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# Transactive Memory Structures and Collaborative Information Technology Role in Turbulent Teams: An Experiment

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### ABSTRACT

This research examines the role of collaborative information technologies and their interaction with transactive memory. We simulated a project group where members worked towards completing an interdependent sequence of tasks to reach a common goal. In our experiments, we observed that the change in technology functionalities did not affect group performance significantly although their impact on transactive memory strength was significant. Additional analyses showed that these functionalities can increase the team performance when a dynamic event such as departure occurs in a group. In summary, the role of technology can be unclear in a static group but collaborative information technologies can moderate the impact of a dynamic event on the team performance.

### Keywords

Collaborative Information Technologies, Transactive Memory Systems, Performance, Team Member Departure, Mediation Effect.

### INTRODUCTION

The role of information technologies on performance has been a topic of debate both in academia and practice. Businesses used nothing more than best practices and benchmarks to decide on the level of information technology (IT) investment and use of IT functionalities, and they questioned its return especially during financial downturns.

Starting with the evidence on IT productivity paradox by Brynjolfsson (1996) the number of studies questioning the value of information technology has been increased (Aral et al. 2006; Dewett et al. 2001; Kanawattanachai et al. 2007; Sambamurthy et al. 2003). However, they either provided mixed evidence on the value of IT or listed negative consequences of the use of IT (Dewett et al. 2001). For example, Brynjolfsson (1996) showed that IT has an impact on productivity but not necessarily has an impact on the profitability which is quite confusing for businesses. In such research, the use of secondary data prevented researchers from understanding the processes that would explain how information technology can increase performance. This study focuses on specific functionalities of information technologies to explain the ways in which those functionalities could enhance collaboration performance.

Information technology is a general term that might include a wide spectrum of functionalities and it is often loosely used. In this research, we analyze the role of collaborative information technologies (CIT), defined as the integrated sets of information processing functions that facilitate knowledge sharing and integration among inter-connected entities (Pavlou et al. 2007). CITs can incorporate a set of functionalities such as storage, synchronousity, workflow management, and richness. For example, email can be used as a CIT that has limited storage capability with lower synchronousity than video conferencing. A common web space, and versioning system has excellent storage function, but it lacks in synchronousity and richness. To understand how each of these CIT functionalities play a role in a collaboration, we employ transactive memory theory (Wegner 1986).

Transactive memory (TM) is based on the idea that collaborators can serve as external memory aids, and theory deals with the encoding of external knowledge, in other words, who knows what (Wegner 1986). Transactive memory systems (TMS) is a developed group theory proposing that the encoding, storage, retrieval and communication develops in groups, hence forming specialized team members (Hollingshead 2001; Wegner 1986).

Prior experiments on TMS consisted either memory recall tasks in dyads (Hollingshead 1998a; Hollingshead 1998b; Wegner et al. 1991) or they were based on physical tasks that require co-location such as radio assembly (Lewis 2003; Lewis et al. 2007; Liang et al. 1995; Moreland et al. 2000). However, in this age, physical presence is not a requirement for many tasks that create value in a project. Therefore, we designed a brand new experiment where subjects work on a virtual task, drawing certain shapes on the computer, and combine them to produce the final product: a picture.

### Objective

The objective of the experiment is to understand the role of collaborative information technologies (CITs) and departure of a team member. Therefore, independent variables in this experiment are collaborative information technologies and team member departure. Moreover, we used specialization, credibility and coordination components of TMS (Lewis 2003) to measure the group's TM as a latent variable. We hypothesize, TMS level acts as a mediator between departure and team performance. Lastly, we explore the impacts of aforementioned variables' role on (the dependent variable) team performance, which is a combination of task output performance evaluations (Hackman 1987).

### Hypotheses

Departure of a team member initiates a complex chain of events in teams. Departure is felt as skill loss, distortion of regular flow and psychological distress. If the departing member's skill is valuable for the project tasks, lost skill is taken by the departing team member can affect the future task quality. In our experiments, we also realized that completed tasks may be lost along with the skill of the departing collaborator, which doubles the impact of lost skill if the storage system is not effective.

A shared mental model is developed about how tasks are distributed among team members in the early stages of the collaboration and it is developed over time. An unexpected departure directly removes a node in the social network of who knows what, and creates a structural hole in that network. Therefore the team must reallocate previously assigned tasks that cost time and effort which otherwise can be used on tasks in hand. The loss of time and effort damages the overall performance (Hackman et al. 1976).

Psychological distress can emerge after unexpected events and it can significantly reduce the efficiency of an individual. The departure of a team member is a good example of an unexpected event. The shared cognition of the team structure and all relationships pertaining to the understanding of the social structure changes after departure (Cannon-Bowers et al. 2001). Not only remaining individuals' mental states but also the shared cognition of the team can be affected from this distress. Therefore, an unexpected departure reduces team performance.

