TESTING A MODEL OF USER RESISTANCE TOWARDS TECHNOLOGY ADOPTION IN CONSTRUCTION ORGANIZATIONS

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SUMMARY: Drawing upon diffusion of innovation (DoI) theory, technology acceptance models (TAMs), social network perspective and resistance literature, the study developed and tested a model, named integrated resistance factor model (IRFM), which integrates four key elements i.e. resistance indicators, support network factors, experience and disposition factors and the integration and accessibility factors. The study investigated if the model applies in a selected technology, namely online project information management systems (OPIMS). The IRFM was tested with partial least square (PLS) techniques and results from the R^2 analysis of the whole PLS structural model were significant and the data were coherence with the proposed model (R^2=0.484). These results indicated that user resistance to technology innovation can be predicted using the IRFM.

KEYWORDS: *User resistance, Technology innovation, Diffusion of innovation, Technology acceptance model, Social network*

1. INTRODUCTION

The large majority of technology innovation studies have focused on how the early stages of technology implementation can be managed and the technology can be accepted and used most effectively. There is a clear focus on the factors that influence user adoption and a strong presumption that technology innovation will bring a positive benefit to operations. This focus however has overshadowed the particular implementation issues associated with more mature technology innovations and the broader aspects of post-implementation management. There are two dominant theoretical perspectives applied in technology innovation studies that are diffusion of innovation (DoI) and technology acceptance models (TAMs). In practice, both DoI and TAM are fairly mundane perspectives and do not provide an effective way to resolve real-world practice and technology implementation issues in organizations. The large majority of innovation studies use DoI and/ or TAM, and almost all focus on the early processes of technology implementation from a user adoption perspective. This emphasizes factors such as the technology specification, existing operations and change management.

In assessing the merits of a technology, Rogers (1962) suggested five attributes, termed the characteristics of innovations: (1) relative advantage, (2) compatibility, (3) complexity, (4) trialability and (5) observability. Rogers (1962) stated that individual perceptions of these characteristics both influence and predict the take up of innovation. Moore and Benbasat (1991) examined and extended the attributes of innovation introduced by Rogers (1962), and undertook an extensive development of the survey instrument used to evaluate the user perceptions of IT innovations. Their study shows that the most important perceived characteristics of an IT innovation affecting a user's decision regarding use of technology are: voluntariness of use, image, relative advantage, compatibility, ease of use, trialability, result demonstrability and visibility. Most studies related to DoI theory have used Rogers (1962) and Moore and Benbasat (1991) criteria and focused on the technical aspects of innovation, these have had a considerable positive impact on innovation research. However, it falls short of some theoretical constructs that help address the necessary condition for an adoption, collective adoption behaviour and complex nature of social forces.

TAM is increasingly criticized as having saturated the research field and for the inevitable bias and limitations such a saturation creates, especially relative to the entire technology implementation cycle (Benbasat and Barki (2007)). A key limitation of TAM is that it fails to recognize the potential for the functionality of a given technology to change in the process of adoption and through the dynamic sense-making behaviours of users (Salovaara and Tamminen (2009)). Other limitations of TAM and further calls for alternative theoretical frameworks are growing (Goulding and Alshawi (2012); Peace et al. (2010); Tookey (2011)). Venkatesh (2006) is particularly explicit in arguing that, in isolation, TAM is not sufficient to address the complexity of the technology implementation process. This paper draws from Venkatesh (2006) and others in seeking to shift the focus of theoretical and implementation studies from acceptance and diffusion (in isolation) to a more integrated framework that includes user resistance. A change in theoretical perspective for technology innovation is necessary to provide some structural simplification to the plethora of factors now associated with the lifecycle of technology innovation. That simplification will be articulated from the perspective of user resistance, as a means of addressing some of the key limitations associated with the current DoI and TAM approaches.

Envisioning a scenario of mature technology is the focus of this study. Online project information management systems (OPIMS) were taken as the research case. OPIMS is a collective term used in this research to cover web-based project management systems, web-enabled project management, project extranets, online project management technologies, online collaboration and electronic document management systems as well as similar technology innovations. OPIMS has been evolving for more than a decade and is a relatively mature and robust technology.

