Predicting Uptake of Technology Innovations in Online Family Dispute Resolution Services: An Application and Extension of the UTAUT

Abstract

Parental separation can be psychologically distressing for families; particularly when conflict between parents is high. In Australia, recent reforms to Family Law legislation have introduced mandatory mediation for litigants. Consequently, there is a burgeoning need for community-based family dispute resolution (FDR) services. Providers have responded to these needs with innovative solutions—including online computer-assisted mediation technologies. This paper reports on the pilot of an Australian online family dispute resolution (OFDR) system. Specifically, we evaluated the unified theory of acceptance and use of technology (UTAUT) within this unique context and extended the model to include trust and personal web innovativeness, which we proposed would be implicated in the intentions of staff to use a family mediation service in their daily practice. A cross-sectional web-survey methodology was employed to collect data from 127 staff in the implementation organisation. The measurement and structural models were evaluated with partial least squares (PLS) modelling and the results provided some support for our hypotheses. Specifically, the core UTAUT model was partially validated in this context. Moreover, effort expectancy mediated the effects of trust in technology on behavioural intention. Contrary to expectations, trust in the organisation and innovativeness did not produce significant effects on intention. Practically, these results suggest that pre-contemplation technology acceptance research can have utility for change management and system design.

Keywords: ODR, UTAUT, technology acceptance, PLS, mediation, divorce, negotiation, trust, innovativeness, human-computer interaction.
Predicting Uptake of Technology Innovations in Online Family Dispute Resolution Services: An Application and Extension of the UTAUT

The rate of divorce in Australia, as with many other counties, continues to rise. Indeed, approximately 33% of marriages in Australia entered into during 2000-2002 ended in divorce (ABS, 2007). Estimates suggest that nearly 50% of divorces in Australia involve partners with children (ABS, 2007). Parental separation is an especially stressful time for all involved parties (Kelly, 2000), particularly children (Amato & Keith, 1991; Kelly, 2000; Liu, Li & Ge, 2009); therefore, numerous community-based organisations have expanded their services to assist with the resolution of parenting disputes. One such process is family mediation (or Family Dispute Resolution as it is known in Australia).

The Telephone Dispute Resolution Service (TDRS) is a national family dispute resolution (FDR) service operated by Relationships Australia Queensland (RAQ). Accessed though the Family Relationships Advice Line (FRAL), the TDRS currently provides telephonic mediation services for thousands of clients throughout Australia. Processing over 5,000 client cases since its inception in 2007, the TDRS continues to expand in size and client volume. In 2009, the Australian Federal Attorney-General’s Department commissioned RAQ to conduct a pilot implementation study of Online Family Dispute Resolution (OFDR).

This paper reports on the assessment of staff readiness and willingness to use this OFDR service during project development. A cross-sectional web-survey methodology was employed to examine the relationships between antecedents of mediation technology use. The rationale for the study was two-fold. First, to evaluate the application of an established theory of user IT acceptance—the unified theory of acceptance and use of technology (UTAUT). Second, to integrate findings regarding staff technology acceptance into the implementation methodology of the project. The paper begins with an overview of a particular theoretical model of technology acceptance and relevant literature that supports our
extension of this framework. The results of model testing and path analysis are then presented and discussed. The paper concludes with a discussion of practical implications, study limitations and directions for future research.

**THE UNIFIED THEORY OF ACCEPTANCE AND USE OF TECHNOLOGY**

The variables implicated in technology acceptance have been of interest to managers, researchers and practitioners for many years. Over this period, a number of models of technology uptake have emerged. In an attempt to bring together a range of theoretical frameworks and ideas, Venkatesh and colleagues (Venkatesh, Morris, Davis & Davis, 2003) developed and evaluated a unified theory of technology acceptance and use. The UTAUT consolidated previous research on technology acceptance through the integration of prevalent technology uptake models. Further, the UTAUT has been found to successfully predict a large proportion of variance in users’ IT uptake intentions and behaviour (Anderson, Schwager & Kerns, 2006; Venkatesh et al., 2003).

Scholars have demonstrated empirical support for the UTAUT model across a range of contexts—from radiological departments (Duyck et al., 2008) to the classroom (Straub, 2009). The diversity of applications supports the proposition that the UTAUT might be suitably employed to predict client uptake of OFDR technology.

The UTAUT framework consists of four antecedent variables (Venkatesh et al., 2003)—performance expectancy (PE), effort expectancy (EE), social influence (SI) and facilitating conditions (FC). Taken together, these dimensions have been found to explain as much as 70% of pooled variance in behavioural intention to use a technological innovation (Venkatesh et al., 2003).

Performance expectancy was conceptualised by combining constructs including perceived usefulness, extrinsic motivation, job-fit, relative advantage and outcome expectations (Venkatesh et al., 2003). This construct is defined as the belief that using a
particular innovation will lead to positive outcomes. Performance expectancy is comparable to perceived usefulness from the technology acceptance model (van Raaij & Schepers, 2006; Nov & Ye, 2004).

Effort expectancy, conceptually similar to perceived ease of use (van Raaij & Schepers, 2006), is defined as a user’s subjective ease of engaging with an IT system (Nov & Ye, 2004; Venkatesh, et al., 2003). Sub-components of this construct include perceived ease of use, system complexity and ease of use (Venkatesh et al., 2003).

Social influence is defined as the extent to which important others are perceived to support the user’s intention to adopt an IT innovation (Venkatesh et al., 2003). Arising from the construct of social norm within the theory of planned behaviour (TPB), SI was conceptualised as an individual’s perceptions of social benefit from using the innovation (Venkatesh et al., 2003). Research has shown that as experience with a system grows, SI exerts less of an effect on adoption intention—people seem to rely on others’ opinions more so when uncertainty with the innovation is high (Venkatesh & Davis, 2000).

The construct of facilitating conditions is the final component of the UTAUT model. Encapsulating perceived behavioural control from the TPB, this construct is defined as the level of accessibility to technological and organisational resources that facilitate use of the IT system (Venkatesh et al., 2003). In previous research, the effect of FC on intention over and above EE was non-significant—these variables were shown to be highly correlated (Venkatesh et al., 2003). Consequently, FC was incorporated within the UTAUT as a direct determinant of actual use (Venkatesh et al., 2003).

