# Impact Of Employee Reaction And Turnover Rates On The Successful Implementation Of An Information System: A Game Theory Approach

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**ABSTRACT**

*A perusal of the literature on Management Information Systems reveals 2 important issues that the field continues to investigate. First is the role of user reaction (resistance or acceptance) in the successful implementation and working of a new information system (IS). Second is the issue of the continued high rate of turnover of employees in MIS careers. These two branches establish two facts -that user reaction plays a crucial role in determining system success, and that a high rate of turnover in careers is a problem for any organization. In this paper, I ask whether these 2 issues are related. Using game theory, I develop a theoretical framework to assess whether employee turnover rates interact with employee reaction to influence the successful implementation of a new IS in any firm. In other words, if there is a high turnover rate, does this increase the users' resistance to the implementation of a new information system? The answer depends on several factors such as the initial cost of implementation, the rate of turnover, relative compensation of the players, and the personal rates of discounts of the players.*

## INTRODUCTION

Broadly speaking, there are two basic bands of research in the field of Information Systems (IS). First, IS research investigates the reasons for the success (and failure) of information systems (Lyytinen, 1988: Sauer, 1993: Wastell, 1999: Yoon et al 1995). This investigation has established user reaction as one important factor that determines such success (Maish, 1979). Another stream of IS research studies the various aspects of Management Information Systems (MIS) careers: the reasons for high employee turnover in MIS careers, (Igbaria and Greenhaus, 1992) and the theoretical aspects of such turnovers (Ginzberg and Baroudi, 1988). These two branches of IS work establish two facts: that user reaction plays a crucial role in determining system success, and that a high rate of turnover in MIS careers is a problem for any organization.

It is true that there maybe a high rate of turnover in personnel in any organization and that most organizations continue to implement new information systems. Given this, I develop a game theory framework to analyze whether in any firm, employee turnover rates influence employee reaction to a new IS, and how this interaction impacts the success of the new IS. I ask the following questions: Does the presence (absence) of high turnover rates change the way employees react to a new IS? If so, how does this impact the successful implementation of a new IS?

The primary concern of a substantial portion of IS research has been the identification, operationalization and measurement of the factors that make an information system successful. The importance of system success has been underlined by the failure of many information systems. Information system development projects often run over budget, require expensive budget changes, and are developed but not implemented (Tait and Vessey, 1988). Factors believed to affect the successful development and implementation of an IS system range from the characteristics of the task, the staff, the organization (Zmud, 1981) to factors such as individuals and organizational reaction to systems implementation (Maish, 1979). A review of the various reasons for IS success is presented in DeLone and McLean, 1992. Of the six categories they identify, the one relevant to this study is the 'USE" variable – the interaction between the intended user of the system with the information system.

Empirical forays into the relationship between user involvement and system success have largely proved inconclusive (Alter, 1978: Alter and Ginzberg, 1978: Gallagher, 1974: Guthrie, 1974: Lucas, 1975, 1976: Maish, 1979: Olsen and Ives, 1981: Powers and Dickens, 1973: Schewe, 1976: Swanson, 1974: and Tait and Vessey, 1988). Ives and Olsen (1984) review 22 empirical studies of the effect of user involvement on system success. They reach three conclusions (as presented in Tait and Vessey, 1988). First, that research based on user involvement is rarely based on strong theory. Second, that empirical research has not convincingly demonstrated the benefits of user involvement. Finally, that the majority of studies on user involvement have been methodologically flawed to the extent that few conclusions can be made about the relationship of user involvement to system success.

This paper addresses the first of these conclusions. I present a theoretical model of user implementation. The model allows for the possibility of different rates of turnover. I ask whether a high turnover rate increases the user's resistance to the implementation of a new information system. The answer depends on several factors such as the initial cost of implementation, the rate of turnover, relative compensation of the players, and the personal rates of discounts of the players.

The paper proceeds as follows. In section II, I present the theoretical model and discuss the results. I conclude with suggestions for future research in section III.

## THEORETICAL MODEL

When studying user reaction to new information systems, the rate of turnover plays a crucial role. This paper explores the implication of this role for the success of an information system. Specifically, does the existence of a high turnover rate imply increased user resistance to the implementation of an IS system.

### The Model

Suppose the manager or supervisor in a firm is considering implementing a fully functioning information system into her department. The average employee in that department, Player I, is the direct user of the system.

#### *Modeling User Reaction*

Player I has the option to adopt the system into her every day work, or proceed without it. In other words, Player I can implement the system, cooperate (C), or not implement the system, not cooperate (NC). [1] Every other employee in the department (Player II) has the same option. The payoffs that the players receive are a function of the actions they choose. In this setup, the payoffs indicate the change in compensation that the players receive as a consequence of their actions.