The benefits of this technology are very well understood in the Australian construction industry, but it is still facing resistance and slow adoption (Kajewski et al. (2004); Nitithamyong and Skibniewski (2011); Peansupap and Walker (2006); Stewart and Mohamed (2004)). Resistance to technology manifests differently at different levels: individual, organisation and industry or economy more broadly. Relatively, little research has focused on the individual level. The individual level is also the preferred level of consideration for this research because the current technology innovation strategies tend to over-emphasise the technology and discount the people factors. People are the core element in any organization. Where a technology innovation is implemented as a mandatory requirement of the organization, the attitude of the individual can be critical. Individual attitudes are influenced by a range of factors, and a better understanding of those factors will significantly affect the implementation of any technology innovation. Moreover, the organizational aspects of technology innovation specific to the construction industry have already been researched extensively. There is every indication that resistance at an organizational level is largely driven by resistance at the individual level, but little has been done to explore the reasons for this individual or end-user level resistance. The aim of this study is to develop and test a resistance model that influence effective technology innovation, that incorporates a range of theoretical foundations that are specific to diffusion, acceptance and resistance of innovation.

2. USER RESISTANCE

2.1 Concepts and definition

The term resistance can be defined in broad terms, from an organizational perspective, as "the forces against change in work organizations" (Mullins (1999), p. 824) and "an inability, or an unwillingness, to discuss or to accept organizational changes that are perceived in some way to be damaging or threatening to the individual or group" Huczynski and Buchanan (1958, p. 887) cited in Price and Chahal (2006 p. 243). Resistance has all the trappings of both a natural tendency and an individual preference (Marakas and Hornik (1996); Martinko et al. (1996); Rivard and Lapointe (2012)). The tendency or preference may be to maintain what is well-known and familiar, or it may be to seek change through new practices, ideas, innovations and/or technologies.

The definition of user resistance has been almost entirely viewed as something that is negative and potentially adversarial. It is discussed in terms of something that must be overcome to ensure that a given change in an organization is successfully achieved. However, a significant body of studies have also observed that resistance might better be perceived as something positive (Bauer (1997); Hartmann and Fischer (2009); Hirschheim and Newman (1988); Martinko et al. (1996); Rivard and Lapointe (2012); Val and Fuentes (2003); Waddell and Sohal (1998)). The case is made that user resistance is not only an inevitable part of every technology implementation process, but that it is also a necessary check on poor technology implementation. There may be sound operational and organizational reasons for resisting poorly designed or implemented systems. The evidence of user resistance can provide essential clues that show that perhaps more evaluation and improvements to the technology would be beneficial, or that the basic presumptions may be ill-founded. User resistance, when interrogated and leveraged appropriately, can be used by developers to improve future implementations, increase process awareness and render technology change more effectively. From the perspective of technology innovation, and for the purposes of this research, resistance is defined as: the actions of a potential user of a new technology implementation that reflect his or her concerns with, or, his or her opposition to particular aspects of that technology relative to a given work-practice context.

2.2 Resistance theory and models

Resistance theory is comprised of a range of specific models, drawn from a variety and combination of theoretical fields. Marakas and Hornik (1996) proposed a passive resistance misuse (PRM) model, which assumes that resistance to change is an observable behaviour that manifests as covert action. PRM subscribes to the view that resistance is motivated more by individual personal gain or the desire to sabotage the change effort itself. The theoretical foundation for PRM is a combination of passive-aggressive behaviour theory, espoused theory and theory-in-use. The passive-aggressive behaviour theory is used to understand the human aspects of how a user responds to the real or perceived personal threats or stresses that they associate with a new technology. Another theoretical foundation of PRM originates from the theory of actions by Argyris and Schon (1974). The theory of actions links a concept of espoused theory (which refers to how the user claims he or she would act) and theory-in-use (which refers to how the user actually acts).

Cenfetelli (2004) proposed a model called the “dual-factor model of IT usage”. The core argument for this model is that the TAM, which has been studied extensively (Davis (1986); Venkatesh and Davis (2000); Venkatesh et al. (2003)), successfully fosters positive user attitudes and encourages system use. However, the factors that influence user resistance are different from the factors that encourage use. The model therefore designed two factors to predict resistance: an enabler factor and an inhibitor factor. In the dual-factor model, the perceived usefulness and ease of use of IT factors taken from TAM are identified as enabling factors. The inhibitor factors are based on the work of DeLone and McLean (1992) relative to information and system quality measures. In the dual factor model, information quality refers to a user's evaluation of the systems' delivery of semantic meaning and/or communication of knowledge. System quality refers to the technical capabilities of the system and its usability.