However, the UTAUT is not without its criticisms. More specifically, the multifaceted design of UTAUT constructs has been described as overly complex and unlikely to measure individual constructs (van Raaij & Schepers, 2006). Further, the dependency on moderating variables to elicit the high $R^2$ reported by Venkatesh et al., (2003) adds to the
complicated nature of this empirical framework (van Raaij & Schepers, 2006). Nonetheless, given the real world complexity of IT implementation, there is some ecological validity in attempting to capture a broad range of individual and contextual factors implicated in technology uptake. Moreover, we contend that the issue of construct overlap may be reduced through item selection and refinement.

The use of a more parsimonious framework (such as TAM) could conceivably reduce the level of fidelity to inform future research and applications to practice. In the context of OFDR technology implementation, we propose that the UTAUT should allow for greater breadth of exploration of antecedents that influence online mediation uptake; in particular, integrated video-conferencing, telephony and document sharing technologies. Finally, the UTAUT is a relatively new model, yet to be tested extensively across multiple domains (Straub, 2009). Therefore, we applied the model to explore its utility in this unique context.

Other scholars have applied technology acceptance models to online mediation settings—focusing on the perceived ease of use and usefulness constructs (e.g., Turel & Yuan, 2007; Turel & Yuan, 2008; Turel, Yuan & Rose, 2007). The results of this work support the premise of our study; perceived usefulness of the mediation system was found to significantly predict the positivity of attitudes towards online mediation (Turel & Yuan, 2007) and intentions to use an online mediation system (Turel et al., 2007). This study extends earlier research by considering a broader range of antecedents to online mediation technology uptake intentions.

The relative importance of SI on behavioural intention to adopt technology is unclear. Research shows mixed support for the inclusion of this construct within the UTAUT model, with some studies indicating a strong relationship with intention (Gupta, Dasgupta & Gupta, 2008; Venkatesh et al., 2003) and others have reported a non-significant relationship.
(Anderson et al., 2006). To our knowledge, no research exists regarding the role of SI on intention to use an online mediation system.

Within a change management context, social influences to partake in mediation could be particularly strong, which may increase the relative importance of this variable as a direct antecedent of behavioural intention. The change management literature suggests that the influence of peers and management is implicated in successful technology acceptance (Amoako-Gyampah & Salam, 2003; Luo, Hilty, Worley & Yager, 2006). Although the role of social influence in predicting behavioural intention to use OFDR may be equivocal (due to competing influences on intention from other UTAUT constructs), our early thinking suggests that:

H1: Performance expectancy, effort expectancy and social influence will have positive and direct effects on behavioural intention (to adopt OFDR).

Originally, Venkatesh and colleagues (2003) included FC as a direct determinant of adoption behaviours. The results indicated that EE accounted for the variance in intention over and above that contributed by FC. Therefore, in this study, we did not include FC within the model.

**Trust**

Trust has been a difficult concept to define consistently (Bigley & Pierce, 1998; Connolly & Banister, 2007; McKnight & Cervany, 2002; Rousseau, Sitkin, Burt & Camerer, 1998; Wang & Emurian, 2005). With the aim of adopting a well-supported conceptualisation of trust to extend our research model, we drew on previous research arguing that trust is a multifaceted construct (Gefen, 2002). Arguably, trust arises from the interplay of three dimensions; benevolence, ability and integrity (Evans & Revelle, 2008; Gefen, 2002; Mayer, Davis & Shoorman, 1995). Benevolence refers to perceptions that an individual has good intentions. A person demonstrates ability if they are thought to have the competence to
deliver on expectations. Finally, those that convey integrity are believed to be honest and aligned with a set of commonly accepted principles (Mayer et al., 1995; Mayer & Davis, 1999).

Online environments present a challenging setting for establishing trust. Research has demonstrated that people hold common beliefs and attitudes when it comes to the online operating space (Einwiller, 2003; Jian, Jones & Javie, 2008; Miyazaki & Fernandez, 2001; Sheehan & Hoy, 2000). In general, online users appear most concerned about the risks posed to their security and privacy (Einwiller, 2003; George, 2003; Miyazaki & Fernandez, 2001), which undermines the ability of Internet-based entities to form trusting relationships with users (Jian, Jones & Javie, 2008). Thus, the relationship between trust and technology usage intentions—in the context of online mediation—warrants further exploration.

Researchers have previously integrated trust with models of technology acceptance (Lippert & Davis, 2006; Pavlou, 2003). Two forms of trust are important during IT implementation; trust between the organisation and the employee, and trust in the implemented technology (Lippert & Davis, 2006). The enhancement of both determinants of trust is thought to lead to greater efficiencies in adoption by promoting an environment that is conducive to IT acceptance. Moreover, Pavlou (2003) extended the TAM to include trust in online merchants as a determinant of purchasing intentions. Support was found for trust as both a direct and indirect (effects mediated by perceived usefulness and ease of use) antecedent of behavioural intention to conduct transactions online. Similarly, Fang, Shao and Lan (2009) utilised an extended TPB to explain web survey participation—demonstrating that trust directly and indirectly (via attitudes toward participation) influenced users’ intentions to participate in an online survey. These findings lend support to the inclusion of trust as an antecedent of behavioural intention within the context of technology acceptance and use.
However, the literature is unclear regarding the integration of trust with the UTAUT; despite calls to explore the role of trust in the UTAUT (Komiak & Benbasat, 2006), to our knowledge, little research has been published on this relationship. Nonetheless, trust has been researched in many other similar contexts, which provides a framework for the logical integration of this construct within the UTAUT. Trust in the technology sponsor (i.e., the organisation) is consistently shown to have a positive and direct relationship with intentions toward engaging in specific online behaviours (e.g., George, 2003; Fang et al., 2009; Pavlou, 2003). Second, findings suggest that trust may also be related to the perceived ease of use of technology (Lippert, 2007; Pavlou, 2003). In the absence of clear theoretical justification regarding the placement of trust in relation to the pre-existing constructs of the UTAUT, we proposed that trust in technology would influence intention via core UTAUT constructs. Specifically:

H2: The positive effects of trust in technology on behavioural intention will be mediated by effort expectancy.

