The relationship between user participation and system success: a simultaneous contingency approach

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Abstract

The relationship between user participation and information system (IS) success has drawn attention from researchers for some time. It is assumed that strong participation of future users in the design of IS would lead to successful outcomes in terms of more IS usage, greater user acceptance, and increased user satisfaction. However, in spite of this, much of the empirical research so far has been unable to demonstrate its benefits. This paper examines the participation–success relationship in a broader context, where the effects of user participation and two other factors, user attitudes and user involvement, on system success occur simultaneously. Other contingency variables considered here are: system impact, system complexity, and development methodology. The theoretical framework and the associated hypotheses are empirically tested by a survey of 32 organizations. Empirical results corroborate the positive link between user participation and user satisfaction and provide evidence on the interplay between user attitudes and user involvement. © 2000 Elsevier Science B.V. All rights reserved.

Keywords: User participation; System success; User satisfaction; User attitudes; User involvement; System impact; System complexity; Outsourcing; Contingency; Simultaneity

1. Introduction

User participation has long been regarded as an important factor to improve the chances of the success in developing an information system (e.g., \cite{6,31,36,68}). User participation refers to 'the various design related behaviors and activities that the target users or their representatives perform in the systems development process’ \cite{5}. Through participation, users of an information system (IS) can interact with system designers in the stages of planning, analysis, design, testing, and implementation and, hence, aid in many aspects of the system development process. A variety of development methodologies, such as codevelopment, participative design (PD) and joint application design (JAD), have been proposed to operationalize user participation \cite{3,10}.

There are a number of benefits which can be expected of such user participative behaviors. Ives and Olson \cite{37} have pointed out that user participation in system development can enhance system quality through a more accurate and complete identification of user information requirements \cite{60,63}, knowledge and expertise about the organization the system is
intended to support [49], avoidance of unacceptable or unimportant system features, and a better user understanding about the system. User participation is also believed to increase user acceptance of the system with a more realistic expectation about system capabilities [27], an opportunity for users and designers to resolve conflicts about design issues [41], users’ feelings of ownership toward the system, a decrease in user resistance to possible changes incurred by the system, and greater commitment from users [51]. In consequence, user participation has been extensively sought and encouraged by practitioners in developing IS [32].

In the meantime, researchers also have made great efforts to find the empirical evidence of efficacy of user participation in improving system success. However, the reported results have been mixed and fragmented. In an earlier comprehensive review of 22 empirical studies conducted from 1959 to 1981, Ives and Olson were able to identify only eight (36%) that show a positive link between user participation and some measure of system success, including system quality [9,24], system usage [68], user behavior/attitudes [1,35], and information satisfaction [22,30,38]. The results from other studies are either inconclusive or contrary to expectations.

Cavaye [11] has reviewed 19 more recent studies published from 1982 to 1992, but also found only seven (37%) of them can substantiate a positive participation–success relationship [2,7,14,16,23,40,42]. Despite the fact that 10 more years of research have lapsed, the progress seems to be limited and slow. The findings are still mixed and fragmented.

Researchers have identified several possible causes of the ambiguity and contradiction. Poor research methods and the omission of important contextual factors are possible causes [53]. Also a simple direct causal relationship between user participation and system success may not be sufficient. DeBrabander and Edstrom [13] suggested that the context in which the system is being developed has to be considered. Hence, the contingency approach has been widely utilized to address this issue (e.g., [17,43,48,50,54,64,65,69]). This is helpful in identifying factors that may alter the consequences of a process. However, most of these models are sequential, with assumed direct causal relationships.

Furthermore, it is suggested that several confounding constructs have to be carefully defined to reduce the possibility of confusing results (e.g., [6,44]). Hwang and Thorn [34] meta-analyzed 25 studies and found ‘both user involvement and user participation are beneficial, but the magnitude of these benefits much depend on how involvement and its effects are defined’.

The purpose of this paper is to explore the relationship between user participation and system success in a broader context where all major effects on system success are simultaneously and jointly determined. Due to the complexity of this scenario, we believe it is beneficial and appropriate to study the relationship by means of a simultaneity and contingency approach.