*HYPOTHESIS 1a: Member departure leads to reduced team performance*

The above arguments also explain why transactive memory of each team member can be damaged in case of departure. Departure of a useful team member (who is effectively working on task completion) alters the processes in a team (Moreland et al. 2003). Aggregate skill level lessens, trust in others' credibility reduces and coordination is disturbed. The aggregation of these negative impacts reduce TMS strength since specialization, credibility and coordination are factors of TMS.

Departure has a tendency to harm all interdependent tasks and people related to departed member (Arrow et al. 2000; Levine et al. 2005). The credibility damage is a direct result of the skill reduction in the subgroup. Dependents are believed less in finishing the assigned task on time and with the sufficient quality. Through these changes, a team's specialization structure, credibility and coordination factors and thus its TMS strength is negatively affected.

*HYPOTHESIS 1b: Member departure leads to reduced transactive memory strength*

CITs have different functionalities that facilitate knowledge integration. Firstly, CITs enable communication among team members (Pavlou et al. 2007). These functionalities can reduce effects of departure including skill loss, distortion of regular flow and psychological distress.

Storage functionality can act as a backup repository that can be used in case of departure. The immediate benefit of using an effective repository system may not be noticeable. Or worse, the costs of procuring and using a storage system may exceed its benefits. Therefore, investment on a CIT with storage functionality can have negative returns. However, in our observations we saw that repository functionality is immensely used in case of a crisis event such as departure. For that reason, storage functionality may be confusing in a routine environment but it becomes functional once the departure occurs.

Workflow management tools provide a second layer of protection against process distortion after departure. Problems can be solved faster when there is common knowledge on "who knows what" and "how much they know". After departure, remaining tasks can be allocated according to stored common knowledge of skills. Credibility component of TMS is also directly affected from the use of workflow management tools (WMT). Team members are endowed with a permanent of addressing the work done and who has done it. This helps credibility which since an aggregated record of performance is more reliable than human memory.

Other functionalities such as synchronous and rich communication help aforementioned problem solving and task reallocation. Being synchronous provides speed and being rich helps in accuracy.

*HYPOTHESIS 2: When facing member departure with greater CIT functionality, the team performance is reduced less than when facing member departure with less CIT functionality.*

TMS Strength – Team Performance connection has been analyzed in the literature but we argue that TMS is can also act as a mediator in explaining how and why events like departure and technology functionalities plays a role in team performance. Moreover, this empirical study intends to validate theoretical work done on TMS mediation.

*HYPOTHESIS 3: TMS mediates the relationship between collaborator departure and team performance.*

Figure 1 depicts the hypothesis and the theoretical model used in the structural equation model.

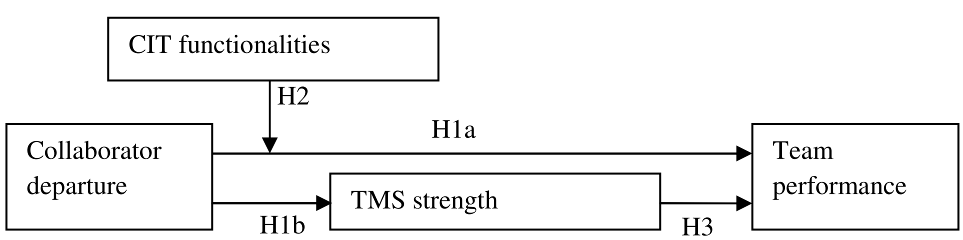



**Figure 1. Conceptual model used in SEM**

## METHOD

### Participants

Subjects in this experiment were 120 students recruited from two sections of an undergraduate course at a large public university in the southwest United States. Course instructors, who were not involved in the research, gave participating students extra credit toward their course grade. There were 79 female, 41 male participants averaged 20 years in age. We used three-member teams both because it is the most economical size and teams quickly learn their routine and members focus on efficiency especially in small teams with sizes from three to ten (Levine et al. 2005). Subjects are randomly assigned to three-member groups. Subjects are given code names (Red, Yellow, and Blue) and they are asked to use only those names. All experiment communications occurred between aforementioned anonymous code names, so previous relationships between subjects and identities became irrelevant.

All experiments conducted at the same location, Behavioral Research Laboratory of a University setting. Subjects were in the same room but located at separated workstations where communication other than provided CIT level is not possible. Two to four groups were used in each session to create competition for better performance and additional motivation. All trainings and debriefs were given in video format to ensure standardization among different groups.

### Procedure and Tasks

The objective was to draw different shapes in each round (see Figure 2), paint them, and combine them to form bigger objects such as a farm (which is the combination of house and barn.) Finally, they completed a picture using previously drawn objects. All subjects were given thorough and detailed sketch/task guidelines.