Organisational trust has received some attention from the research community in relation to its effects on technology acceptance and use. Online users’ perceptions of a merchant’s competence, integrity and benevolence have been shown to contribute to trust and intentions to partake in certain behaviours (e.g., participate in an online service or conduct transactions online) (Connolly & Bannister, 2007; Gefen, 2002). In the context of online mediation, Turel and Olfen (2008) suggested that trust in virtual mediation organisations may be influenced by interactions with service staff, which in turn, may influence users’ intentions to adopt an online mediation system. Thus, trust is likely to be a key variable in predicting the use of innovative mediation services from both a staff and client perspective.

In light of the importance placed on trust, not only in technology adoption, but also the potential impact of electronic mediums on trust formation, trust in the organisation was
incorporated within our conceptual model. Based on the findings of studies that integrated trust into a TAM framework (Gefen et al., 2003; Lippert, 2007; Ha & Stoel, 2009) and change management principles regarding the importance of trust in management (Hattori & Lapidus, 2004; Morgan & Zeffane, 2003), we predicted that trust in the organisation would directly influence staff attitudes and intentions towards the use of OFDR. Specifically, we proposed that:

H3: The positive effects of trust in the organisation on behavioural intention will be mediated by social influence.

**Innovativeness**

According to innovation diffusion theory (Rogers, 1993, as cited in Rogers, 2002), a new product, idea or concept is communicated predictably through a social system. Innovativeness is defined as the openness of particular groups within a social system to new product experiences (Rogers, 2002). Conforming to a normal distribution, individuals can be classified into groupings that indicate their relative likelihood of adopting a novel product or service. Rogers’ model proposed that 2.5% of a social system can be classified as ‘innovators’—people who are the most likely to adopt a novel product or service. The model suggests that in voluntary adoption situations, a small percentage of a population will hold extreme views either way regarding an innovation, whereas a larger portion may need persuading or time to consider the innovation before they commit.

Measurement of innovativeness must take into account the level of analysis of the target domain. First, global innovativeness is an individual’s inherent tendency to seek out new experiences; for example, a personality trait or disposition to seek out and engage with novel stimuli. Second, domain-specific innovativeness is the likelihood of adoption within a confined area (e.g., general information technology). Finally, product-specific innovativeness
refers to a highly constrained measurement of adoption in respect to a single product or service (van Rijnsover & Donders, 2009), such as an online mediation system.

We examined user attitudes towards OFDR at the conceptual or pre-contemplation stage—before a concrete example of the innovation was available, which effectively rules out product-specific innovativeness for validity reasons. Given previous findings that global innovativeness is best conceptualised as an antecedent of the domain-specific construct (van Rijnsover & Donders, 2009), and that potential relationships between personality and specific behaviours are often difficult to demonstrate due to confounds (van Rijnsover & Donders, 2009), domain-specific innovativeness was chosen for inclusion in the model.

Others researchers have investigated the role of domain-specific innovativeness within the TPB model (Fang et al., 2009). Findings indicated that personal innovativeness within the domain of IT significantly predicted behavioural intention to use a specific IT system, product or web-based service (Fang et al., 2009; Hung & Chang, 2005; Lu, Yao & Yu, 2005). Online mediation permits a further refinement of the broad definition outlined above. As OFDR will be an exclusively Internet-based service, the construct of ‘personal web innovativeness’ (Fang et al., 2009) was appropriate to include as an antecedent to OFDR usage intentions. Innovativeness here is defined as the willingness of a potential user to adopt or trial new online services. Previous findings indicate that web innovators are more likely to adopt an IT system (Hung & Chang, 2005; Lu et al., 2005) due to greater experience with unfamiliar systems (Fang et al., 2009) and positive attitudes towards the use of new online services in general (Lian & Lin, 2008). Therefore, we proposed that:

H4: The positive effects of personal web innovativeness on behavioural intention will be mediated by performance expectancy and effort expectancy.
Model Overview

Research from the information systems (IS) literature suggests that trust (Komiak & Benbesat, 2006; Nicolaou & McKnight, 2006; Pavlou, 2003) may mediate the effects of technology acceptance constructs. However, in the context of this study, staff are likely to hold measurable pre-existing attitudes toward the trustworthiness of the organisation and its technology infrastructure. In addition, other researchers have successfully demonstrated that trust may be an antecedent to technology acceptance constructs in particular contexts (Pavlou, 2003). Further, web innovativeness is a self-assessment based on previous online behaviour (Agarwal & Prasad, 1998). These pre-existing attitudes and self-appraisals should be drawn on by staff to inform attitudes and intentions toward a hypothetical OFDR system. Therefore, at the conceptual stage of technology development (i.e., before a tangible product exists), we argue that trust and innovativeness are direct antecedents to technology acceptance attitudes and may influence intention via indirect effects mediated by these UTAUT constructs.

Consequently, two models were developed to evaluate the proposed relationships between variables. Model one evaluated the simultaneous direct effects of all predictors on intention. Model two introduced indirect mediated pathways between variables. The results of this model testing were used in conjunction to assess the proposed mediated relationships between antecedents and technology acceptance constructs.

According to the procedures outlined by Baron and Kenny (1986), mediation can be evaluated using four steps. First, the predictor must be significantly correlated with the criterion. Second, the predictor must be related to the proposed mediator. Third, the mediator must influence the criterion once the effects of the predictor have been controlled. Finally, complete mediation is indicated if the predictor-criterion relationship becomes non-
significant once the mediator is introduced; otherwise, partial mediation may be occurring. These steps were employed to evaluate the hypothesised relationships between constructs.

In sum, drawing on a UTAUT model augmented with trust and personal web innovativeness, we designed a cross-sectional research study to test our propositions prior to the implementation of an online service delivery methodology for family mediation.

**METHOD**

**Sample**

A total of 127 valid responses were submitted to the OFDR web survey. The response rate was approximately 42%. All service-delivery and managerial staff were included within the sampling frame for this study for two main reasons. First, sample size concerns were addressed by including employees outside of the FDRP role and second, the technological infrastructure employed by OFDR may impact on non-FDRP staff in the future. Therefore, it was deemed relevant to include the perspectives of these peripheral staff in this research.