Other resistance models emphasize the influence of individual personal gains and social factors (Joshi (1991); Kim and Kankanhalli (2009); Meissonier and Houze (2010); Prasad and Prasad (2000)). Prasad and Prasad (2000) studied the “informal” aspects of resistance or what they named “routine resistance” in workplace using the “Iron Cage” theory. The term iron cage refers to the oppressive bureaucracy or rules within organizations that constrain employee action (Weber (1958)). Prasad and Prasad (2000) found that routine resistance is complex and can develop in a situation that is planned or unplanned, often as a consequence of multiple actors in an organization. Routine resistance does not create real resistance, but rather makes use of it as a kind of holding space from which to wait out/delay the changes. Joshi (1991) introduced the Equity-Implementation (E-I) model, which is based upon the equity theory. It assumes that in every exchange relationship, people are concerned with differentiating their inputs, outcomes and the fairness of the exchange with others in the same group. Joshi (1991) contends that if one user feels that other users have benefited more than they have from a new system, that user is more likely to resist the change.

Addressing more of the social aspects of user resistance, Kim and Kankanhalli (2009) developed a status quo bias model of resistance (mR) that integrated TAM with the status quo bias theory. This model focused on how users respond socially to technology innovation in resistance terms. It classified responses in terms of switching the costs or switching the benefits. Switching costs refer to social actions that seek to reduce the effort/resources required to achieve the same or improved outcomes. Switching benefits refer to social actions that seek to increase the real or perceived value of the outcomes achieved using a new technology. Another approach to the social aspects of resistance is the IT conflict-resistance theory (IT-CRT) of Meissonier and Houze (2010). IT-CRT builds on the more social psychology perspective of Ajzen and Fishbein (1980) and the theory of reasoned action. The model assumes resistance is the consequent behaviour arising from conflict. Conflict is a form of attitudinal belief and corresponds to the affective or evaluative judgment of a person about the likely consequences of an action. The IT-CRT proposes that the task-oriented conflicts expressed towards the implementation of new technology may be masking broader socio-political conflict. From this perspective, the key factor is the socio-political conflict and an avoidance management strategy can be particularly effective in addressing this form of issue.

Based on literature, it is evident that current models span various human, social, technical and organizational perspectives and, as a consequence, the breadth of resistance theory incorporates a large number of potential causal factors. However, the range of perspectives have two common foundations, one is based on the different forms of human psychological and behavioural outcomes, and the other is based on factors specific to the technology itself. It is also apparent that many of the factors identified have parallels across the different perspectives, and in light of this there have been limited attempts to consolidate the range of possibilities into a more unified (and usable) theory, see for example Davis (2004), Ferneley and Sobreperez (2006), Klaus et al. (2010), Laumer and Eckhardt (2010). Davis (2004) was one of the first to attempt to develop an integrated model by seeking to combine change management, theory of reasoned action and theory of planned behaviour perspectives. The social architecture factor model (SAFM) proposed by Davis (2004) assumes that resistance to technology change can be measured effectively by incorporating a wide variety of factors, including the type and scope of change; method and speed of technology introduction; the demographics of the individuals involved; personal attitudes, beliefs and fears; and the demographic features of the organization. Laumer and Eckhardt (2010) also proposed a more comprehensive model of resistance to technology-induced organizational change (MRTOC). MRTOC draws from technology acceptance, organization sciences and managerial psychology to identify a wide range of potential drivers of user resistance based largely on individual characteristics (attitude, age, gender, tenure and educational background) and contextual background (social influence from superiors, colleagues and IT staff). Laumer and Eckhardt (2010), Klaus et al. (2010), Kim and Kankanhalli (2009), Davis (2004) and Cenfetelli (2004) each demonstrate that the basic resistance theory model can be usefully incorporated with TAM.

Consolidating those resistance factors that are more specific to the technology itself with those factors arising from behavioural and psychological issues, particular to workplace change, is certainly more likely to provide a richer model of user resistance. However, it also seems clear from previous research that, to do justice to the individual, it is necessary to understand how individual positions change relative to a technology change over time. Perspectives are known to change over the course of a technology diffusion process, and this would require modifications and adjustments to the TAM predictions. The most widely accepted theory of technology diffusion is the DoI theory proposed by Rogers (1962), but this has not previously been integrated with TAM as part of any resistance theory consolidation. One further obvious shortfall with the current resistance theory is in terms of the social influence and social network factors that contribute to resistance. This aspect has been rarely considered or included in the previous studies. A social network perspective that could address the lack of social influence and social network factors in the current resistance theory seems an obvious candidate for inclusion in any comprehensive understanding of user resistance.

