Consensus or Divergence: Examining the Aggregation of Individual to Team Level Adoption of Innovations

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Abstract
The examination of multi-level phenomenon has been a perennial issue within the IS discipline. However, despite recent advancements, we see a gap in the literature in our lack of understanding of how team level perceptions, when aggregated, predict team level performance. In this paper, we report upon an experimental study of 216 subjects, representing 72 3-person teams who performed a business simulation. Our findings demonstrate a mixed set of factors predicting performance – both consensus of the team towards the technology and divergence in opinions of the team towards the technology. These results highlight the need for more work in the area of aggregating individual to team level data when examining the adoption of innovations.

Introduction
The examination of multi-level phenomenon has been a perennial issue within the IS discipline. Since the advent of the discipline, it has been recognized that individual use of information technology (IT) occurs within both an organizational and workgroup context that influences how the IT is leveraged for productivity and efficiency. While the need for understanding multi-level phenomenon has remained an enduring challenge, little work has been done to question some of the fundamental assumptions made by multi-level researchers as we aggregate phenomenon from the individual to the team level of behavior.

Following recent commentaries regarding the need to aggregate individual behavior (Burton-Jones and Gallivan (2007), there is an increasing recognition that there are alternative (and sometimes contradictory) assumptions made in our aggregation behavior into higher levels of phenomenon. For example, what is the ideal configuration of workgroup level assessment of an IT as a composite of the individual level perceptions towards the target IT? Should a workgroup have consensus or divergent opinions towards the IT? And how do these opinions shape the overall workgroup performance? Specifically, if a workgroup has a common view towards the IT, does this mean that this workgroup will perform better than an alternative workgroup that has divergent opinions towards that same IT? The complexity of aggregation is further exasperated as we move from the workgroup to the functional to the organizational level. Therefore, we posit that it is time to take a reflective pause to investigate the need to aggregate multi-level phenomenon to better assess the diverging assumptions made by researchers of the aggregation of individual to team level behaviors.

Furthermore, while Burton-Jones and Gallivan (2007) focused upon the aggregation of use behavior, we posit that the same assessments can be made based upon the overall perceptions towards the IT and that these different configurations of perceptions will result in differing outcomes of use and productivity. Specifically, if individual perceptions towards IT are aggregated to the team level to predict team level performance, what is best – for the team to have consensus regarding the perceptions or to have divergence? This then provides the motivation for our work – to understand how individual level
perceptions, when aggregated to a team level, predict team level performance. We will explore this gap in the literature next.

**Theoretical Development**

The examination of why individuals adopt IT has a long history within the academic community. Drawing from work by Rogers (1962), the field has employed a variety of theoretical approaches to understand why individuals adopt and use IT. With the advent of the Technology Acceptance Model (TAM) (Davis 1989), the adoption community has spent the past 25 years proposing and testing alternative models, including the Perceived Characteristics of Innovations (PCI) (Moore and Benbasat 1991), Task Technology Fit (TTF) (Goodhue and Thompson 1995), the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al. 2003), and UTAUT2 (Venkatesh et al. 2012). Each of these approaches shares a common characteristic of predicting either the intention to use or the use pattern of an IT. However, this study utilizes additional outcomes that provide more potential value to an organization than mere use, namely team performance.

The IS academic community has recently been encouraged to employ multi-level models to better understand organizational behavior. For the adoption community, this translates to a need to better understand how team perceptions influence team performance when employing an IT. We posit that a simple understanding of a single team member’s opinion of a technology will not predict team performance as well as how the team perceives the technology.

For example, consider a Group Support System (GSS). Under conditions of volitional control (i.e. where the technology is not mandated to be used by the organization), one individual within a team may assess the technology to offer advantages of using this type of system to complete team work. However, the others in the team may not share this perception. Without a consensus of opinion (assuming no mitigating influences), our current theories cannot explain the tipping point in the adoption decision – which is, at what point the team coalesces around the use of the technology. We therefore suggest that an individual engages in a two-part adoption decision: (1) How do I feel about the technology and (2) How do others in my team feel about the technology? We suggest that current adoption theory can assist us in answering question #1, but not question #2. While the decision-making algorithm is complex, we believe that more work in adoption needs to focus upon the role of the perceived adoption decision within the team vis-à-vis the individual him/herself.