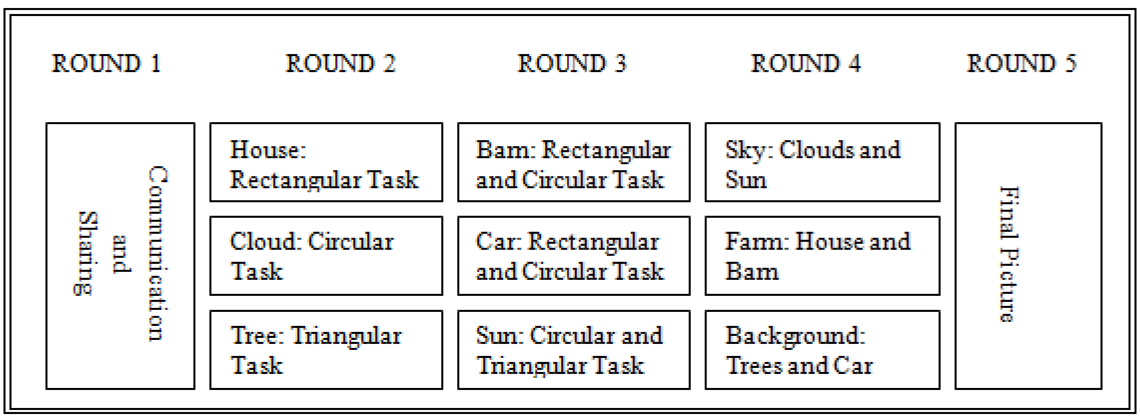



**Figure 1. Summary of each round's task objectives**

The treatments were the departure and the CIT level. Departure treatment had two levels: when a team member left after round 3 or stays. Providing CIT that complements task required a little more complex subdivision. Team members are assigned conjunctive tasks with reciprocal interdependency in our experiment. Therefore one treatment group provided with tools that have a technical fit to the task characteristics. Treatment 1 received a set of CIT that includes a messenger, pooled repository and planning tool that complements tasks better. The other treatment group used only a messenger that allows dyadic sharing with no storage capability. Table 1 is a summary of the treatment sets and their properties.

| | | Collaborative information technologies | |
|---|---|---|---|
| | | High CIT functionality | Low CIT functionality |
| Departure | Yes | • Available CIT components:<br>Google Talk<br>Webspace folder<br>Workflow management tool<br>• One team member leaves after round 3 | • Available CIT components:<br>Google's messenger in browser<br>No storage folder<br>Memoryless rating system<br>• One team member leaves after round 3 |
| | No | • Available CIT components:<br>Google Talk<br>Webspace folder<br>Workflow management tool<br>• Team continues round 4 with all members | • Available CIT components:<br>Google's messenger in browser<br>No storage folder<br>Memoryless rating system<br>• Team continues round 4 with all members |

**Table 1. Summary of the treatment sets and their properties**

## Measures

The experiment is controlled by the independent variable departure which is moderated by the CIT-functionality. We measured transactive memory system (TMS) as the mediator and team performance as the dependent variable. Moreover, we controlled for demographics, motivation and prior experience with the technologies provided in the experiment. Variables' definitions, variation procedure, measurements and control mechanisms are as follows:

*Independent Variable: Departure*

Departure is the sudden exit of a current member from the collaborating social group. Sudden departure usually leads to unfinished tasks that would contribute towards the completion of the project. In this experiment the team member with the highest centrality is selected to depart. Principal investigator selects him/her after the third round upon the highest frequency of interaction.

*Moderator: CIT Functionality*

Collaborative information technologies (CIT) enable communication among team members (Pavlou et al. 2007). Secondly, they offer a repository for completed tasks and all previous versions (Kock 2001; Neus et al. 2005). Last but not least, for departure they provide an effective means of WMT that report the amount of work done and the person who had done it. CIT level provided at two different levels (see table 1) and its impact controlled by post experiment survey and discussions.

*Mediator: TMS*

Transactive memory system (TMS) in this experiment is measured by a 9 item scale survey to compute team level latent variables of specialization, credibility, and coordination adapted from Lewis (2003). Survey was applied to all rounds, to observe the development of TMS throughout the experiment duration. TMS Measurement by means of the recalled information is commonly used in the literature previously since the establishment of TMS theory by Wegner (Hollingshead 1998; Liang et al. 1995; Moreland et al. 2000; Wegner 1986); however, our experiment is designed over creative interdependent tasks that fit better with Lewis' measurement scheme.

*Dependent Variable: Team Performance*

The dependent variable is team performance, which is measured by two researchers where inter-rater agreement (Cohen's Kappa) is found to be substantial (0.78).