Participant contact details were obtained by searching the RAQ internal Intranet and Outlook distribution lists. Staff were included in the sample if they were allocated to the ‘service provider’ Intranet category or possessed previous experience in a similar role (e.g., managers and directors). Support and administration staff were excluded from the sample (except where staff also worked in a service provider role). Table 1 shows descriptive statistics for each demographic item.

Respondents were aged an average of 43.21 years (SD = 10.85) and over-represented by females (N = 93, 73.23%), which reflects the general demographic of the organisation. As expected, the majority of respondents were service providers (N = 92, 72.44%); a small proportion of the sample identified as managers (N = 15, 11.81%), support staff (N = 10, 7.89%) and directors (N = 4, 3.14%). Most respondents were located within the Brisbane metropolitan zone (N = 50, 39.37%), followed by the northern Queensland (N = 36, 28.34%)
and border zones (N = 26, 20.47%). Respondents also provided an estimate of the number of hours they used a personal computer outside of work—this value was used a proxy for computer experience. Approximately 43% of the sample reported using computers for 10 hours or more per week, which suggests that most respondents were relatively experienced users.

**Measures**

**UTAUT:** Following our review of the literature, survey questions were created by adapting previously tested items. The original 20-item scale developed by Venkatesh et al., (2003) was adapted for use within this study (see Appendix A). Scale developers have recommended that between five and nine response options should be used (Spector, 1992); therefore, participants indicated their agreement with each item along a 7-point Likert scale (1 = *strongly disagree* and 7 = *strongly agree*). An example item for the performance expectancy construct read: “People would find OFDR useful in their jobs”. The staff survey contained three items for each construct, which was determined through discussion with subject matter experts and pilot testing with TDRS staff. The UTAUT constructs have previously demonstrated high convergent validity by correlating highly with scales from their respective theoretical constituents (Venkatesh et al., 2003). Two items were utilised to measure behavioural intention to adopt OFDR.

**Trust in Organisation:** A three-item measure was used to assess the level of trust in the host organisation, which was adapted from a scale developed by Fang et al., (2008). Previously reported reliability statistics were acceptable (α = 0.86; Fang et al., 2009). The items were slightly re-worded to increase relevance to the TDRS. Participants indicated their agreement with each item along a 7-point Likert scale (1 = *strongly disagree* and 7 = *strongly agree*). An example item read: “In general, RAQ management has supported the introduction of OFDR”.

Table 1.

*Descriptive statistics for demographic items.*

<table>
<thead>
<tr>
<th>Age</th>
<th>Gender</th>
<th>PC Hours per Day</th>
<th>Role</th>
<th>Zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>43.21</td>
<td>10.20</td>
<td>1.73</td>
<td>2.14</td>
</tr>
<tr>
<td>Median</td>
<td>44.00</td>
<td>7.00</td>
<td>1.00</td>
<td>2.00</td>
</tr>
<tr>
<td>Mode</td>
<td>44.00</td>
<td>5.00</td>
<td>1.00</td>
<td>2.00</td>
</tr>
<tr>
<td>SD</td>
<td>10.85</td>
<td>10.21</td>
<td>1.47</td>
<td>0.79</td>
</tr>
<tr>
<td>Skew</td>
<td>-0.16</td>
<td>-1.29</td>
<td>3.08</td>
<td>1.99</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.07</td>
</tr>
</tbody>
</table>

*Note: Categorical variables were coded as follows; gender (male = 1, female = 2), role (service provider = 1, manager = 2, director = 3, administrator = 4, support staff = 5, other = 6), zone (border = 1, metropolitan = 2, northern = 3, virtual = 4).*
Trust in Technology: A three-item measure was developed to assess the level of trust in OFDR technology, developed in consultation with subject matter experts. The original nine-item scale ($\alpha = 0.87 – 0.92$) utilised by Li and colleagues (2008) was adapted by selecting exemplary items and including references to OFDR technology. Participants indicated their agreement with each item along a 7-point Likert scale (1 = strongly disagree and 7 = strongly agree). An example item reads: “I could rely on an OFDR system to be working when I needed it”.

Personal Web Innovativeness: A two-item measure was adapted for the client survey from a pre-existing three-item version ($\alpha = 0.81$) used by Fang and colleagues (2009). Item wording was modified to refer to ‘online services’, which increased the relevance to the OFDR context. Participants indicated their agreement with each item along a 7-point Likert scale (1 = strongly disagree and 7 = strongly agree). An example item reads: “Generally, I spend a lot of time using new online services”. The original version of this measure was developed by Agarwal and Prassad (1998) and validated within the area of information technology usage. Previously reported alpha reliability indices were acceptable ($\alpha = 0.87$).

Procedure

Ethical approval for the study and procedures was granted by the RAQ Human Research Ethical Committee (RAQHREC). All aspects of the study complied with NH&MRC Guidelines (2007) for conducting research. Staff provided electronic consent to participate in this study. All measures were empirically designed and implemented with confidential and supportive conditions. The sample was recruited by requesting the voluntary participation of selected RAQ staff via email.

Staff engagement was encouraged by conducting face-to-face presentations of the overarching project and interim survey results, and the distribution of interim reports to management for further dissemination. Staff were encouraged to discuss the research topic
within these sessions and provide feedback regarding the continued technical efficiency of
the survey platform. Maintaining staff involvement in this manner assisted the extraction of
accurate data and high participation rates.

Limesurvey (version 1.85+) was employed as the survey platform, based on our
assessment of its functionality (automated data collection, data export options, conditional
question branching), ease of use (user-friendly interface and customisability) and
compatibility with existing IT infrastructure (PHP-based). PASW Statistics (version 18) was
used as a basis for data cleaning, recoding variables, missing values analysis, generating
descriptive statistics and multiple imputation procedures. SmartPLS version 2.0 M3 Beta
(Ringle, Wende & Will, 2005) provided partial least squares (PLS) equation modelling.

**Missing Values Analysis**

First, we screened the data using the missing values analysis (MVA) procedure in
PASW statistics. The output revealed that 9.9% of data points were missing. Moreover,
37.8% of cases were affected by missing data. The MVA function in SPSS revealed that
social influence was particularly affected by missing values (> 10% missing). Consequently,
we did not perform list-wise deletion of cases with missing values as this would have reduced
the dataset markedly.