If Player I cooperates, she bears a one-time cost, C, of implementing the new IS in period 1. This cost can be thought of as the time and effort needed for Player I to learn the new system. She also earns a benefit, $B_1$, from her increased efficiency. Therefore, her net benefit in period 1, $NB_1$, is the benefit accruing from the new IS, less the cost of learning the system. That is:

$$NB_1 = B_1 - C.$$

If Player I does not implement the system, she still receives the benefit $B_1$ in period 1 from the new IS system, but does not bear the cost, C. This can happen, for instance, if the new IS increases the efficiency and reputation of the department. Player I herself does not contribute to the increased efficiency, but receives the accolades. This kind of positive externality means that in period 1, her payoff is $B_1$ ($> NB_1$).

[1] This terminology is adopted merely for the sake of convenience. It follows closely the terminology of the Prisoner's Dilemma - a game after which this one is modeled.

There is, however, a cost to not cooperating. The non-cooperating player will incur this cost in the next period, and it will persist in subsequent periods. This cost (A) can be thought of as a bad performance review that goes into the player's "permanent record" and lowers her compensation relative to her colleagues.

Note that if nobody implements the new IS system, they all receive the same benefit as before the game started. This benefit is $B_0$, and it is higher than the first period benefit from implementing, but lower than the benefit from implementing in the absence of cost. In other words,

$B_1 > B_0 > NB_1$

I assume common knowledge. Each player is fully cognizant of the others strategies (C, NC) and payoffs. The players are fully rational. They choose actions that maximize their respective payoffs. The game in the first period is represented in Figure 1 below.

**Figure I**

| | | **Player I** | |
|---|---|---|---|
| | | Cooperate **(C)** | Not Cooperate **(NC)** |
| **Player II** | Cooperate **(C)** (Implement) | $NB_1$, $NB_1$ | $NB_1$, $B_1$ |
| | Not Cooperate **(NC)** (Not Implement) | $B_1$, $NB_1$ | $B_0$, $B_0$ |

If both players choose NC, choose not to implement the system, [south east cell], there is no increased benefit from the IS, so they both earn $B_0$. If they cooperate, and implement the system, then they gain $NB_1$ [northwest cell] each. The interesting case is when one player decides to implement the system, but the other does not. This situation can arise if, for instance, one employee of the department decides that the cost of implementing is too high, and chooses to free ride. This case makes especial sense in situations where the employee is planning to leave the company. The player who chooses NC can still makes a positive gain ($B_1$). $B_1$ can be thought of as the benefits of the increased productivity of the player's coworkers, a positive externality.

*Modeling Turnover Rates*

Next, I introduce the possibility of different turnover rates. I basically ask the question, will the employee leave her current job soon. The employee is in the job, but we don't know for how long. Let p be the probability that the player will stay in this job. In other words, p is the probability that game will continue in the next period. High turnover rate implies low p, and vice versa.

**Results**

*The payoffs*

This is a one-time game with repeated payoffs. I calculate the present value of payoffs to the player for a finite game with end period unknown in 2 scenarios: Player cooperates and implements the IS, or Player does not cooperate and does not implement the system.Her payoff from cooperating, $\pi_c$ :

$$NB_1 + B_1\left[\frac{p}{(1+r)}\right] + B_1\left[\frac{p}{(1+r)}\right]^2 + B_1\left[\frac{p}{(1+r)}\right]^3 + \ldots\ldots\ldots\ldots\ldots + = NB_1 + B_1\left[\frac{p}{(1-p)+r}\right]$$

The first term in the expression, $NB_1$, is her payoff from incurring both the cost and benefits of implementing the IS in the first period. The subsequent terms represent the present value of her payoffs in the future.
Her payoff from not-cooperating, $\pi_{nc}$:

$$= B_1 + (B_1 - A)\left[\frac{p}{(1+r)}\right] + (B_1 - A)\left[\frac{p}{(1+r)}\right]^2 + (B_1 - A)\left[\frac{p}{(1+r)}\right]^3 + .......+ = B_1 + (B_1 - A)\left(\frac{p}{(1-p)+r}\right)$$

The first term in the expression, $B_1$, is her payoff from incurring the benefit of the new IS in the first period, without bearing the cost. The subsequent terms represent the present value of her payoffs in the future. Notice that this payoff includes A. A is subtracted from the non-cooperating payoff because an employee who does not implement the IS in the first period is "punished" by receiving a bad performance review in the next period. This permanently lowers her compensation relative to her coworkers.

In both cases, p is the probability that the game will continue in the next period. It is a measure of turnover. The internal discount rate, r, is a measure of the patience of the player. In other words, it measures how (un)willing the player is to postpone consumption to the future. A high r implies more impatience, and vice versa.