2. Theoretical model and hypotheses

The terms user participation and user involvement in virtually all MIS research were used interchangeably in the past. To align research with the relevant concepts in such disciplines as psychology, marketing, and organizational behavior and, hence, to take advantage of their experience, Barki and Hartwick [6] felt it was necessary to differentiate between these two constructs, with user participation referring to ‘the behaviors and activities that the target users or their representatives perform in the systems development process,’ and user involvement to ‘a subjective psychological state of the individual,’ depending on the importance and personal relevance that users attach to a particular system or to IS in general. Fig. 1 presents our theoretical model.

2.1. Participation–success relationship

User participation in the IS development process has been regarded as a special case of participative decision making (PDM), which refers to group decision making. Participation from users can be classified into type and extent. The type may be consultative, representative, or consensus. The extent increases in degree from consultative to consensus [57]. Because the degree of participation is a more general concept than the type, it is used in this study to measure user participation.
System outcome, though difficult to be measured in economic terms, has a number of surrogates [6]. Garrity and Sanders [26] have suggested considering multiple perspectives. System use is frequently used to measure system success when system use is discretionary or voluntary [15]. However, user satisfaction is the most widely used measure for system success in the literature. In this study, user satisfaction is used as the surrogate for system success.

Significant empirical results from PDM suggest a positive relationship between the degree of participation in decision making and decision acceptance (e.g., [33,47,66]). This would suggest that there is a positive relationship between the degree of user participation and system success. Accordingly, it is hypothesized that:

Hypothesis 1. User satisfaction (X1) of using the information system increases with higher degree of user participation (X2) in the development process.

2.2. Simultaneous relationship: user participation, attitudes, and involvement

There is a difference between user involvement and user participation. User involvement is a subjective psychological state reflecting the importance and personal relevance that a user attaches to a given system. At the same time, user involvement is different from user attitude, which has been defined as an affective or evaluative judgment toward some object or behavior, measured by a procedure that specifies the individual on a bipolar scale (e.g., good or bad) [21]. Therefore, in IS development, user attitude reflects a psychological state that shows the user’s feelings about a new IS.

Thus, user participation is conceptualized as a behavioral construct (the degree of participative behaviors of users during the development process), while user involvement and user attitudes are psychological constructs. The relationships among user participation, user attitudes, and user involvement appear to be interrelated and complex. This leads to the hypotheses:

Hypothesis 2A. User participation (X2) increases with more favorable user attitudes (X3) toward the proposed system.

Hypothesis 2B. User participation (X2) increases with more user involvement (X4).

Many early researchers claimed that users who are actively participants in the system development
process are likely to establish the feeling that the system is good. Participants become acquainted with the new system. Their uncertainty and fear is alleviated through the participative process.

Information systems which are thought to be both important and personally relevant to users are also likely to result in positive affective or evaluative feelings of the users. Similar supports for this argument can be drawn from relevant research in other disciplines. Persons who are highly involved with an issue have been found to possess more favorable attitudes about the issue (e.g., [67]). In marketing, customers who are highly involved with a product have been found to develop more positive feelings toward this product (e.g., [25,62]). Organizational behavior research shows that employees who are highly involved with their jobs have been found to appreciate their jobs (e.g., [39]). It is, therefore, hypothesized that:

**Hypothesis 3A.** User attitudes (X3) become more favorable through more user participation (X2).

**Hypothesis 3B.** User attitudes (X3) become more favorable with more user involvement (X4).

A number of psychological theories are able to elucidate the positive influence of user participation on user involvement. Cognitive dissonance theory [20] and attribution theory [8] suggest that a person’s beliefs will be aligned with his or her behaviors. Robey and Farrow [63] have claimed that participative users may change system attributes to meet their needs and desires, and help develop a system deemed as important and personally relevant.

The correlation between user involvement and user attitudes is bi-directional. Persons with extreme attitudes toward an issue tend to develop belief that the issue is both important and personally relevant. Millman and Hartwick [55] have argued that users with positive attitudes toward the new systems tend to become more involved. As a result, two hypotheses are made:

**Hypothesis 4A.** User involvement (X4) increases with more user participation (X2).

**Hypothesis 4B.** User involvement (X4) increases with more favorable user attitudes (X3).

### 2.3. Contingency factors

The contingency factors which have been studied in previous research include system complexity (e.g., [52]), stage development, resource constraints (e.g., [18]), communication, user attitudes, degree of user involvement, management styles, top management support, system impact, etc. It would be unwieldy and imprudent to incorporate all of these factors into one model. This study considers three other important contingency factors: system impact (X5), system complexity (X6), and development methodology (X7).