3. RESEARCH MODEL

DoI theory is one of the most widely used theories in the technology implementation literature. The theory describes in detail the factors that influence the scope of the diffusion and the speed with which technology is adopted. It identifies five attributes, termed the characteristics of innovations: relative advantage, compatibility, complexity, trialability and observability Rogers (1962). An instrument to measure the five characteristics of innovation proposed by Rogers (1962) has been developed specifically for users of digital technology by Moore and Benbasat (1991). Moore and Benbasat (1991) proposed a set of seven perceived characteristics such as relative advantage, ease of use, image, compatibility, visibility, result demonstrability and voluntariness of use.

The TAM literature has generated many different models and each model has a set of determinants that are theoretical constructs. Soon after it was first introduced by Davis (1986), the model was revised in Davis et al. (1989). These initial models were developed based on the theory of reasoned action (TRA) by Fishbein and Ajzen (1975). The models suggest that actual technology usage is determined by behavioural intention, which is directly predicted by user's attitude towards using the technology. Attitude towards using the technology is indicated by two factors: perceived usefulness and perceived ease of use. Subsequent to the work of Davis (1986) and Davis et al. (1989), modifications and improvements to TAM include the extension of external variables, published in Venkatesh and Davis (2000) and Venkatesh et al. (2003). A modification proposed by Venkatesh and Davis (2000), called TAM2, incorporates additional theoretical constructs across social influence processes and cognitive instrumental processes. TAM2 proposes three interrelated social processes as persuading an individual to adopt or reject a new system: subjective norm, voluntariness and image. In another version of the model, the UTAUT by Venkatesh et al. (2003), elements of the extant TAM are integrated with elements developed in diffusion theory and social cognitive theory. Additional constructs developed in the UTAUT are based on the model of personal computer utilization, motivational model, DoI theory and social cognitive theory.

Most previous research has applied DoI and TAM in isolation, which has left an important deficiency in how the two theoretical frameworks might act in concert. There has been no previous consideration of the social network perspectives in drawing together a comprehensive and integrated mR. The addition of a social network perspective is significant because it more explicitly recognizes the broader social impact on technology innovation. DoI, UTAUT and MRTOC have strong potential for the addition of a social influence in the adoption of technology, but these tend (with UTAUT in particular) to be limited to describing factors based on the perception of others. MRTOC has confirmed the importance of a 360degree-type approach, but personal reflection is also an important indicator. An integrated perspective must incorporate social network theory along with established technology attributes and human attitude elements to frame a new body of knowledge and approach to resistance research.

The social network threshold (SNT) model/concept by Valente (1996) suggested that an effective diffusion process occurs when individuals have sufficient information to satisfy their personal exposure (threshold) requirements. A threshold is the number of individuals who must be engaged in an activity before a given individual will join that activity (Rogers (1962)). This number can vary. For instance, the individual who is the earliest to adopt (or an innovator himself/herself) will have a low threshold of adoption. The early adopter will accept a new idea almost without intervention, and interpersonal network influences are rarely needed for adoption. Conversely, a large majority of individuals has a much higher threshold. The peer network of a late majority individual must exert a heavy influence to overcome their resistance. In either event, however, an individual is more likely to adopt an innovation if more of the others in his or her personal network have already adopted that innovation. Not all members of a network are equal, as there are typically particular individuals who are more interconnected than others. These individuals are linked to others by patterned communication flows. The threshold concept is applied in this study in terms of personal exposure to innovation. Personal exposure is gained from a range of people (leaders, peers and affiliates) involved in the adoption network of an individual and the communication that links and connects the people within that network.

Based on the review of the current literature and critical elements identified above, an integrated model of user resistance, the integrated resistance factor model (IRFM) was proposed as shown in Fig. 1. The model is comprised of four key elements: (1) resistance indicators, (2) support network factors, (3) experience and disposition factors and (4) integration and accessibility factors. For each element of the IRFM, a number of features are used to represent that aspect of the model, with 17 features in total.

Resistance indicators are critical elements as they provide a gauge for the level of user resistance associated with each combination of causal factors. The resistance indicators are drawn from DoI theory and simplified as: (1) time of adoption of technology and (2) usage level.

Personal networks and relationships in the workplace are very important influences on the propensity of users to adopt new technologies (Rogers (1962); Valente (1996); Venkatesh et al. (2003)). The support network factors are included to represent the influence of social relationships in the work place (Valente and Davis (1999)). The factors include: (1) leaders, (2) peers and (3) affiliates.