Ratings are given according to the contribution to the team, timeliness, and quality ratings. We chose to move from self reported performance evaluation to the researcher evaluation where raters evaluated performance according to strict guidelines. Quality and timeliness ratings are measured with the following guideline and aggregated to form a performance measure.

| Timeliness rating | Definition |
|---|---|
| 5 | WELL BEFORE: Subject completed tasks under 10 minutes |
| 4 | ON TIME: Subject completed tasks between 10 and 15 minutes |
| 3 | LATE: Subject completed tasks between 15 and 20 minutes |
| 2 | VERY LATE: Subject completed tasks after 20 minutes |
| 1 | NOT FINISHED: Subject did not complete the tasks |

**Table 2. Timeliness measure guidelines**

Quality of work is rated by two referees whom are not principal investigators according to the guideline below. Raters are provided with detailed guidelines of the shapes that will be drawn with the guideline.

| Quality rating | Definition |
|---|---|
| 5 | Shapes are perfect according to the given specifications: full compliance |
| 4 | Shapes are slightly imperfect: isosceles triangle is tilted, or less than 0.1 inch short |
| 3 | Shapes have visible issues but they are complete : i.e. ellipses instead of circles |
| 2 | Shapes are incomplete: there is a missing tire on the car or a window on the house |
| 1 | Shapes are not drawn correctly or not drawn at all: i.e.: draw tree instead of a house |

**Table 3. Quality measure guidelines**

Initially, the experiment subjects filled a survey about their demographical characteristics and their prior experience on CIT and drawing tools. A post experiment survey collected after the tasks completed. Post-experiment survey used to check departure and CIT-level manipulations as well as task complexity, CIT usefulness, and motivation.

## ANALYSIS AND RESULTS

In this study, we utilized SPSS version 17 and WarpPLS, a Partial Least Squared (PLS, a second-generation multivariate method) based, structured equation modeling (SEM) tool to analyze the data. PLS and WarpPLS allowed us to identify the linear and nonlinear relationship among the latent variables/constructs with their estimated coefficients of the paths as well as the regression between latent variables. Both PLS and WarpPLS appraise the theoretical model and the measurement model simultaneously (Chin et al. 2003).

Table 4 reveals the bivariate correlations of the latent variables as well as the means and standard deviations as represented in the last two rows. The significance level of the relationships are 0.05 for (*) and 0.01 for (**).

| | Departure | TMS | Performance | CIT |
|---|---|---|---|---|
| Departure | (1) | | | |
| TMS | -0.485** | (1) | | |
| Performance | -0.333* | 0.352* | (1) | |
| CIT | 0 | 0.257 | 0.138 | (1) |
| Mean | 0.500 | -0.095 | 0.009 | 0.500 |
| Std. Dev. | 0.506 | 0.351 | 0.556 | 0.506 |

**Table 4. Correlations, mean and standard deviation values**

Notes:

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).
-Std. Dev.: Standard Deviation.

Table 4 shows that TMS is negatively correlated with departure at 0.01 significance level (β = -0.485). While performance is significantly and positively correlated with TMS (β = 0.352; $p < 0.05$), it is negatively correlated (β = 0.333; $p < 0.05$) with team member departure. On the other hand, our results did not find any significant correlation between CIT and neither of departure, TMS, or performance. Table 4 shows also the mean (mean for: a) departure is 0.5; b) TMS is -0.095; and c) performance is 0.009) and standard deviation (standard deviation for: a) departure is 0.506; b) TMS is 0.351; and c) performance is 0.556) values of our constructs.

In order to examine the multicollinearity, we measured Variance inflation factors (VIF). All VIF values are below the threshold, which is 5, and therefore there is no multicollinearity in our data. For example, VIF between constructs are as followed: VIF for change in TMS and performance is 1.212; VIF for departure and performance is 1.210; VIF for interaction of CIT and departure, and change in performance is 1.002. Table 5 shows the calculated VIF values for our constructs.

| **Constructs** | **Departure** | **Δ TMS** | **CIT** | **Δ Performance** |
|---|---|---|---|---|
| Departure | | | | |
| Δ TMS | | | | |
| CIT | 1.002 | | | |
| Δ Performance | 1.210 | 1.212 | 1.002 | |

**Table 5. Calculated VIF values for the constructs**

The model with its latent variables, relationships among latent variables with calculated path coefficients are presented in figure 3. In this model, β represents the path coefficients while the variances explained by the model are shown as $R^2$.