System impact refers to the potential changes in the organization brought about by the system. A new IS may incur organizational changes, such as jobs, interpersonal relationships, and organizational structure. Positions in the organization may be eliminated or created, and the job descriptions of people may be altered to incorporate different responsibilities.

Based on organizational change theory, it is known that people are used to the status quo and any disruption of the organizational balance would evoke human resistance. It is, therefore, hypothesized that:

**Hypothesis 5.** System impact (X5) has a negative influence on user attitudes (X3).

System complexity arises in the developer’s environment and refers to the ambiguity and uncertainty that surround the practice of development. A complex IS is considered difficult to develop due to the large number of interdependent parts and the lack of a model structure. It is hypothesized that

**Hypothesis 6.** Higher degree of system complexity (X6) results in more user participation (X2).

Development methodologies range from traditional system development life cycle, prototyping, off-the-shelf software, and end-user computing, to outsourcing. Among these development methodologies, outsourcing has drawn much attention recently and is now in vogue in the IS domain [56].

When outsourcing shifts the burden of developing a system to outside parties, it also appears to reduce user responsibility for developing and validating the complex evolving IS functions as well as the need to learn how to apply new technologies. Such a mitigation in
the responsibility as a consequence of outsourcing may mislead users to the belief that the outsourced IS is less important and less personally relevant. Moreover, one major disadvantage of outsourcing is the loss of control [46]. Therefore, it is hypothesized that

**Hypothesis 7. Outsourcing (X7) leads to less user involvement (X4).**

3. Estimation models

3.1. The structural form

The simultaneous contingency model can be expressed as a simultaneous-equations system of the following form:

\[ X_{1i} = \beta_{10} + \beta_{12}X_{2i} + v_{1i}, \quad i = 1, 2, \ldots, n \quad (3.1) \]

\[ X_{2i} = \beta_{20} + \beta_{23}X_{3i} + \beta_{24}X_{4i} + \beta_{26}X_{6i} + v_{2i}, \quad i = 1, 2, \ldots, n \quad (3.2) \]

\[ X_{3i} = \beta_{30} + \beta_{32}X_{2i} + \beta_{34}X_{4i} + \beta_{35}X_{5i} + v_{3i}, \quad i = 1, 2, \ldots, n \quad (3.3) \]

\[ X_{4i} = \beta_{40} + \beta_{42}X_{2i} + \beta_{43}X_{3i} + \beta_{47}X_{7i} + v_{4i}, \quad i = 1, 2, \ldots, n. \quad (3.4) \]

Three contingency variables X5, X6 and X7 (system impact, system complexity, and outsourcing) are the exogenous (independent) variables which are determined outside of the model. Variables X1, X2, X3 and X4 (system success, user participation, user attitudes, and user involvement) are the endogenous (jointly dependent) variables that are interdependent and should be determined jointly. Since there are four endogenous variables, there are exactly four equations in the simultaneous-equations system.

The hypotheses established from the relationships in the simultaneous contingency model as well as the associated coefficients are summarized in Table 1, in which the dependent variable is highlighted in boldface and an independent variable is expressed in normal font.

A model is identified if it is in a unique statistical form, enabling unique estimates of its parameters to be subsequently made from sample data. An equation is under-identified if its statistical form is not unique; otherwise, it is exactly- or over-identified. It is necessary that the order condition for identification be satisfied for each equation in the system. The order condition stipulates that the number of variables (exogenous) excluded from an equation should be greater than (over-identification) or equal to (exact identification) the number of endogenous variables in the equation less one [28,29].

The application of the order condition to the simultaneous Eqs. (3.1)–(3.4) reveals that Eq. (3.1) is over-identified, and Eqs. (3.2)–(3.4) are exactly-identified. None of the equations is under-identified and, consequently, there is no problem of identification.

3.2. Estimation issues

The ordinary least squares (OLS) estimation method is not appropriate because the estimators of the structural coefficients are biased and inconsistent due to the so-called simultaneity bias or simultaneous-equation bias [45]. Instead, the methods of two-stage least squares (2SLS) and three-stage least squares (3SLS) should be used.