The topic of consensus within teams is not new within the academic community. Beginning with the work of Argyris (1962), organizational researchers theorized that conflicts (or a lack of consensus) during team work is an inhibitor to team effectiveness. However, subsequent research determined that conflict may not always be detrimental and that, in some cases, may improve team outcomes. In a meta-analysis based upon 20 years of team research (namely 1990 to 2010), De Wit, Greer, and Jehn (2012) identify 116 articles that have examined this question and distinguish between three types of conflict that emerge during the process of completing team tasks: (1) task conflict, which entails “disagreements among group members about the content and outcomes of the task being performed” (p. 360); (2) Relationship conflicts, or “disagreements among group members about interpersonal issues,” (p. 360); and (3) Process conflicts, or “disagreements among group members about the logistics of task accomplishment” (p. 360). We posit that consensus (or conflict) over the views towards the IT utilized to complete a team task fall within the domain of a process conflict. Most prior research in the area has concluded that process conflict leads to negative outcomes (Behfar et al. 2002; Greer and Jehn 2007; Jehn et al. 2008; Matsuo 2006; Passos and Caetano 2005; Vodosek 2007). However, recent research suggests that these disagreements might encourage the team to reevaluate the processes that the team uses and may improve team outcomes (e.g., Jehn & Mannix 2001). Other research (e.g. Behfar et al. 2010) supports these findings and argues that these disagreements may result in better communication within the team (e.g. Jehn and Mannix 2001 and Jehn et al. 2008), but that these interventions depend upon the stage of the
team (Goncalo et al. 2010). This leads us to conclude that there is no consensus around whether consensus or conflict leads to higher levels of team performance.

To this point, there has been no prior research to investigate whether views towards the IT used during the process of performing a team tasks converge or diverge in order to achieve higher levels of performance. Furthermore, given the breadth of the perceptions towards IT that have previously been studied, we posit that it is useful to investigate whether certain perceptions are more salient in their relationship to team performance. We therefore seek to understand how individual level perceptions, when aggregated to the team level, lead to team level performance when using IT. The model that we employed for this approach is the Perceived Characteristics of Innovations (PCI) (Moore and Benbasat 1991). We utilized this model for two reasons: (a) the PCI has the most robust set of items focused upon the IT and (b) we were interested in these perceptions without the mitigating influences that have been shown to influence the adoption decision within UTAUT and UTAUT2.

The identification of factors that influence the adoption of IT at the individual level originated with the work of Rogers (1962), who identified five salient characteristics of innovations (namely relative advantage, compatibility, complexity, observability, and trialability). This set of factors was subsequently studied by Moore and Benbasat (1991), who expanded the original list to include image and voluntariness of use and re-termed these factors the Perceived Characteristics of Innovations (or PCI). Between 1991 and 2003 (when the set of factors was re-examined by Compeau et al. (2007)), 31 studies employed either all or a sub-set of the PCI factors in their empirical studies.

In their re-conceptualization, Compeau et al (2007) separated some of the dimensions into more precise elements, expanding the observability construct to include Others’ Use, Measurability, and Communicability. In a similar vein, Karahanna et al. (2006) expanded the use of compatibility to include compatibility with previous experiences and compatibility with values. This expanded list of 10 constructs thus marked a broader set of constructs that served as the basis for the PCI. Since 2007, 6 studies have employed either all or a sub-set of these factors (including Aubert et al. (2012); Andrews and Bianchi (2013); Gounaris and Koritos (2012); Hester (2011); Tsai, et al (2014); Zhang (2011)) . Thus, drawing from the PCI set of constructs and extant studies on team performance, we seek to understand if consensus (or the consensus hypothesis) or divergence (or the divergence hypothesis) in the view of the team towards the IT employed during the team task will lead to higher levels of team performance. This leads to two competing hypotheses:

**The Consensus Hypothesis:** A team that experiences less process conflicts over their views of the IT will perform better than those that have more conflicting perspectives

**The Divergence Hypothesis:** A team that experiences more process conflicts over their views of the IT will perform better than those that have less conflicting perspectives

We seek to investigate the consensus versus divergence hypothesis by applying the PCI to understand three performance outcomes: the intent to use a similar IT for a future task, the perceived performance of the team in accomplishing a task, and the actual performance of that team. By investigating these hypotheses, we can better understand IT-enabled team performance and the constitution of the perceptions within teams that leads to these outcomes. Furthermore, through this understanding, we can begin further examinations in to the conditions that lead to divergence and consensus and whether these findings are consistent when we aggregate our understandings to the organizational level to understand IT-enabled organizational outcomes.