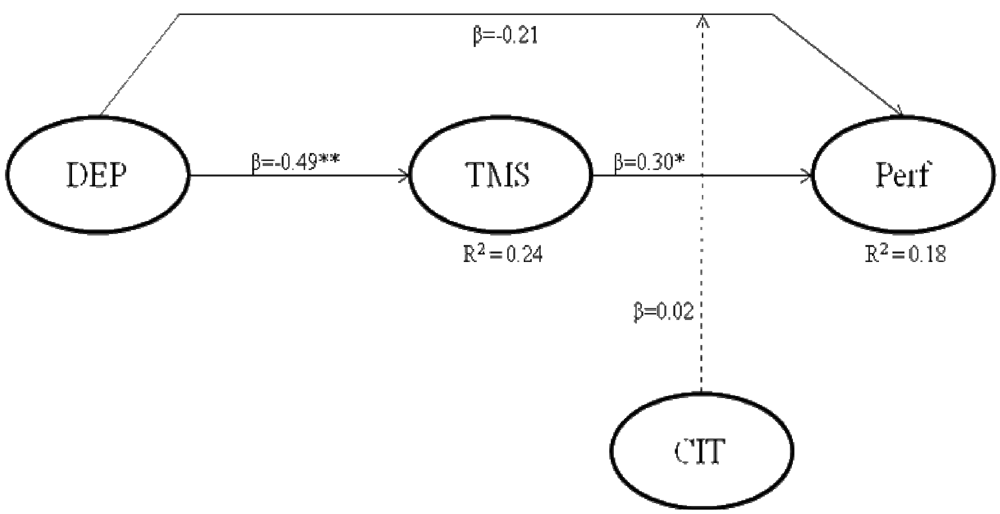



**Figure 3. Path Coefficients in Structural Equation Model**

Notes:

DEP: Departure of team member(s)
TMS: Change in Transactive Memory System
Perf: Change in Performance of team
CIT: Collaborative Information Technologies
*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).

The WarpPLS results show that the relationship between team member departure and TMS is negative and significant (β = -0.49) at 0.01 level. The relationship between TMS and performance is positive (β = 0.30) and significant at 0.05 level. However, our results indicate that the relationship between departure and performance is only slightly insignificant. CIT does not have a significant impact as a moderator on the relationship between team member departure and performance. On the other hand, the variance explained for TMS is 0.24 and for performance are 0.18. Therefore, these findings reveal that while hypothesis 1a and hypothesis 3 is supported, hypothesis 1a was partially supported whereas hypothesis 2 was not supported.

The model that has been presented in this research has been compared with various other models and their measurements to identify that these results are the rigorous ones. During this process, all models have been analyzed and the significance levels, $R^2$ values, coefficients, etc. are recorded and compared. In addition to that process, we measured the model fit for each alternative model. Kock (2010) suggests that ", if the goal is to find out whether one model has a better fit with the original data than another, then the model fit indices are a useful set of measures related to model quality." Therefore, average $R^2$ (ARS) and average variance inflation factor (AVIF) values are two model fit indices that we measured through WarpPLS. The significant ARS value, which is calculated via re-sampling, and the AVIF value less than 5 are indicators of good fit. Therefore, our model provides a good fit (Kock 2010). Our results reveal that ARS value is 0.210 with a P-value of 0.048 and AVIF value is 1.141, which is less than the threshold value of 5.

In addition to the aforementioned analysis, we conducted ANOVA to examine the difference in means. Figure 4a and b summarize the effects of departure and use of CIT on TMS and performance. The figure shows that when there is a departure from a team, it has a negative impact on both TMS and performance. In case of TMS, the use of CIT eliminates some amount of risk regarding departure. However, considering the overall impact of departure, even CIT is not enough to compensate this negative effect. Performance, as well, is affected by team member departure. Like TMS, the use of CIT has a compensating effect; however, it is not enough to eliminate the whole risk of departure. The figure also reveals that when there is no departure from any team, CIT has a positive impact on both TMS and performance.

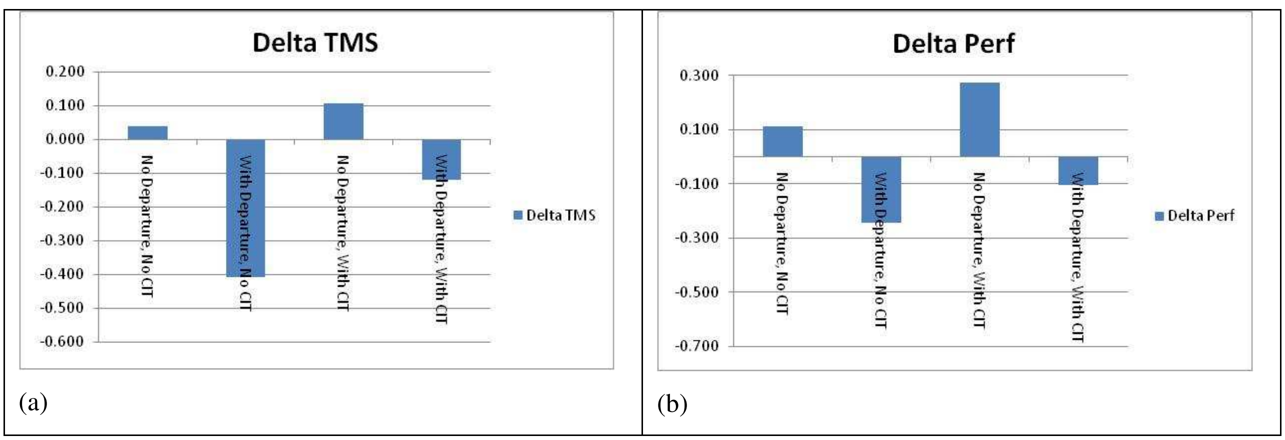
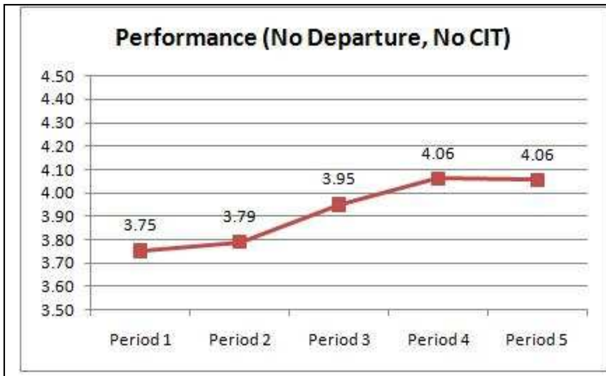
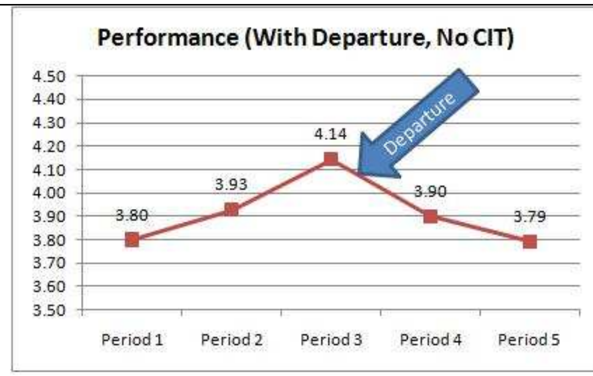