The major difference between 2SLS and 3SLS lies in the assumptions underlying the random errors \( v_1, v_2, v_3 \) and \( v_4 \) of Eqs. (3.1)–(3.4). If the \( v \)'s of these equations are correlated (i.e., \( E(v_jv_k) \neq 0 \), for \( j, k \in \{1, 2, 3, 4\} \) and \( j \neq k \)), then 3SLS is more appropriate than 2SLS because it produces more efficient

<table>
<thead>
<tr>
<th>Relationship</th>
<th>Hypothesis</th>
<th>Coefficient</th>
<th>Direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>System success (X1)</td>
<td>User participation (X2)</td>
<td>( \beta_{12} )</td>
<td>+</td>
</tr>
<tr>
<td>User participation (X2)</td>
<td>User attitudes (X3)</td>
<td>( \beta_{23} )</td>
<td>+</td>
</tr>
<tr>
<td>System complexity (X6)</td>
<td>User participation (X2)</td>
<td>( \beta_{42} )</td>
<td>+</td>
</tr>
<tr>
<td>System impact (X5)</td>
<td>User attitudes (X3)</td>
<td>( \beta_{43} )</td>
<td>+</td>
</tr>
<tr>
<td>User involvement (X4)</td>
<td>User participation (X2)</td>
<td>( \beta_{26} )</td>
<td>+</td>
</tr>
<tr>
<td>Outsourcing (X7)</td>
<td>User involvement (X4)</td>
<td>( \beta_{47} )</td>
<td>—</td>
</tr>
</tbody>
</table>

Table 1

Hypotheses tested and associated coefficients

3.1. The structural form

The simultaneous contingency model can be expressed as a simultaneous-equations system of the following form:

\[ X_{1i} = \beta_{10} + \beta_{12}X_{2i} + v_{1i}, \quad i = 1, 2, \ldots, n \quad (3.1) \]

\[ X_{2i} = \beta_{20} + \beta_{23}X_{3i} + \beta_{24}X_{4i} + \beta_{26}X_{6i} + v_{2i}, \quad i = 1, 2, \ldots, n \quad (3.2) \]

\[ X_{3i} = \beta_{30} + \beta_{32}X_{2i} + \beta_{34}X_{4i} + \beta_{35}X_{5i} + v_{3i}, \quad i = 1, 2, \ldots, n \quad (3.3) \]

\[ X_{4i} = \beta_{40} + \beta_{42}X_{2i} + \beta_{43}X_{3i} + \beta_{47}X_{7i} + v_{4i}, \quad i = 1, 2, \ldots, n. \quad (3.4) \]
estimates. Such correlations among the random errors could be present if other possible contingency variables are unintentionally omitted from the simultaneous contingency model, leaving the influence of these omitted variables to be absorbed by the random errors of the equations and rendering the random errors correlated.

3.3. The reduced form

The reduced form of the structural form can readily be obtained through an algebraic operation. First, the structural-form equations are written in matrix form:

\[ \hat{Y}_i = B \hat{X}_i + V_i \]  

(3.5)

where

\[ \hat{Y}_i = (X_{1i}, X_{2i}, X_{3i}, X_{4i})' \] is the 4 \times 1 column vector of the endogenous or jointly dependent variables, \( X_i = (1, X_{5i}, X_{6i}, X_{7i})' \) is the 4 \times 1 column vector of the exogenous variables and \( V_i = (v_{1i}, v_{2i}, v_{3i}, v_{4i})' \) is the 4 \times 1 column vector of the random disturbances,

\[ B = \begin{bmatrix}
1 & -\beta_{12} & 0 & 0 \\
0 & 1 & -\beta_{23} & -\beta_{24} \\
0 & -\beta_{32} & 1 & -\beta_{34} \\
0 & -\beta_{42} & -\beta_{43} & 1
\end{bmatrix} \]

is the 4 \times 4 matrix of coefficients of the simultaneously dependent variables, and

\[ \Gamma = \begin{bmatrix}
-\beta_{10} & 0 & 0 & 0 \\
-\beta_{20} & 0 & -\beta_{26} & 0 \\
-\beta_{30} & -\beta_{35} & 0 & 0 \\
-\beta_{40} & 0 & 0 & -\beta_{47}
\end{bmatrix} \]

is the 4 \times 4 matrix of coefficients of the exogenous variables.