**Methodology**

**Context**

To investigate our research model, we designed an experimental setting that enabled us to focus upon team performance in a controlled environment. Specifically, our experiment was designed to utilize
student teams of 3 to participate in a simulated business environment employing SAP. Using ERPSIM (Léger 2006; Léger et al. 2007), we utilized the distribution game. This simulation requires a team of students to use SAP to sell and market water to three regions in Germany. Over three rounds, the student teams set their prices and marketing budgets within SAP and, using market analysis reports, make adjustments to their strategy to gain market share. We therefore selected to understand the consensus of the team towards SAP in this experimental setting.

**Research Model and Measurement**

With our context in mind, we examined each of the 10 PCI constructs to ensure that each was appropriate for our context. We identified 7 of the 10 constructs as being salient for our specific context. Based upon this refinement, our proposed research model is below in Figure 1.

![Proposed Research Model](image)

Based upon this research model, we identified scales to measure our constructs and re-worded the items to reflect our context. All of the PCI items were adapted from the work of Compeau et al (2007). In addition to the perceptions, we created items for two additional constructs – the perceived performance of the team and a calculated performance of the team. The perceived performance was created for this project, while calculated performance was based upon the data from the simulation. We have included our set of items in Table 1 below.
Our empirical study was conducted with the members of a research participation subject pool at the College of Business at a university in the Southeastern United States. A prerequisite for our study was that the students could not have prior experience using SAP. All participants in the pool are undergraduate students in the college and, for course credit in specified courses, must participate in research activities. Participants in the pool were offered various times to participate in the study. They selected one session and volunteered 90 minutes on that day in order to complete the exercise. Upon arrival, the subjects were randomly assigned to teams of three; teams comprised of more than three individuals were not included in our analysis, as we wanted to ensure a consistent team size for our analysis. Subsequent to the assignment, the teams were introduced to the simulation and provided with the training necessary to use SAP. The training was standardized and presented by the first author. After completing the training, the teams participated in the simulation. After the completion of the 3rd round, the subjects were directed to a web-based survey to assess their performance on the task and predict their performance. Once all subjects had completed the survey, the results were revealed and the teams were debriefed on the objective of the research. A total of 216 individuals participated in the research task.

**Analysis**

Each subject answered the survey based upon their own perception towards SAP. However, to examine our research question, we needed to aggregate the data from the individual to the team level. Historically, this aggregation has been approached in one of two ways – either through inter-rater reliability (IRR) or
inter-rater agreement (IRA). As LeBreton and Senter (2008) note, “IRR refers to the relative consistency in ratings provided by multiple judges of multiple targets” (p. 816) while “IRA refers to the absolute consensus in scores furnished by multiple judges for one or more targets” (p. 816). In other words, IRR is employed to assess whether a set of respondents rank a target in a consistent manner with others, while IRA is employed to examine whether a set of scores are equivalent to one another. For the purpose of this investigation, IRA approaches are more suitable. While multiple IRA options exist, the most used estimates of IRA have been the approach enumerated by James et al. (1984) and James et al. (1993) [this claim is based upon the meta-analysis conducted by LeBreton and Senter (2008), where they found more than 700 uses of this approach within the literature]. The index of agreement (or r) can either be examined at the single-item level (rWG) or the multi-item level (rWG,J). We opted to utilize the single-item level approach, determining the degree of agreement for each item that was presented to the respondent. Specifically, for each of our items, we created an index of agreement within each team. Mathematically, this calculation was performed using the following formula:

\[ r_{WG} = 1 - \frac{S^2}{\sigma^2_E} \]

Where \( S^2 \) is the observed variance for each item and \( \sigma^2_E \) is the expected variance. To employ this technique, researchers must a priori predict the expected variance for each item based upon: (a) The number of items in the scale (in our case 7) and (b) the predicted skewness of the data (which we assumed to be normal). Based upon our study, we assumed that our expected variance would be 4. The range for r is between 0 and 1, where 1 indicates that all of the team members perceived SAP similarly (or consensus), while 0 demonstrates that there are diverging perceptions among the team members. The 216 individual scores were thus aggregated into 72 team scores. Given the exploratory nature of our study (Westland 2010), we selected the partial least squares (PLS) approach, specifically Smart PLS software (Ringle et al. 2014) to analyze the data for this step of the process.