**Figure 4 a, b. Performance and TMS values**

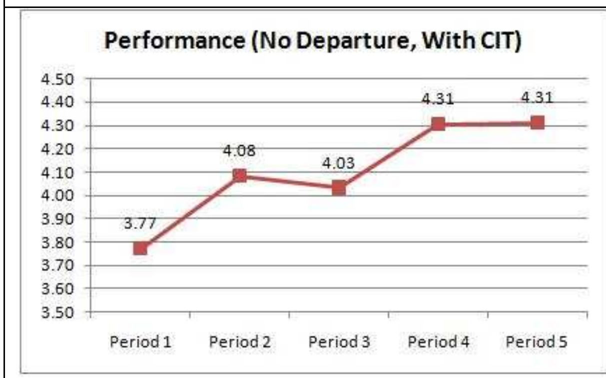
Figure 4 can be explained in more details through figure 5 and 6. Figure 5 a, and c represent that the average performance within periods are higher with CIT usage under no team member departure. When there is a departure from a team, the performance of teams drop drastically (see figure 5 b and d). However, when the team members are using CIT among them, the reduction in performance is less and in fact it increases after some point. Therefore, as figure 5 represents, while departure of team member(s) causes reduction in performance, the use of CIT can eliminate this decrease in performance to some degree.



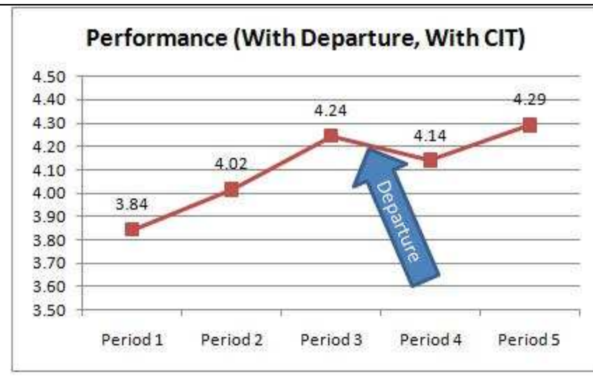

(a)




(b)




(c)




(d)

**Figure 5 a, b, c, d. Performance output under all treatments (w&w/o departure and CIT)**

A similar explanation can be done for figure 6, in which the change in TMS has been drawn. As seen in figure 6 a, and d, use of CIT leads to more stable TMS under no team member departure. Departing team members cause a decrease in TMS strength level. Similar to the performance, use of CIT reduces the TMS strength drop to some degree (see figure 6 b and d).