Secondly, premultiplying the structural form (3.5) through by \( B^{-1} \), the inverse of \( B \), and rearranging yields the reduced form in matrix terms:

\[ Y_i = \Pi X_i + W_i, \]  

(3.6)

where

\[ \Pi = -B^{-1} \Gamma = \begin{bmatrix}
\pi_{10} & \pi_{11} & \pi_{12} & \pi_{13} \\
\pi_{20} & \pi_{21} & \pi_{22} & \pi_{23} \\
\pi_{30} & \pi_{31} & \pi_{32} & \pi_{33} \\
\pi_{40} & \pi_{41} & \pi_{42} & \pi_{43}
\end{bmatrix} \]  

(3.7)

is the 4 \times 4 matrix of the reduced-form coefficients, and \( W_i = B^{-1} V_i \) is the 4 \times 4 matrix of the reduced-form random disturbances.

Alternatively, we can write out the reduced-form system (3.6) algebraically, analogous to the structural-form Eqs. (3.1)–(3.4):

\[ X_{1i} = \pi_{10} + \pi_{11} X_{5i} + \pi_{12} X_{6i} + \pi_{13} X_{7i} + w_{1i} \]  

(3.8)

\[ X_{2i} = \pi_{20} + \pi_{21} X_{5i} + \pi_{22} X_{6i} + \pi_{23} X_{7i} + w_{2i} \]  

(3.9)

\[ X_{3i} = \pi_{30} + \pi_{31} X_{5i} + \pi_{32} X_{6i} + \pi_{33} X_{7i} + w_{3i} \]  

(3.10)

\[ X_{4i} = \pi_{40} + \pi_{41} X_{5i} + \pi_{42} X_{6i} + \pi_{43} X_{7i} + w_{4i} \]  

(3.11)

Each of the reduced-form equations shows the dependence of an endogenous variable on all of the exogenous variables and a random disturbance. Thus, it enables us to find the total effect (sum of the coefficient estimates) of the exogenous contingency variables on an endogenous variable.

4. Research method

4.1. Data collection

We conducted a survey of 154 organizations randomly selected throughout the US to gather the data. The survey was directed to organizations that were under or had just completed the implementation of a new IS. Most of the organizations surveyed belong to the manufacture and service industries, and some were non-profit entities. The response rate was 54%. Excluding those returned blank or with incomplete information requested, the valid responses from 32 of the surveyed organizations were used to estimate the simultaneous contingency model and test the hypotheses presented. From the viewpoint of statistics, the sample size is considered large enough (\( n \geq 25 \)). Users and system designers were surveyed separately to elicit data on different measures.

4.2. Measurement of variables

Several previous and useful studies were used as guidelines to design the survey questionnaire and to measure the relevant variables. They are listed in Table 2.

The survey involves 53 questions. Most of the questions contain five to six bipolar adjective pairs in a question. For each pair, the respondents were
requested to check or circle the numbered box that is considered most suitable in the seven interval scale (from 1 to 7). The weights used to quantify the scaling of the seven intervals (boxes) went from $-3$ through $+3$. During computation, these were assigned weights $1, 0.85, 0.70, 0.55, 0.40, 0.25, \text{and } 0.10$. The score was then computed using

$$S_i = \sum_{j=1}^{n} R_{ij} W_{ij}$$

where $R_{ij} = \text{the reaction to factor } j \text{ by individual } i$, and $W_{ij} = \text{the importance of factor } j \text{ to individual } i$ [4].

### 4.3. Data analysis

The Cronbach alpha reliability coefficient [12] was computed to assess the reliability of the responses to all instruments. The alpha coefficients for system success, user participation, user attitudes, user involvement, system impact, and system complexity are 0.91, 0.86, 0.83, 0.89, 0.78, and 0.72, respectively. These alpha reliability coefficients are favorably comparable to those reported in the literature and exceed the commonly accepted level of 0.70 used in social sciences studies. The descriptive statistics of the variables and the corresponding correlation matrix of the variables are shown in Tables 3 and 4, respectively.