Experience and disposition factors draw from a psychology perspective and attitude- behaviour theories. Disposition is best considered as an evaluation of how (un) favourable, (un)pleasant, good or bad a person considers a new technology, and that attitude is always influenced by personal experience. Six consistent constructs can be identified from the literature to constitute experience and disposition: (1) knowledge of ICTs, (2) use of ICTs, (3) motivation, (4) efficacy, (5) anxiety and (6) power.

The construction of the integration and accessibility factor is primarily based on Rogers (1962), extensive work by Moore and Benbasat (1991) and TAM. Integration includes the inherent characteristics of the technology: (1)

relative advantage, (2) compatibility and (3) complexity. These factors are relevant to issues of operability and the extent to which a technology can support work tasks and enhance working collaborations with others. An accessibility factor is concerned with making the technology available for: (1) learning, (2) trialing and (3) visibility to users.

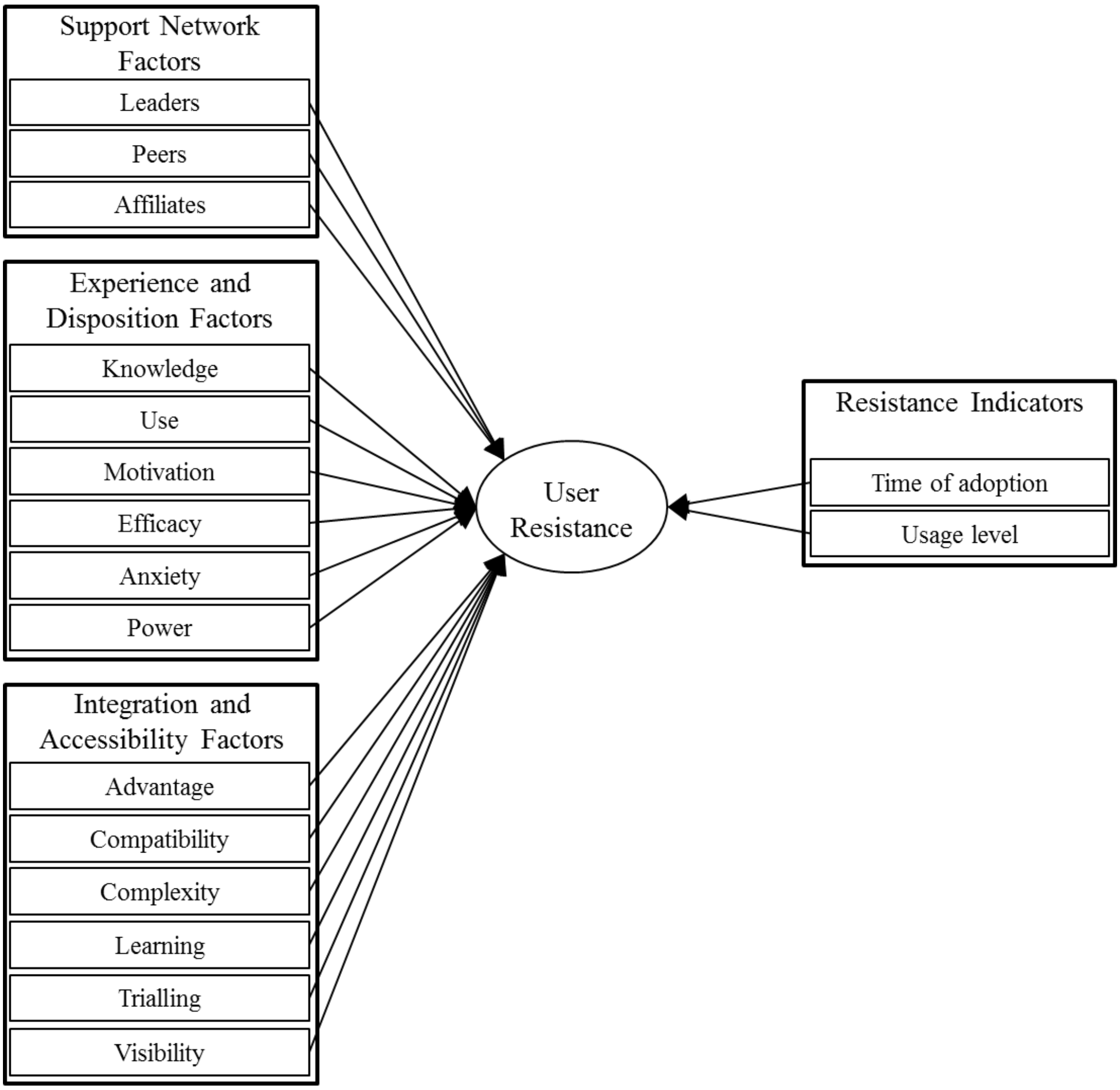

Figure 1: Features of Integrated Resistance Factor Model.

