play such a central role in UDA evaluation is a separate question.

Imagine a case wherein the DP group fails at its job of convincing top management that user

developed applications are cost effective (assuming, in fact, they are). In such a situation, senior management would be likely to register concern at the money being spent on UDA, and would decide to restrict the Information Center budget (as happened at firm D). This provoked negative user reaction against the DP department and the IC staff, as users perceived themselves as being poorly serviced in their UDA activities. Thus, the DP group was "caught in the middle," and was seen as a poor performer by both users and top management.

The solution to this problem seems clear. Users themselves should be held directly responsible for demonstrating that the applications they develop are cost effective for the firm. In order to make this feasible, a chargeback scheme would have to be implemented so as to provide a cost calculation mechanism for users' cost benefit analyses.

It might appear that users in organizations with no central DP chargeback scheme would not undertake UDA activities at all, since central DP services were "free," and they would be charged for UDA service. However, most users interviewed in this study indicated that such would not be the case: users *are* willing to pay (via their operating budget) for UDA support. Rockart and Flannery [23] drew a similar conclusion from the data they collected in one large company. They stated that "users are willing to pay significant hardware running cost premiums to get systems up and running quickly under their control" [23, p. 359].

This is not to imply that the DP group would not have a role in the evaluation process. However, this role would be one of advisor; that is, DP staff might assist users in their cost benefit analysis, but the final responsibility for demonstrating cost effectiveness would reside where it belongs — in the hands of the users.

The advantages of this approach to UDA evaluation are:

1. It properly couples the authority and responsibility associated with undertaking UDA activities.

2. It is more efficient since users better understand the situation surrounding their application. They are in a better

position to advocate the benefits (and delineate the costs).

3. It serves a purpose similar to UDA itself, that is, it distributes the evaluation activity "out to the users," thereby reducing the potential bottleneck that would be caused by limited central DP manpower resources.

4. Finally, it helps to make the end user better aware of the true costs and benefits of computer-based systems, by forcing him or her to think through carefully — and be prepared to defend — the benefits and costs of specific applications.

There are two major areas of difficulty posed by the approaches advocated above. The first involves the use of a chargeback scheme; the second concerns the non-tangible benefits that might be derived from the applications developed.

Effective use of chargeback as an information systems measurement and control mechanism is difficult [20]. If charges are not well understood by users, dysfunctional effects may occur. Criteria for effective chargeback systems are well known, but designing and implementing them is still a challenge [3].

Perhaps more problematic still is the use of intangible benefits [7]. While evaluation of the full spectrum benefits provided by information systems has been discussed in some depth in the literature [13, 14], the present study and other field studies suggest that most organizations still concern themselves only with measurable monetary benefits [10]. However, many of the computer applications which are developed by users themselves address decision support needs or similar requirements for which assessment of tangible benefits is difficult or impossible. The issue of intangible benefits is also of concern at the level of overall evaluation of UDA in an organization.

The value of reducing user frustration stemming from long waiting periods for new computer applications to be developed by the DP department does not lend itself to simple cost benefit analysis.

Summary

There is a growing literature addressing the concept of end users developing their own computer applications. These studies focus mainly on the advantages of UDA to users, although advantages to DP departments are also frequently discussed. Such investigations tend to emphasize reductions in the DP application development backlog and application maintenance load as being the primary advantages of UDA to DP departments.

The results of this study indicate that, rather than being concerned about impacts on either backlog or maintenance load, DP managers are primarily interested in being able to demonstrate that the applications developed by users are of demonstrable, tangible benefit to the organization, and that the users themselves are satisfied with the UDA services made available to them via the DP department. Moreover, it was found that the evaluation of such tangible benefits is a critical issue for DP managers. This article proposes a simple evaluation framework, based on an earlier model by Keen, to help explain why some DP departments are successful in their evaluation while others are not. Finally, this article argues that the responsibility of the evaluation should belong to users rather than to the DP department.

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