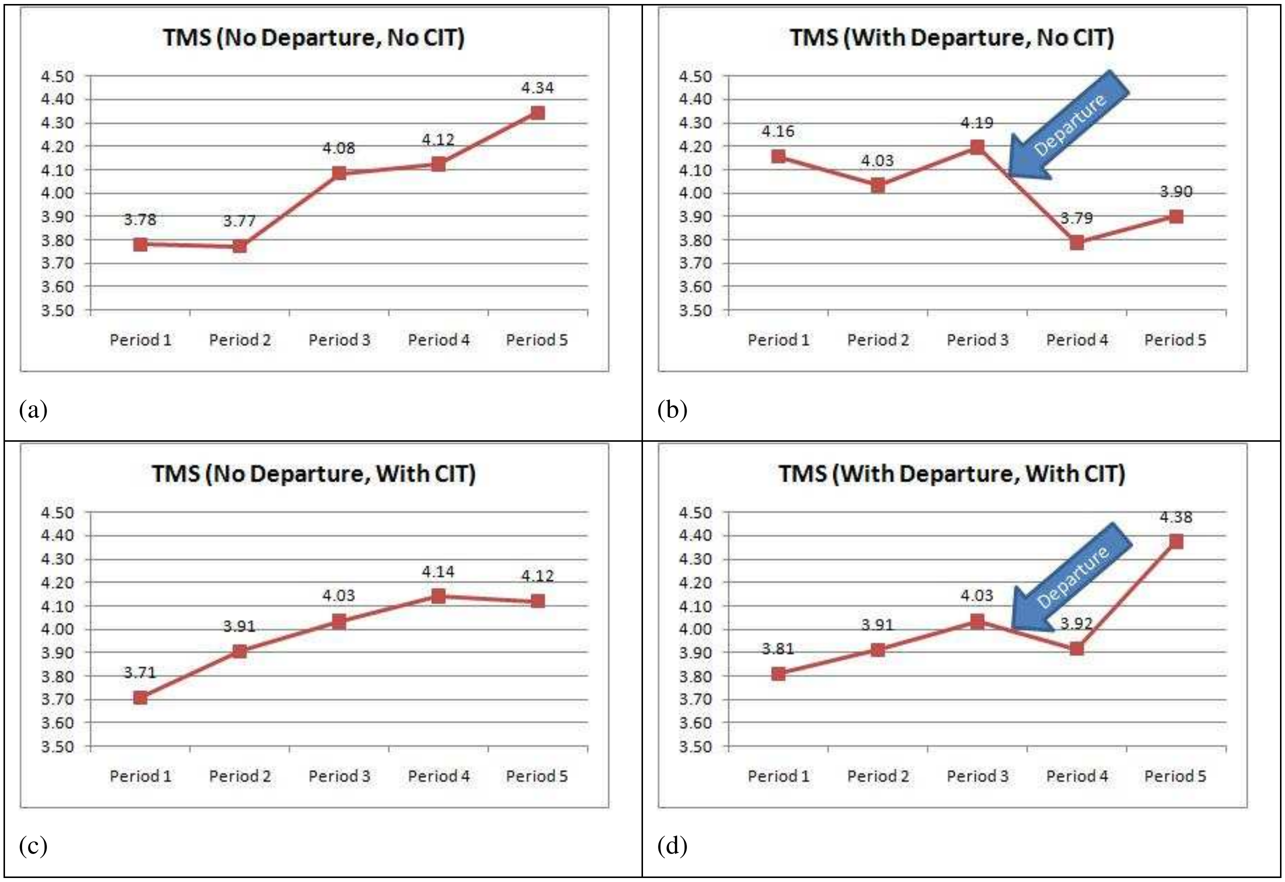


**Figure 6 a, b, c, d. TMS output under all treatments (w&w/o departure and CIT)**

ANOVA results confirm findings that are visible in figure 4a and b. The results reveal that for performance, there is a significant difference between groups regarding team member departure (F value is 4.585 at 0.05 significant level). The same results also are present for TMS: for TMS, there is a significant difference between groups regarding team member departure (F value is 12.591 at 0.01 significant levels) (see Table 6).

| Dependent Variable(s) | Independent Variable(s) | SS | F Value | Significance |
|---|---|---|---|---|
| Change in Performance | CIT | 0.229 | 0.788 | 0.38 |
| | DEP | 1.334 | 4.585 | 0.039 |
| | CIT*DEP | 0.000 | 0.003 | 0.95 |
| Change in TMS | CIT | 0.316 | 3.527 | 0.06 |
| | DEP | 1.129 | 12.591 | 0.001 |
| | CIT*DEP | 0.123 | 1.374 | 0.24 |

**Table 6. ANOVA Results**

### Sobel's Test for Mediation

Mediation effect has been tested through (Baron et al. 1986) test. Baron et al. (1986) state that mediation can be tested in four steps through consequent regression analysis: a) regression between independent variable and mediator; b) regression between independent variable and mediator; c) regression between mediator and dependent variable while controlling for the independent variable; and finally regression between independent variable and dependent variable while controlling mediating variable. The results of these analyses must show that the dependent variables in these two should be significantly affected by the dependent variable of the same equation. The next requirement for an appropriate mediation effect is that the results of the regression between independent variable and dependent variable while controlling the mediating variable should be non-significant. As Table 7 represents, these requirements have been satisfied and TMS significantly mediates the relationship between team member departure and the difference in performance.