A considerable literature has been written regarding the methods of handling missing
data. Methodological scholars have recommended that data should firstly be examined to
establish whether there is a pattern to the missing values (Acock, 2005; Rubin, 1987).
Further, the selected method of path analysis—partial least squares—relies on a complete
dataset (Bovaird, Kupzyk, Maikranz, Dreyer & Steele, 2007; Chin, 1998); therefore, we
reviewed the methodological literature to identify best practice in missing data management.

The problem of missing data has been extensively investigated by methodologists and
researchers alike—the common view is that traditional methods (e.g., list-wise deletion, pair-
wise deletion and mean substitution) are sub-optimal (Fichman & Cummings, 2003). Specifically, these techniques may increase the prevalence of Type II errors and underestimate correlations and regression weights (Acock, 2005). Multiple imputation (MI; Rubin, 1987) is a relatively new and promising method of estimating missing values in social sciences research (Allison, 2000; Schafer, 1999). Simply, MI estimates plausible values for missing data based on the results of a regression performed for complete cases. Random variation is then introduced to the regression equation to reduce the issue of inflated estimates (Allison, 2003). Multiple runs of the MI algorithm allow the researcher to produce a set of composited estimates that further increases the confidence in the final generated values (Allison, 2000; Allison, 2003; Schafer, 1999).

We conducted MI with five iterations—between five and 10 imputations are typically recommended (Schafer, 1999). The first assumption of MI—that data are missing completely at random (MCAR; Little & Rubin, 1987)—was assessed using Little’s (1998) Chi$^2$ test of MCAR data, which was non-significant, $\chi^2(521) = 493.86, p = 0.80$. The second assumption relating to multivariate normality was assessed through visual inspection of QQ plots and Mardia’s (1970) multivariate tests for each imputed dataset. Mardia statistics were all significant, which indicated a violation of multivariate normality (this result was confirmed following inspection of the plots). However, scholars have suggested that the MI method is relatively robust to moderate violations of multivariate normality (Allison, 2000; Fichman & Cummings, 2003); therefore, we proceeded with the analysis using imputed values. Table 2 presents missing data information and the impact of MI on sample descriptive statistics.
Table 2.

*Missing data and multiple imputation descriptive statistics for UTAUT constructs.*

<table>
<thead>
<tr>
<th></th>
<th>Original Sample</th>
<th>MI Data (Average of five datasets)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>N missing</td>
</tr>
<tr>
<td>PE</td>
<td>121</td>
<td>6</td>
</tr>
<tr>
<td>EE</td>
<td>118</td>
<td>9</td>
</tr>
<tr>
<td>SI</td>
<td>99</td>
<td>28</td>
</tr>
<tr>
<td>Tr_Tech</td>
<td>116</td>
<td>11</td>
</tr>
<tr>
<td>Tr_Org</td>
<td>119</td>
<td>8</td>
</tr>
<tr>
<td>Innov.</td>
<td>113</td>
<td>14</td>
</tr>
<tr>
<td>BI</td>
<td>115</td>
<td>12</td>
</tr>
</tbody>
</table>
Data Analysis

The theoretical framework (including proposed relationships among study variables) was evaluated using partial least squares (PLS). The PLS method is essentially a combination of multiple regression and factor analysis (Chin, 1998). Therefore, PLS is best conceptualised as a form of variance-based structural equation modelling—both measurement and structural models can be evaluated using this technique (Henseler, Ringle & Sinkovics, 2009). Further, PLS is best suited to theory development rather than evaluation (Barclay et al., 1995; Gefen, Straub & Boudreau, 2000). Thus, PLS was selected to analyse the exploratory research propositions outlined in this paper.

Despite recent research which suggests PLS is less robust to violations of normality than previously thought (Marcoulides, Chin & Saunders, 2009; Marcoulides & Saunders, 2006), we propose that the reasonable sample size and moderate non-normality present within this data preserve the integrity of the results reported in this paper. In addition, following the recommendations of PLS scholars (Chin, Marcolin & Newstead, 2003), statistical power was calculated for each pathway regression using Soper’s (2011) online application. All values were above 0.9. Furthermore, PLS-specific power tables provided by Marcoulides and Saunders (2006) indicated that power was above 0.8.

RESULTS

Attitudes Towards the use of OFDR

The majority of the sample indicated they held positive attitudes towards the use of OFDR in the context of their current dispute and intended to use OFDR when it became available. Table 2 describes the distribution of respondents’ average rating for each UTAUT construct. Of note, staff tended to rate both the organisation ($M = 5.85, SD = 1.03$) and OFDR technology as trustworthy ($M = 5.06, SD = 1.07$), and indicated that OFDR was useful ($M = 5.07, SD = 1.06$).
 Measurement Model

The PLS method allows researchers to account for error that is attributable to measurement. Further, reliability and validity can be assessed by calculating indicators’ composite reliabilities, average variance extracted (AVE), factor loadings and construct inter-correlations (Chin, 1998; Thatcher & Perrewé, 2002).

Composite reliability indices are interpreted in the similar fashion to Cronbach’s reliability alpha coefficients; thus, a figure of 0.7 or above is considered acceptable for research purposes (Fornell & Larcker, 1981). The AVE figures represent the proportion of variance attributable to the indicators relative to measurement error (Fornell & Larcker, 1981). An AVE value should be above 0.5 (Barclay et al., 1995). Table 3 shows that the measurement model demonstrated adequate reliability and AVE values.

Discriminant and convergent validity were assessed with inter-construct correlations and factor loadings (Thatcher & Perrewé, 2002). Specifically, adequate discriminant validity was inferred given that the square root of each construct’s AVE was greater than the correlations with other latent constructs. Moreover, indicators loaded highest on their relevant constructs (Chin, 1998). Table 3 displays the values used to assess validity.

 Structural Model

Five separate PLS runs were performed using the MI parallel datasets. To examine the hypothesised mediated effects between the UTAUT, trust and innovativeness constructs, analyses were performed across both the direct and indirect models. Bootstrapping with 1,000 samples was used to generate standard errors and t-statistics (Chin, 1998). The formulae provided by Rubin (1987) were used to combine estimates across imputed dataset results and to perform inferential hypothesis testing (see Appendix B). Figure 1 presents an overview of the direct and mediated effects structural models—combined estimates are reported.
The $R^2$ values provided by the PLS algorithm are interpreted in a similar fashion to multiple regression—the proportion of variance in the criterion explained by the model (Barclay et al., 1995). Overall, the direct effects model predicted approximately 55% of variance in behavioural intention. Moreover, trust in technology and web innovativeness accounted for 50% of variance in EE. Trust in TDRS explained roughly 30% of variation in social influence, and web innovativeness accounted for 8.3% of variance in PE.