3.1 Resistance indicators: Time of adoption and usage level

Time strongly influences the decision process of an individual on whether to adopt or reject an innovation (Rogers (1962)) and the development of familiarity with a technology and the level of exposure to technology (Valente (1996)). It can be assumed that delay in adoption is generally a “signal” that indicates resistance. Individuals in an organization are typically directed to adopt an innovation by management. However, if those individuals perceive that adopting a technology will not be of benefit to them, even when others in the organization have already adopted, they can tend to display unfavourable attitudes towards the technology (Joshi (1991)). For example, an organization may decide to implement an OPIMS based on a top management decision. The length of time taken for adoption across the organization will vary. Some people within the same organization can require many years to adopt OPIMS, while others may easily adopt it within just a few months. These differences stem from various causes related to skills and training, motivation and concern/skepticism over the new technology. It is possible that early adopters might subsequently resist an innovation, needing to spend more time to understand its technical functionality and gain motivation before "fully" adopting it. Thus, resistance may be dependent on the time of implementation of the innovation in the organization. For this reason, the first hypothesis was formulated as follows:

Hypothesis 1. Resistance toward OPIMS is significantly indicated by the time of adoption.

Time of adoption has been used extensively as the key independent variable to predict adoption of an innovation (Valente and Rogers (1995)). However, it is argued that this variable can lead to inaccurate measurement, especially when respondents' recall of time of adoption is used as the measurement of the time dimension (Rogers (1962)). Respondents are usually asked to look back in time to reconstruct their memory about their experience of an innovation, however, people forget the past and their recall is unlikely to be completely accurate. Therefore, we propose that another important variable to determine resistance should be the individual usage level of an innovation. Usage level is broadly studied in TAM, related to intention to use and actual use of technology (Bagozzi (2007a); Turner et al. (2010)). In TAM, usage level can be influenced by many factors, including ease of use, advantage and expectation, etc. A second hypothesis was thus developed as:

Hypothesis 2. Resistance toward OPIMS is significantly indicated by the individual usage level of the technology at work.

3.2 Support network factors

Marakas and Hornik (1996) proposed that if initially resistant users are exposed to co-workers who have been able to adjust to using a technology easily, then they will come to believe that they too can master the new technology. Conversely, where resistant users see supervisors and co-workers expressing their resistance to the new IT and/or placing blame on it for failures, the resistant users' negative attitudes will be strengthened. A study by Kissi et al. (2012) shows that middle managers have a significant leadership role in fostering innovation. The support and leadership demonstrated by the middle management was particularly significant in encouraging the championing behaviour toward the implementation of new ideas. Those with leadership responsibility (e.g. supervisors and middle managers) have the biggest influence in persuading users. Supervisor expectations and behaviours regarding technology affect and determine the expectations and behaviours of other users (Valente (1996)). It follows that leadership behaviour in the workplace directly affects the behaviour and performance of others.

People are more likely to want to communicate with others if they share interests or perform similar tasks in similar settings (Granovetter (1973)). Where a person is able to speak constructively to friends, peers or co-workers about a particular technology, such communication reinforces the positive user belief system and, consequently, innovativeness (Valente (1996)). It is to be expected that a higher intensity of communication with supportive peers about the technology will lead to greater use and less resistance.

Communication can be quite intensive in close-knit or immediate groups e.g. customer support, technical or admin staff (Rogers (1962); Valente (1996)). Those lacking a network or being unable to resolve difficulties alone may not be interested in the technology and may either limit the amount of time spent on the technology or abandon it completely.

Taken together, we propose the following relationships between the social network factors associated with resistance:

Hypothesis 3. A network that consists of support ties from leaders will have a significant influence on resistance.

Hypothesis 4. Support from peers significantly influences resistance.

Hypothesis 5. The social network that is formed through relationships with immediate people (affiliates) who are assigned to support new technology significantly influences the individual resistance.