| IV | DV | Control | Model | B | Std.Err. | Beta | t-value | Sign. |
|---|---|---|---|---|---|---|---|---|
| DEP | Perf | None | Cons | 0.192 | 0.119 | | 1.615 | 0.115 |
| | | | IV | -0.365 | 0.168 | -0.333 | -2.176 | 0.036 |
| DEP | TMS | None | Cons | 0.074 | 0.069 | | 1.058 | 0.297 |
| | | | IV | -0.336 | 0.098 | -0.485 | -3.420 | 0.02 |
| IV | DV | Control | Model | | Mean Square | | F-Value | Sign. |
| TMS | Perf | DEP | Intercept | | 0.031 | | 0.048 | 0.897 |
| | | | TMS | | 0.326 | | 3.545 | 0.229 |
| | | | DEP | | 0.195 | | 2.119 | 0.279 |
| | | | TMS*DEP | | 0.092 | | 0.864 | 0.476 |
| DEP | Perf | TMS | Intercept | | 0.031 | | 0.096 | 0.759 |
| | | | TMS | | 0.195 | | 2.119 | 0.279 |
| | | | DEP | | 0.326 | | 3.545 | 0.229 |
| | | | TMS*Departure | | 0.092 | | 0.864 | 0.476 |

**Table 7. Three Regression Results suggested by (Sobel 1982), and (Baron et al. 1986)**

Table 8 shows the hypotheses tested in this study and their status regarding whether they are supported or not.

| Hypotheses | Supported? |
|---|---|
| H1a: Member departure leads to reduced team performance. | Partial support |
| H1b: Member departure leads to reduced transactive memory strength through its factors (specialization, credibility, coordination). | Yes |
| H2: When facing member departure with greater CIT functionality, the team performance is reduced less than when facing member departure with less CIT functionality. | No |
| H3: TMS mediates the relationship between collaborator departure and team performance. | Yes |

**Table 8. Summary of hypotheses and their status**

### Manipulation Check and Control Variables

The experiment results showed no significant change depending on demographical characteristics and prior experience with CIT and drawing tools. Moreover, we controlled for task complexity, CIT usefulness, and motivation that showed no significant change among groups.

The manipulations of departure and CIT functionality level were constant within groups but we got reports from subjects on the impact of CIT and departure. To test statistically, we randomly selected 20 samples and ran regression analysis. The correlation for departure and the aggregated post experiment survey value was 0.41 with 0.05 confidence level. For CIT, correlation was 0.55 at the 0.01 confidence level.

## DISCUSSION & CONCLUSION

These results indicate that the role of collaboration information technologies continues to be elusive even in dynamic setting but we provide partial proof for its role in reducing the negative impact of departure. This research provides empirical verification on the hypotheses: collaborative information technologies play a significant role in teamwork context. This study provides insight to both information technology and transactive memory systems literature. As our field does, human resources, too, can benefit from our model, where we treat departure not as a dependent variable, but as a treatment. Our basic model can be modified to incorporate dynamisms other than departure such as project scope change, negotiation and crisis situations.

The main contribution of this study is to show that CIT functionalities can help teams not only during routine tasks but also in a dynamic environment when unexpected events occur. Additionally, we investigated a specific dynamic environment where a team member departed from the project.

Main purpose of this study was to investigate whether CIT alleviates the effects of departure. Departure’s effect on the TMS is theorized in order to understand CIT moderation. Our results contribute to studies in collaborative information technologies (Easley et al. 2003; Majchrzak et al. 2000; Pavlou et al. 2007) by identifying the moderating effect of several types of collaborative tools such as email, rich-media technologies, repository tools and workflow management tools. Moreover, an exclusive study of the departure phenomenon will bring depth to turnover concept (Arrow et al. 2000; Levine et al. 2005; Powell et al. 2004) since departure and arrival of the newcomers are two separate processes in team or personnel turnover. In the past, they have been considered together yet separating them led to a deeper analysis of the departure phenomenon alone. We leave newcomer effect for future research.

In addition to the aforementioned theoretical implications, this study will contribute to the practitioners by evaluating CITs. For example, executives make decision to invest thousands of dollars in collaborative technologies as well as spending time implementing the use of CIT throughout their organizations. In general, returns on these investments are not explicitly understood. This study not only provides a prospectus for the benefit of each of those technology types but also addresses the fact that departure dynamism can be an important instance when CIT functionalities become useful. Managers may not be able to anticipate a departure but they can at least anticipate its effects on the project performance, and reduce it by providing CIT functionalities that fit to project tasks. In other words, information systems managers can put systems in place to alleviate effects of unexpected departures. In summary, we make this suggestion for the managers of information systems: "you can leave when the systems are in place."

One limitation of this study is the assumption of collaborative behavior. We assume that team members are working towards a common goal. Yet, team members do not always work together towards a common goal. From time to time agency problems occur when members have different agenda. Relaxation of this assumption may change the model and bring a game theoretical approach to the same question. Another limitation is focusing only on the departure of a team member as a part of turnover phenomenon. Arrival of a newcomer would complete a theory of turnover for small groups.

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