The player will cooperate, that is, implement the system if the payoff from implementing is higher than the payoff from not implementing. In other words, the IS will be successful if:

$$\pi_c > \pi_{nc}$$

That is:

$$NB_1 + B_1\left[\frac{p}{(1-p)+r)}\right] > B_1 + (B_1 - A)\left[\frac{p}{(1-p)+r)}\right]$$

This reduces to:

$$C - A\left(\frac{p}{(1-p)+r}\right) < 0 \tag{1}$$

*Analysis of the result*

Let us examine equation (1). The condition will hold, that is the IS will be successful, under the following circumstances: If C is relatively small, if A is relatively large, if p is relatively large, or if r is relatively small. Before discussing the implications of these magnitudes, let us restate the condition in the form of a credible trigger strategy. Solving for r yields:

$$r^* = p\left(\frac{A}{C} + 1\right) - 1 \tag{2}$$

In this equation, r* is an equilibrium threshold value. If the player's discount factor of future earning is below this value, she will cooperate. If it is greater than r*, she will not-cooperate. If we think of r* as a market interest rate, then this condition says that if the player's r is higher than r*, she will not cooperate, and the IS implementation will fail. So for a successful implementation, r* has to be large. This makes it likely that employee's internal r will be smaller than r*. Therefore, the information systems will be successfully implemented under the following circumstances:

- r small: If the player's internal rate of discount is lower than the market rate, she will implement the system. In other words, if the player is intrinsically a patient person and is willing to postpone consumption, she will implement the system. In terms of the game, this means that she is willing to wait for the higher payoff in the future. In other word, she tends to pay less attention to the cost of implementing the system and more to the future benefits from the system.
- C small: From equation (2), dr*/dC is negative. This means that a decrease in C will increase r*. This makes it less likely that the player's internal r will be bigger than r*. Intuitively, the smaller the initial cost of implementing the system, the more likely that the player will adopt the new system.
- A large: Again from equation (2), we see that dr*/dA is positive. This means that an increase in the value of A will increase r*. In other words, if there is a possibility that the player loses a lot from a bad performance review such that her compensation turns out to be a lot less than her coworkers, she will be more likely to adopt the IS, and therefore cause it to be successful.
- p large: dr*/dp is positive. An increase in p will increase r*. A higher p means that there is a higher probability that the game will continue in the next period. Remember that this is our measure of the rate of turnover. A higher p means a low turnover. This condition thus says that the lower the turnover rate, the more likely that the player will adopt the system. Naturally, if the employee is considering staying with the firm, she will lean toward learning and using the new system. So, firms with low turnover rates have a greater chance of IS success. Note that this completely matches our intuition, and the experience of MIS firms. They tend to have high turnover rates (low p), and therefore lower rates of successful implementation of new IS.

Several observations can be made from these results. The most obvious ones relate to the values of C and A. A manager should attempt to implement those systems which are relatively easy to learn. This lowers C and makes success more likely. If C is high, however, all is not lost. The manager can increase A relative to C, so that, even when C is high, the employee gains a lot in compensation for adopting the system. In fact, even when both p and r have magnitudes that are incompatible with the success of an IS (e.g. for employees close to retirement), increasing A could influence them to adopt the IS.

Also, notice that r and p are closely related. It might appear that they should be part of a singe variable. This could be the case, for instance, if the intended user of the IS is close to retirement. The costs of learning and using the new technology may outweigh the benefit that she personally derives from it. Being close to retirement would mean that the user discounts the future heavily, i.e., her r would tend to have higher values. Also, by definition, a person who is close to retirement has low p (will leave very soon). The combination of a high r and low p makes it unlikely that she will implement the IS.

However, in several situations r and p may be influenced separately. A person may be intrinsically an impatient person, and is considering leaving the firm (p value uncertain). In this case, the manager can provide incentives to the employee to stay, thereby lowering her p. Notice that the person remains intrinsically an impatient person, so that her r is unchanged.

As pointed out above, firms with high rates of turnover will find it harder to have success in adopting new systems. Notice that the converse is not necessarily true, especially for a firm with a lot of employees who are impatient. In other words, if people are impatient (r high), they will resist the IS even if the organization is not facing a high turnover rate (p low). We can conclude that even if turnover rates are low, the user has an incentive to resist IS implementation.

## CONCLUSION

In this paper, I study the impact of the interaction of user reaction and turnover rates on the successful implementation of a new information system. The interaction is modeled using game theory. I find that the conclusions depend on the initial cost of implementation, the rate of turnover, relative compensation of the players, and the personal rates of discounts of the players.

As expected, high turnover rates are an important reason for the lack of IS implementation. Organizations that experience a high rate of employee turnover should expect to see a large proportion of its information technology unused. However, even when turnover rates are low, if the players have high internal discount rates, the new IS will not be readily implemented.

Firms that implement new systems that are time consuming, and difficult to learn and adopt, will not have much success with new systems. On the other hand, if the employees are penalized heavily in the form of bad performance reviews for not using the system, so that their compensation is much smaller than their coworkers', the chance of successful adoption of the system increases.

Research future research can be two-pronged. The theoretical model can be extended in various ways. First, the manager's role can be modeled explicitly. For instance, the manager could be the third player. She could be facing a pool of users in an asymmetric information situation (does not know who the potential implementers are). This sort of Bayesian updating model could provide more practical solutions to firms adopting new systems. Second, the game could be a repeated game, where the user has option to implement the new system in (every) any period. Third, the incentive structure could be changed. For instance, A may not be permanent.

On the empirical front, the major conclusions could be tested using historical data. Alternatively, the results could be tested using a laboratory experimental setting.

These theoretical and empirical extensions have the potential to enrich the current model and yield prescriptions for the manager of any firm, as well as for information systems developers.

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**NOTES**