3.3 Experience and disposition factors

Theories and empirical evidence indicate that there is a positive relationship between experiences and the use of technology (Fishbein and Ajzen (2005); Igbaria and Iivari (1995); Liao and Lu (2008); Peansupap and Walker (2006); Thompson et al. (1994)). The findings of Thompson et al. (1994) in particular, indicate that system experience is positively related to the perceived ease of use and increased utilization of the system by individuals.

Findings from a study by Liao and Lu (2008) suggest that prior experience can also change the intention to adopt or continue to use an innovation. The technology adoption of learners with prior e-learning experience is different from those without e-learning experience. The perceived relative advantage, compatibility and image factor are higher for those with prior experience of using e-learning websites, which positively affects the intention to adopt. Also, basic computer skills and background also appear to influence the use of an ICT application. Adoption and use of technology varies with experience, both direct and indirect (Mao and Palvia (2008)). Direct experience is gained through using the target technology, while indirect experience involves working with or experiencing a similar technology.

Several studies have shown that motivation is one of the main forces for individuals to resist or accept new technology, see for example Davis et al. (1992), Hartmann and Fischer (2009), and Venkatesh et al. (2003). Commitment and motivation require that management induces and reinforces several actions, including recognition (intrinsic and extrinsic rewards) and participation (Davis et al. (1992); Hartmann and Fischer (2009)). Employee motivation can be gained through pay rises, fringe benefits, work autonomy, job enlargement and flexible working conditions, etc.

There is strong evidence that self-efficacy plays a key role in the decision to use computers (Compeau and Higgins (1995); Hsu et al. (2009); Igbaria and Iivari (1995)). Self-efficacy involves personal judgment as a key factor in the use of a particular technology to accomplish a particular job or task. Individuals tend to prefer and enjoy behaviours that they feel capable of performing, and dislike those they do not feel they can successfully master.

Anxiety towards technology is defined as the fears, apprehension and hope people feel when considering its use or which actually using it. Anxiety about using that technology has been suggested as a possible explanation for the tendency of some users to avoid direct involvement with similar technology or ICTs (Chua et al. (1999); Meuter et al. (2003)). For example, a study by Meuter et al. (2003) found that customers who were uncomfortable and hesitant about using one self-service technology also had issues with any equivalent self-service technology (e.g. phone banking and internet shopping).

Adoption of a new technology can be used by employers as a measure of self-improvement, but it can also improve how a person is perceived more generally in terms of their image and interpersonal relationships (Moore and Benbasat (1991); Venkatesh et al. (2003)). People who use new technology tend to experience more prestige as well as a higher profile and status than those who do not (Moore and Benbasat (1991)).

Accordingly, the specific hypotheses associated with experience and disposition factors were formulated as follows:

Hypothesis 6. General knowledge of ICT-related technologies significantly influences an individual's resistance toward OPIMS.

Hypothesis 7. General use of ICT technology at work significantly influences resistance towards OPIMS.

Hypothesis 8. It was proposed that motivation will have a significant influence on resistance.

Hypothesis 9. Efficacy significantly influences an individual's resistance towards OPIMS.

Hypothesis 10. Feelings of strong anxiety or uncertainties related to the use of OPIMS will significantly influence resistance.

Hypothesis 11. Interpersonal power will significantly influence an individuals resistance to OPIMS.

3.4 Integration and accessibility factors

Modified from Moore and Benbasat (1991) and Rogers (1962), this research proposes the construct of perceived advantage. This is defined as the extent to which an OPIMS user believes that the technology complements their work. It is believed that better relative advantage and benefit in one's job means better adoption will be achieved. The advantage or perceived usefulness of a technology remains one of the most significant factors for example, in a study of mobile computing in construction, it was found that the perceived usefulness of the technology by construction professionals was more significant than how easy the technology was to use (Son et al. (2012)).

Compatibility is considered as a relevant factor. Previous studies indicated that where a technology is incompatible with the employees' work task, this will frustrate the user and cause a negative reaction (Liao and Lu (2008)). If the technology fails to perform reliably and does not meet the expectations of a user, the technology will be used less frequently and put to less use than originally intended.

Complexity is a significant factor to the acceptance of technologies (Davis et al. (1989); Meuter et al. (2003); Thompson et al. (1994); Venkatesh et al. (2003)). When the use of technology is perceived to bring an improvement to work productivity and is relatively effortless, users are likely to develop a positive attitude towards its use (Venkatesh et al. (2003)). The level of complexity could trigger resistance.