Hypothesis one predicted that PE, EE and SI would have positive and direct effects on behavioural intention to adopt OFDR. The results partially supported this proposition—both PE ($p < .05$) and EE ($p < .05$) were positively and significantly related to BI. However, contrary to expectations, the relationship between SI and BI was non-significant ($p = 0.10$).

Trust in the organisation did not demonstrate a significant direct relationship with BI in the presence of other predictors; therefore, the first step of mediation was not satisfied. Thus, hypothesis two was not supported ($p = 0.47$).

Hypothesis three predicted that trust in technology would influence both behavioural intention and EE. Results provided some support to this prediction. Notwithstanding a $p$-value that approached significance ($p = 0.06$), the direct relationship between trust in technology and BI was substantive. In addition, this relationship became non-significant once a mediated pathway was added (model 2; $p = 0.08$). Follow up mediation analysis was conducted using an online application (Preacher & Leonardelli, 2001) that provided values for the Sobel (1986), Goodman (1960) and Aroian tests. All values were significant at the $p < .05$ level (see Table 4). Thus, EE completely mediated the effects of trust in technology on BI, which supports hypothesis three.

Finally, hypothesis four predicted that personal web innovativeness would be related to PE, EE and behavioural intention. The first step required for mediation was non-significant
(p = 0.13). However, innovativeness was significantly related to both PE (p <.01) and EE (p <.01). Therefore, this prediction received only limited support.
Table 3.

*Evaluation of PLS measurement model.*

<table>
<thead>
<tr>
<th>Correlations between constructs and average variance extracted (AVE)</th>
<th>CR</th>
<th>PE</th>
<th>EE</th>
<th>SI</th>
<th>Tr_Tech</th>
<th>Tr_Org</th>
<th>Inn</th>
<th>BI</th>
</tr>
</thead>
<tbody>
<tr>
<td>PE</td>
<td>0.9355</td>
<td><strong>0.8471</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EE</td>
<td>0.9025</td>
<td>0.6053</td>
<td><strong>0.8691</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SI</td>
<td>0.8871</td>
<td>0.6339</td>
<td>0.4285</td>
<td><strong>0.8519</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tr_Tech</td>
<td>0.8803</td>
<td>0.7342</td>
<td>0.6353</td>
<td>0.5975</td>
<td><strong>0.8433</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tr_Org</td>
<td>0.9057</td>
<td>0.6461</td>
<td>0.5222</td>
<td>0.5505</td>
<td>0.7424</td>
<td><strong>0.873</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inn</td>
<td>0.8729</td>
<td>0.2885</td>
<td>0.5361</td>
<td>0.2488</td>
<td>0.3591</td>
<td>0.2345</td>
<td><strong>0.9343</strong></td>
<td></td>
</tr>
<tr>
<td>BI</td>
<td>0.9355</td>
<td>0.6522</td>
<td>0.6129</td>
<td>0.5130</td>
<td>0.6459</td>
<td>0.5743</td>
<td>0.3741</td>
<td><strong>0.9374</strong></td>
</tr>
</tbody>
</table>

*Note: Bolded values on the diagonal are the square root of the AVE. Values on the off-diagonal represent inter-construct correlations.*
Figure 1. Direct effects and mediated effects modelling. Note: * = p < .05 and ** = p < .01. Dashed lines represent non-significant relationships.
Table 4.

*Results of mediation testing between trust in technology, EE and BI.*

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Statistic</th>
<th>Standard Error</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sobel</td>
<td>2.21</td>
<td>0.05</td>
<td>0.03</td>
</tr>
<tr>
<td>Aroian</td>
<td>2.19</td>
<td>0.05</td>
<td>0.03</td>
</tr>
<tr>
<td>Goodman</td>
<td>2.23</td>
<td>0.05</td>
<td>0.03</td>
</tr>
</tbody>
</table>
DISCUSSION

The study found some support for our propositions and for the augmented model of UTAUT in the context of online mediation. Table 5 describes a summary of the results of hypothesis testing. Of note, the study was conducted at the development phase of the project—staff had not yet experienced the system. We anticipate that the strength of the relationships between UTAUT constructs may be subject to change following exposure to the actual OFDR technology. However, this study demonstrates the utility of conducting technology acceptance research at the pre-contemplation stage of change and also supports the use of an extended version of the UTAUT model that includes trust in technology.

Whereas our hypotheses predicted that the trust and innovativeness constructs would be directly related to behavioural intention, path analysis indicated that in the presence of other UTAUT constructs, these direct effects were non-significant. Indeed, all constructs (considered in isolation) shared a large and significant portion of variance with behavioural intention. Considered simultaneously, it is not surprising that there was insufficient variance to distribute amongst the additional constructs. Thus, a parsimonious UTAUT framework consisting of PE, EE and trust in technology is indicated as the optimal model. However, it is noted that the influence of SI (p = .10) and web innovativeness (p = .13) approached significance.

Contrary to previous findings (Venkatesh et al., 2003), the results of this study did not support the inclusion of SI as a predictor of behavioural intention. A post hoc ANOVA indicated that responses to the SI items differed significantly between employment roles, F(4, 94) = 2.88, p <.05. The mean SI value for managers and directors was significantly higher than service delivery staff. SI items suffered the highest rate of missing data (> 10%). In addition, post-research interviews conducted with staff indicated that the face validity of these items may have been questionable. Despite these concerns, the relationship between SI
and behavioural intention approached significance; therefore, we suggest that the absence of a direct relationship in this study may not necessarily indicate that SI is an irrelevant construct in the model of OFDR technology uptake. Further research is required to confirm the role of SI.