### 4.4. Estimation results

Three estimation methods, OLS, 2SLS, and 3SLS, are applied to estimate Eqs. (3.1)–(3.4) of the simultaneous contingency model. The system estimates by 3SLS are more efficient than the 2SLS estimates if the random errors $v$’s of structural Eqs. (3.1)–(3.4) are correlated. The estimation results by OLS, 2SLS and 3SLS are summarized in Table 5, which shows that the OLS estimation yields one estimate ($b_{35}$, which is underlined) with the sign contrary to the expected direction, while the 2SLS and 3SLS estimates correspond to all the theoretical expectations. This abnormal sign may be attributed to the simultaneous-equation bias resulting from the inappropriateness of the OLS applied to estimate Eqs. (3.1)–(3.4) of the simultaneous-equations system. Therefore, we conclude that, for the simultaneous contingency

<table>
<thead>
<tr>
<th>Variable</th>
<th>Instrument</th>
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<tbody>
<tr>
<td>User satisfaction ($X_1$)</td>
<td>[4,36]</td>
</tr>
<tr>
<td>User participation ($X_2$)</td>
<td>[53,61]</td>
</tr>
<tr>
<td>User attitudes ($X_3$)</td>
<td>[19]</td>
</tr>
<tr>
<td>User involvement ($X_4$)</td>
<td>A Likert-type scale from 1 to 7</td>
</tr>
<tr>
<td>System impact ($X_5$)</td>
<td>[52]</td>
</tr>
<tr>
<td>System complexity ($X_6$)</td>
<td>[52]</td>
</tr>
<tr>
<td>Outsourcing ($X_7$)</td>
<td>Dummy variable (1: outsourced; 0: inhouse)</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Variable</th>
<th>$X_1$</th>
<th>$X_2$</th>
<th>$X_3$</th>
<th>$X_4$</th>
<th>$X_5$</th>
<th>$X_6$</th>
<th>$X_7$</th>
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<tbody>
<tr>
<td>Mean</td>
<td>0.986</td>
<td>1.276</td>
<td>1.521</td>
<td>1.661</td>
<td>1.057</td>
<td>$-0.024$</td>
<td>0.607</td>
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<tr>
<td>Std. dev.</td>
<td>0.459</td>
<td>0.824</td>
<td>0.759</td>
<td>1.093</td>
<td>0.633</td>
<td>0.427</td>
<td>0.497</td>
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<table>
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<tr>
<th>$p_{ij}$</th>
<th>$X_1$</th>
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<th>$X_5$</th>
<th>$X_6$</th>
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</thead>
<tbody>
<tr>
<td>$X_1$</td>
<td>1</td>
<td>0.368</td>
<td>0.596</td>
<td>0.634</td>
<td>0.655</td>
<td>0.347</td>
<td>0.129</td>
</tr>
<tr>
<td>$X_2$</td>
<td>0.368</td>
<td>1</td>
<td>0.181</td>
<td>0.009</td>
<td>0.090</td>
<td>0.355</td>
<td>0.211</td>
</tr>
<tr>
<td>$X_3$</td>
<td>0.596</td>
<td>0.181</td>
<td>1</td>
<td>0.470</td>
<td>0.555</td>
<td>0.010</td>
<td>0.324</td>
</tr>
<tr>
<td>$X_4$</td>
<td>0.634</td>
<td>0.009</td>
<td>0.470</td>
<td>1</td>
<td>0.753</td>
<td>0.095</td>
<td>0.148</td>
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<tr>
<td>$X_5$</td>
<td>0.655</td>
<td>0.090</td>
<td>0.555</td>
<td>0.753</td>
<td>1</td>
<td>0.208</td>
<td>0.132</td>
</tr>
<tr>
<td>$X_6$</td>
<td>0.347</td>
<td>0.355</td>
<td>0.010</td>
<td>0.095</td>
<td>0.208</td>
<td>1</td>
<td>0.067</td>
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<td>$X_7$</td>
<td>0.129</td>
<td>0.211</td>
<td>0.324</td>
<td>0.148</td>
<td>0.132</td>
<td>0.067</td>
<td>1</td>
</tr>
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</table>
model developed above, 2SLS and 3SLS are more appropriate than OLS to obtain the estimates of the structural coefficients in Eqs. (3.1)–(3.4).

In addition, one can observe that the 3SLS estimates are more efficient than their 2SLS counterparts. This then suggests that some other contingency variables were unintentionally omitted from the simultaneous contingency model, as it is theoretically and practically impossible to consider all contingency variables.