Measurement Model

The first step in a PLS analysis is the analysis of the measurement (or outer) model. Following the procedures outlined by Wright et al. (2012), our first step was the creation of our measurement model. We first analyzed the loadings and cross-loadings of all items to ensure that they each loaded on their respective constructs. Based upon our initial analysis, seven items (namely CMPPE2, CMPPE4, EOU1, EOU2, EOU3, MEAS2, and COMM5) were eliminated due to low item loadings, leaving the items found in Table 2. Consequently, on determining that none of the items loaded higher on any construct other than the intended construct, we included all of the remaining items.
We next evaluated the reliability, discriminant, and convergent validity of the measurement model. Using the item loadings, we calculated the internal composite reliability (ICR) to evaluate the measure’s reliability, finding that all the dimensions exceeded the .70 threshold and were all above 0.88 (bottom of Table 3). Moreover, to estimate convergent validity, we evaluated each dimension’s average variance
Utilizing the threshold value of 0.50 for AVE (Barclay et al. 1995), our findings support convergent validity (Barclay et al. 1995).

### Structural Model

With the analysis of the measurement model complete, we next analyzed the structural model. In Table 4, we have outlined the impact of each of the independent variables on our dependent variables of actual performance, intent, and perceived performance. The results indicate that, consensus on the PCI constructs of compatibility with the process ($\beta = 0.483$), measurability ($\beta = 0.265$), compatibility with previous experiences ($\beta = 0.262$), ease of use ($\beta = 0.167$), and communicability ($\beta = 0.116$) leads to consensus on the intent to use the IT for future tasks, while divergence towards the compatibility of the IT with the values of the team ($\beta = -0.126$) has a similar effect. Only relative advantage was found to be non-significant in explaining the consensus on intent. While these findings confirm previous research about the intent decision, the perceived and actual performance antecedents were more complex. Namely, consensus on the performance of the team was driven by consensus of the relative advantage of the IT ($\beta = 0.468$), ease of use ($\beta = 0.189$), intent ($\beta = 0.146$) and divergence on the compatibility with the process ($\beta = -0.254$). Finally, actual performance was found to be a function of the consensus towards the compatibility with the process ($\beta = 0.234$) and divergence on the intent ($\beta = -0.267$) and compatibility with the experience ($\beta = -0.206$).
Table 4. Structural Model Results

<table>
<thead>
<tr>
<th>Actual Performance</th>
<th>Intent</th>
<th>Perceived Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Path</td>
<td>t (sig)</td>
<td>Path</td>
</tr>
<tr>
<td>Communicability</td>
<td>-0.124</td>
<td>1.003 (ns)</td>
</tr>
<tr>
<td>Compatibility with Experience</td>
<td>-0.206</td>
<td>2.129 (p &lt; 0.025)</td>
</tr>
<tr>
<td>Compatibility with Process</td>
<td>0.234</td>
<td>1.462 (p &lt; 0.10)</td>
</tr>
<tr>
<td>Compatibility with Values</td>
<td>0.022</td>
<td>0.173 (ns)</td>
</tr>
<tr>
<td>EOU</td>
<td>0.041</td>
<td>0.316 (ns)</td>
</tr>
<tr>
<td>Intent</td>
<td>-0.267</td>
<td>2.201 (p &lt; 0.005)</td>
</tr>
<tr>
<td>Measurability</td>
<td>0.117</td>
<td>0.748 (ns)</td>
</tr>
<tr>
<td>Relative Advantage</td>
<td>0.239</td>
<td>1.267 (ns)</td>
</tr>
<tr>
<td>R²</td>
<td>0.223</td>
<td>0.536</td>
</tr>
</tbody>
</table>

Discussion

The results demonstrate the complex nature of understanding the performance of teams when process conflicts occur. Teams that demonstrate a common view on the role of SAP in the process of running their firm were more successful than their counterparts; however, it was divergent views on the compatibility with experience that led to higher levels of performance. These findings indicate that a diversity of experiences with previous systems leads teams to perform better.

Nonetheless, there was little overlap between the drivers of actual versus perceived performance. While compatibility was a key driver of actual performance, perceived performance aligned with traditional models of adoption that have found the integral role of relative advantage and ease of use in the adoption decision. Furthermore, the findings validate previous work (e.g. Sundaram, et al (2007) that reveals the limitations of our current adoption models in explaining performance. In our model, all but one of the PCI constructs explained intention. However, only a limited set of these same constructs explained performance.

Concluding Thoughts

This study contributes to the discussion of understanding multi-level phenomenon in important ways. First, the gap of the PCI constructs in explaining performance versus intent points to the opportunity for future research to begin investigating the drivers of performance, apart from the traditional adoption models. We also urge researchers to further investigate the role of consensus and divergence during the process of team tasks, with respect to the views of the underlying IT. We believe that this is the genesis of a nexus of team and individual level work that will define a new era of adoption research.

References