The application of the model shows that trust indeed plays a key role in technology uptake. In the context of OFDR, trust in technology (i.e., that the OFDR system operates reliably) appears to have an indirect effect on behavioural intentions to adopt the system. Specifically, the effects of technology trust seem to be completely mediated by effort expectancy. Users may hold reservations about the trustworthiness of online technology, as suggested by previous research (Einwiller, 2003; Miyazaki & Fernandez, 2001; George, 2003). Moreover, trust assessments based on existing experiences with the organisation’s IT systems seem to influence the expected effort required to use a new technology. Users may feel that a non-trustworthy and unreliable infrastructure generalises to innovations, which are likely to require additional resources to use effectively. Organisations should consider and compensate for distrust in Internet technologies and pre-existing attitudes towards IT systems if user acceptance is to be maximised. Providing prominent reassurances to staff and engaging in user-centred pre-implementation testing could be two practical strategies for addressing this trust issue. In addition, effectively promoting the organisation’s technological infrastructure may prove useful to increase system uptake. Open-ended comments provided by staff indicated that recent IT issues had adversely affected trust in the organisation’s infrastructure. Change managers should not discount staff perceptions of technological functionality as it may reduce the likelihood of system uptake—particularly if technology problems are handled poorly.

Direct effects were found between personal web innovativeness and core UTAUT variables, implicating the presence of individual drivers of technology adoption. Innovative
users most likely possess greater confidence in their computer abilities (Fang et al., 2009) and may believe that they can readily apply these skills to the OFDR context. As described by previous research, innovative users are more likely to hold favourable attitudes towards new technologies (Lian & Lin, 2008); perhaps the innovative respondents in this study were more able to appreciate the applicability of a video-conferencing and document-sharing system to the context of a family mediation. Non-innovative users, possessing lower experience with such technologies, may have struggled to visualise or anticipate how technology might be used within an OFDR session. However, these conclusions must be interpreted cautiously. Self-selection bias may have resulted in an empirical validation of the extended UTAUT only amongst moderately or highly innovative people. Future research should aim to increase the diversity of the respondent sample.

**Limitations**

Interpretation of the aforementioned results should be made in light of the following recognised limitations. Staff survey data was moderately non-normal in distribution. Attempts to correct the distribution via transformations were unsuccessful. However, scholars have suggested that violation of normality becomes less of an issue during PLS analysis with moderate sample sizes (Marcoulides et al., 2009). Indeed, some researchers have described PLS as ‘distribution-free’ (Geladi, 1988). Given recent caveats to this proposition (Marcoulides et al., 2009) and our moderately-sized sample, we advise that the results of the statistical analyses should be interpreted with caution.

The non-normal of the data may indicate potential issues with the method of survey recruitment. Self-selection bias occurs when the research sample differs to the general population, limiting the generalisability of the obtained results (Braver & Bay, 1992). Respondents in the current sample may have self-selected for participation for a variety of
reasons. We recognise that this sample differs to other organisational contexts; therefore, the results may not be relevant to other settings.

An additional limitation of this study refers to the nature and timing of the research. The staff survey did not allow for respondents to experience the OFDR system in a tangible sense. Variation in respondents’ imaginings of the OFDR system were reduced by providing a standardised description at the commencement of the survey. However, we acknowledge that this could have hampered respondents’ efforts to adequately anticipate the level of effort they would need to expend to learn how to use the system. This limitation suggests that additional research with staff should be conducted once the OFDR technology has materialised into a tangible, usable product. Respondents could repeat the UTAUT survey following exposure to the actual OFDR system—removing the hypothesised masking effects of familiarity or understanding of the imagined OFDR technology. If the results of the follow-up research replicate the results of this study, greater confidence can be placed in the findings presented here.

In addition, this research employed a cross-sectional survey methodology. Therefore, casual relationships represented here are tentative and need to be confirmed through repeated data collection at a later time point. Further, common methods variance (CMV) cannot be excluded as a contributor to the observed relationships between constructs. Procedural methods to reduce the impact of CMV such as including additional measures (e.g., social desirability, negative affect; Brannick, Chan, Conway, Lance & Spector, 2010) were impractical given constraints on survey length. Therefore, two post-hoc statistical methods were used to assess CMV. First, Harman’s single factor test (Podsakoff, MacKenzie, Lee & Podsakoff, 2003) did not support a single common-methods factor—demographic variables loaded very low on the first extracted factor (i.e., <.04). Second, the marker variable technique (Brannick et al., 2010; Podsakoff et al., 2003) indicated that the inflatory influence
of CMV was negligible (<.05). Specifically, the correlation between two unrelated constructs—role and zone—was low (0.05) and non-significant.

**Practical Implications**

Within the confines of RAQ staff sample, the findings of this study may have several practical implications. Specifically, findings from this study that demonstrated the importance of perceived usefulness, ease of use and trust in technology could be used to inform effective OFDR change management strategies. The identification of salient user acceptance factors could facilitate greater efficiency in the use of organisational resources during the implementation phase of the OFDR project.

Regarding OFDR implementation, Rogers’ (2003) diffusion of innovations model suggests that the uptake of new technologies throughout the general population is facilitated by two important groups—innovators and early adopters. Results from this study indicate that innovative users who explore new online services more often than their peers are also more likely to perceive OFDR technology as useful and easy to use. Appealing to this group through targeted promotion (e.g., online resources, OFDR website) and advertisement of the innovative nature of OFDR technology may result in a higher rate of uptake and acceptance. Indeed, the OFDR management team has identified project champions in an attempt to capitalise on the positive effects of peer enthusiasm and commitment to a new innovation.

Further, the design and implementation of online service delivery should consider the importance of demonstrating and promoting trust between technology and users. Specifically, service providers should ensure that online systems operate reliably and securely. Displaying third-party logos (e.g., online security verification) may assist in ‘transferring’ trust to the online system as suggested by previous research into the design of online surveys (Jiang et al., 2008). Online service providers should also ensure that adequate pre-implementation
testing is completed prior to ‘go-live’ date, which would minimise the potential for system ‘bugs’ (i.e., technical errors) to erode users’ trust in the technology.

Perhaps most relevant to online methods of delivering mediation and family dispute resolution are previous findings that indicate electronic communication results in a slower development of trust between users (Wilson, Straus & McEvily, 2006). Further, when compared to people operating in a face-to-face environment, those communicating electronically have been found to initially rate other group members as less trustworthy. Other notable findings include observations that electronic channels of communication decrease inhibition (resulting in greater chances of inflammatory responses) and hamper intra-group cooperation. However, over time these effects are reduced, with electronic collaborators establishing equivalence to those conversing face-to-face on measures of trust (Wilson et al., 2006). These findings suggest that trust between disputing parties may also influence users’ intentions to take part in online mediation.