The reduced form (3.6) in matrix formulation or Eqs. (3.8)–(3.11) can be estimated by using the relationship (3.7) between the structural coefficients ($B$ and $G$) and the reduced-form coefficients ($\Pi$). The estimates of $\Pi$ are given in Table 6 and reflect the total effect of one exogenous contingency variable on each endogenous variable.

Table 6
Estimates of the reduced form

<table>
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<th>$\pi$</th>
<th>Method</th>
<th>2SLS</th>
<th>3SLS</th>
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<tbody>
<tr>
<td>$\pi_{10}$</td>
<td>0.527</td>
<td>1.399</td>
<td></td>
</tr>
<tr>
<td>$\pi_{11}$</td>
<td>0.361</td>
<td>$-0.133$</td>
<td></td>
</tr>
<tr>
<td>$\pi_{12}$</td>
<td>0.000</td>
<td>3.453</td>
<td></td>
</tr>
<tr>
<td>$\pi_{13}$</td>
<td>0.076</td>
<td>$-0.212$</td>
<td></td>
</tr>
<tr>
<td>$\pi_{20}$</td>
<td>0.859</td>
<td>1.608</td>
<td></td>
</tr>
<tr>
<td>$\pi_{21}$</td>
<td>0.332</td>
<td>$-0.105$</td>
<td></td>
</tr>
<tr>
<td>$\pi_{22}$</td>
<td>0.000</td>
<td>2.721</td>
<td></td>
</tr>
<tr>
<td>$\pi_{23}$</td>
<td>0.070</td>
<td>$-0.167$</td>
<td></td>
</tr>
<tr>
<td>$\pi_{30}$</td>
<td>0.578</td>
<td>2.086</td>
<td></td>
</tr>
<tr>
<td>$\pi_{31}$</td>
<td>0.798</td>
<td>$-0.162$</td>
<td></td>
</tr>
<tr>
<td>$\pi_{32}$</td>
<td>$-1.591$</td>
<td>3.437</td>
<td></td>
</tr>
<tr>
<td>$\pi_{33}$</td>
<td>0.192</td>
<td>$-0.229$</td>
<td></td>
</tr>
<tr>
<td>$\pi_{40}$</td>
<td>$-0.018$</td>
<td>2.423</td>
<td></td>
</tr>
<tr>
<td>$\pi_{41}$</td>
<td>1.451</td>
<td>$-0.256$</td>
<td></td>
</tr>
<tr>
<td>$\pi_{42}$</td>
<td>$-1.599$</td>
<td>5.898</td>
<td></td>
</tr>
<tr>
<td>$\pi_{43}$</td>
<td>0.118</td>
<td>$-0.462$</td>
<td></td>
</tr>
</tbody>
</table>

* significant at the 0.05 level; and ** significant at the 0.01 level.

From the hypothesized directions, it is expected that the total effects of system impact on system success, user participation, attitudes, and involvement (i.e., $\pi_{11}$, $\pi_{21}$, $\pi_{31}$ and $\pi_{41}$, respectively) must be all negative. All the 3SLS estimates match, and all the 2SLS estimates violate, the expectations. This serves as a further evidence that 3SLS is more appropriate than 2SLS in estimating the simultaneous contingency model. Similarly, the total effects of system complexity and outsourcing on the endogenous variables must be positive and negative, respectively. Again, the 3SLS estimates correspond to, but the 2SLS estimates fail to meet, the anticipated directions. Thus, we may conclude that the 3SLS method is indeed a better choice than the 2SLS method.

5. Discussion

5.1. Effect of user participation on system success

One of the main hypotheses of this study is empirically to corroborate the positive influence of user participation on the successful outcome of system implementation. Based on the results, Hypothesis 1 is confirmed.

It should be pointed out that this finding does not come from a hypothesized simple direct causal equation of user participation and system success, estimated by the classical OLS. Instead, it is implied by the simultaneous contingency model estimated by the more rigid methodologies of estimation. The simultaneous contingency model appears to be a better and more appropriate alternative to examining the relationship between user participation and system success.
5.2. Simultaneous relationship: user participation, attitudes, and involvement

The positive effects of user attitudes and involvement on user participation are consistent with our theoretical expectations. But both are statistically insignificant (and hence Hypotheses 2A and 2B are not supported by the data).

The influences of user participation and user involvement upon user attitudes are consistent with the hypothesized directions but the estimates are not significant, and Hypotheses 3A and 3B are not confirmed.

There is a relatively large and positive association of user participation with user involvement but is again not statistically significant and Hypothesis 4A is not confirmed. User attitudes have been found to exert a significant and positive effect on involvement ($\beta_{43} = 0.986$ from 3SLS which is significant at the 5% level) and, hence, Hypothesis 4B is supported by the 3SLS estimate.

5.3. Effects of contingency factors

System impact as a contingency factor has been found to have a negative effect on user attitudes but it is not significant. Hence, Hypothesis 5 is not supported.

The association of system complexity with user participation is positive and significant at the 5% level ($\beta_{26} = 0.608$ from 2SLS and 0.407 from 3SLS) and, hence, Hypothesis 6 is supported. IS managers ask users to participate more in systems which are technically complex, in order to facilitate the development process and increase the likelihood of system success.

Outsourcing has a negative effect on user involvement but the result is not significant. Therefore, Hypothesis 7 is not supported. This may suggest that outsourcing is rarely simple. Which aspects of outsourcing are significant to users is an interesting research question.

Fig. 2 presents the simultaneous contingency model along with the hypotheses tested and the structural coefficient estimates obtained by 3SLS.

5.4. Total effects of exogenous variables on the jointly dependent variables

Based on the estimates of the structural form and the reduced form, we are able to compute the total effects

![Diagram](image-url)
of exogenous variables on the endogenous variables, as presented in Table 7.

The structural total effect on a jointly dependent (endogenous) variable includes the effect of other jointly dependent variable(s) and the contingency variable(s) appearing in the same equation, while the reduced total effect on a jointly dependent variable is the sum of the effects of all contingency variables serving as the exogenous variables in the simultaneous contingency model. The difference between 2SLS and 3SLS is comparatively larger in the reduced form than in the structural form; this is because the reduced form shows the compound effects of all the exogenous contingency variables on each endogenous variable, while the structural form basically reflects the sum of the direct effects of relevant variables in the equation corresponding to this endogenous variable.

For system success, the structural total effect (1.088 from 2SLS and 1.269 from 3SLS) is the same as the direct effect of user participation since user participation is the only dependent variable in the system success equation.

### 5.5. Managerial implications

Several managerial implications can be drawn for IS practitioners. First and foremost, this study confirms the positive contribution of user participation to successful system outcomes. Therefore, IS managers should encourage (or stipulate) active participative behaviors from users during the system development process.

Such a need for user participation is especially important when the systems to be developed are technically complex. User participation may be promoted as a social process of interaction between users and designers through which both parties can learn about each other’s expectations and requirements, and hence resolve their conflicts [58,59].

Managers should also pay attention to the psychological states of users toward the systems. The feelings of the users for or against the systems are interrelated with the importance and personal relevance users perceive about the systems. User participation should have more efficacy if such behaviors originate from the underlying favorable attitudes and spontaneous involvement, instead of from manager’s forcible orders. Therefore, management may want to foster an atmosphere that helps users perceive the importance of the system and enhances their favorable attitudes toward the system, in order to facilitate user participation in the development process.

### 6. Conclusions

In the design and development process of a new IS, the effect of user participation on system outcome is supposedly positive but should not be taken for granted. Such an effect must be scrutinized by considering the contextual environment. It is necessary to include the relevant contingency factors that may affect user participation and system success both directly and indirectly. However, it is equally important to notice that the scenario may not be as sequential. A research model based on the contingency approach and the simultaneity analysis was proposed and empirically tested to investigate the proposition that the relationships among the contingent factors are determined simultaneously, rather than sequentially.

The estimation results affirm the positive link between user participation and system success, and suggest that user participation, user attitudes, and user involvement form a circular relationship. It implies that getting users involved in the development process may improve their attitudes toward the system and enhance the importance and relevance users perceive about the system. Furthermore, the empirical results show that system complexity has a significant effect on user participation.

We conclude by indicating that the simultaneity or interdependence methodology is in sharp contrast with
the sequential causality methodology and that the former may be superior in applied MIS research. This research may answer the call of methodological rigor in IS empirical studies. We hope that more answers to this call are forthcoming.

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References

[33] R. Hoffman, R.J. Burke, N.R.F. Maier, Participation,
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