Future research should explore the relationship between intention and actual usage, which may success in further validating the extended UTAUT within the OFDR context and increasing the utility of the model as a predictive tool. Moreover, several of the constructs investigated here may be relevant during actual use of the system—potentially impacting on the effectiveness of the mediation process. Research is currently underway to explore the influence of these constructs from a human-computer interaction (HCI) framework.

**Conclusion**

As suggested by the results of this study, models of technology adoption continue to demonstrate their applicability and utility in a wide range of contexts. Globally, technological innovation continues to accelerate (Zhang & Maruping, 2008); indeed, it is difficult to describe a task in society that is not facilitated by computerised technology of some description. This research partially validated the core UTAUT model within a unique
technology and change management context, which suggests that further work is needed to fully understand and confirm the relationships between technology uptake antecedents.

Further, trust in technology was shown to influence technology uptake intentions—it is plausible that variables not considered in this study may moderate these effects. We encourage further exploration of trust in online contexts as the current body of literature suggests that it is a fruitful research area. Community services are also seeking to capitalise on the benefits of online technologies to reach a broader client demographic. Thus, it seems that technology acceptance research will continue to grow in the area of community-services IT implementation.
Table 5

*Summary of hypothesis testing results.*

<table>
<thead>
<tr>
<th>Prediction</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1</strong></td>
<td>Performance expectancy, effort expectancy and social influence will have a positive effect on behavioural intention.</td>
</tr>
<tr>
<td><strong>2</strong></td>
<td>The positive effects of trust in technology on behavioural intention will be mediated by effort expectancy.</td>
</tr>
<tr>
<td><strong>3</strong></td>
<td>The positive effects of trust in TDRS on behavioural intention will be mediated by social influence.</td>
</tr>
<tr>
<td><strong>4</strong></td>
<td>The effects of personal web innovativeness on behavioural intention will be mediated by performance expectancy and effort expectancy.</td>
</tr>
</tbody>
</table>
REFERENCES


Chin, W., Marcolin, B. & Newstead, P. (2003). A partial least squares latent variable modelling approach for measuring interaction effects: Results from a Monte Carlo
simulation study and an electronic-mail emotion/adoption study. *Information Systems Research, 14*(2), 189 – 217.


Fornell, C. & Larcker, D. (1981). Structural equation models with unobservable variables and measurement error: Algebra and statistics. *Journal of Marketing Research, 18*(3), 382 – 388.


## APPENDIX A

### Table A1.

Summary of measures used in the study and corresponding sources.

<table>
<thead>
<tr>
<th>Theoretical Construct</th>
<th>Items</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performance Expectancy</td>
<td>Using OFDR would increase the chance of settling a family dispute.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Using OFDR would enhance the current mediation process.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>People would find OFDR useful in their jobs.</td>
<td></td>
</tr>
<tr>
<td>Effort Expectancy</td>
<td>I would find an Online Family Dispute Resolution Service easy to use.</td>
<td>Venkatesh, Morris, Davis &amp; Davis (2003)</td>
</tr>
<tr>
<td></td>
<td>Learning how to operate an OFDR system would be easy for me.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The use of an OFDR system would be clear and understandable to me.</td>
<td></td>
</tr>
<tr>
<td>Social Influence</td>
<td>In general, RAQ management has supported the introduction of OFDR.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>People who influence my behaviour think that using OFDR is a good idea.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>People who are important to me think that using OFDR is a good idea.</td>
<td></td>
</tr>
<tr>
<td>Trust in the</td>
<td>RAQ is acting in our best interests by piloting OFDR.</td>
<td>Fang, Shao &amp; Lan (2009); Lippert (2007)</td>
</tr>
<tr>
<td>Organisation</td>
<td>RAQ would deliver an OFDR service competently.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>I feel comfortable relying on RAQ to fulfil their obligations in relation to OFDR.</td>
<td>Li, Hess &amp; Valacich (2008); Lippert (2007)</td>
</tr>
<tr>
<td>Trust in OFDR Technology</td>
<td>I could rely on an OFDR system to be working when I need it.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>An OFDR system would operate in a truthful and honest manner.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>An OFDR system would operate in my best interests.</td>
<td></td>
</tr>
<tr>
<td>Web Innovativeness</td>
<td>Generally, I spend a lot of time exploring how to use new online services.</td>
<td>Argawal &amp; Prasad (1998); Fang, Shao &amp; Lan (2009)</td>
</tr>
<tr>
<td></td>
<td>Among my peers I am usually the first to try out new online services.</td>
<td></td>
</tr>
<tr>
<td>Behavioural Intention</td>
<td>If Online Family Dispute Resolution was available now, I would use it.</td>
<td>Venkatesh, Morris, Davis &amp; Davis (2003)</td>
</tr>
<tr>
<td></td>
<td>I intend to use OFDR as soon as it becomes available.</td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX B

Rubin’s (1987) formulae used to combine estimates from the analysis of multiple imputed datasets:

- The combined point estimate $Q$ is the average of the $m$ imputed data estimates:
  \[
  \bar{Q} = \frac{1}{m} \sum_{i=1}^{m} \hat{Q}_i
  \]

- The between-imputation variance is calculated using:
  \[
  B = \frac{1}{m-1} \sum_{i=1}^{m} (\hat{Q}_i - \bar{Q})^2
  \]

- The average within-imputation variance of the $m$ complete-data variance estimates is calculated using:
  \[
  \bar{U} = \frac{1}{m} \sum_{i=1}^{m} \hat{U}_i
  \]

- The estimated total variance is:
  \[
  T = \bar{U} + \left(1 + \frac{1}{m}\right)B
  \]

- The test statistic approximates the t-distribution:
  \[
  t = \frac{\bar{Q}}{\sqrt{T}}
  \]

- With degrees of freedom calculated using:
  \[
  v_m = (m-1) \left[ 1 + \frac{\bar{U}}{(1 + m^{-1})B} \right]^2
  \]