Learning and training can either strengthen or weaken the innovation process. The concept of learning has also been linked with knowledge sharing and training among users (Abrahamse and Lotriet (2012); Love et al. (2001); Peansupap and Walker (2006)). Learning is about knowledge transfer, and in the current context that transfer is between experienced users, who have already adopted and use the technology, and inexperienced users. A lack of employee knowledge and understanding has been shown to be one of the main barriers to e-commerce implementation in construction organizations (Love et al. (2001)). Peansupap and Walker (2006) have also associated the learning concept with innovation theory, it is believed that inadequate employee knowledge and managements' lack of experience in ICT have been identified as potential causal factors leading to user resistance.

Hands-on experience gained through trial use and training may help to reduce uncertainty and create favourable user perceptions (Meuter et al. (2003); Venkatesh et al. (2011)). A study by Venkatesh et al. (2011) confirmed that offering a trial use of technologies before they are deployed has a positive impact on the successful implementation of electronic services by government. The study found that trial use of technologies improved user knowledge of the technology and enhanced the quality of user evaluation regarding adoption. In addition, general exposure or visibility to a technology within workplace appears to promote better technology transfer across industry, organization and project team. Visibility is where both potential and current adopters are able to observe others using the technology in the organization (Moore and Benbasat (1991)). Visibility is an important factor because the opportunity to see how a technology progresses through the adoption of others has the potential to change user perceptions and resistance (Bjørn and Ngwenyama (2009)).

On the basis of the above discussion, the following hypotheses were formulated:

Hypothesis 12. Perceived advantage towards use of OPIMS significantly influences an individuals resistance toward OPIMS.

Hypothesis 13. Compatibility of the OPIMS with work tasks significantly influences resistance.

Hypothesis 14. How complex the technology is perceived to be will significantly influence resistance toward OPIMS.

Hypothesis 15. Inadequate learning in developing competency on OPIMS significantly influences resistance behaviour.

Hypothesis 16. Opportunities to trial the OPIMS before using it will significantly influence resistance behaviour.

Hypothesis 17. Visibility of the use of OPIMS at work will significantly influence resistance behaviour.

4. RESEARCH METHOD

4.1 Partial least squares techniques

A quantitative approach is used. Data is collected using a questionnaire and using partial least square (PLS) technique, an approach of structural equation modelling (SEM). The main rationale for this approach is that the quantitative data and PLS analysis provide a predictive understanding of the significant constructs and relationships between the constructs as outlined in the resistance factor model.

PLS is adequate and meets the research objective. The research objective is for theory development and prediction. The covariance-based SEM is perceived as being more related to theory confirmation, while PLS is for theory development, which is primarily intended for causal-predictive analysis in situations of high complexity but low theoretical information. However, covariance-based SEM and PLS, should be seen as complementary rather than competitive, because both are theory-oriented and emphasize the transition from exploratory to confirmatory analysis. Having considered the objective of the research, the justification for using PLS in this study is based on the following: (1) PLS provides better prediction capability. The primary objectives of this research were to predict and generate a mR factors that best describe the resistance behaviour of users who have used OPIMS. (2) PLS focuses on causal-predictive analysis, which also suits the objective. The objective is to build a mR and not to test a well-known theoretical model. (3) The theoretical information of the resistance factor influencing technology innovation is under-developed. The use of PLS is more appropriate in this study, in which most of the measures used are newly developed for the purposes of this resistance model.

There are two key processes that are involved when applying PLS in this research: (1) assessing the measurement model and (2) assessing the structural model. First, in the assessing measurement model or we can call that a process is used for testing validity and reliability of components/indicators/items using significant of weights, Spearman's correlation coefficient, multicollinearity and nomological validity. The assessed measurement model becomes the basis for analyzing the second process i.e. assessment of the structural model. The proposed statistical techniques are path coefficients, R-square (R^2) and effect size (f^2). To ensure the overall consistency of the statistical results, an estimation of R^2 requires the use of a re-sampling technique i.e. bootstrapping (Chin (1998b)). The R^2 value is used to predict the outcome of the model based on the relationship between the independent variables and dependent variables. R^2 was also extended to examine how well the dependent variable acts as a predictor of the independent variable using the f 2 technique.

4.2 Validity, reliability and formative design

A range of techniques are suitable to test the validity and reliability of both the measurement model and the structural model include loadings, composite reliability, convergent and discriminant validity and average variance extracted. The composite reliability measure, for example, can be used to check how well a construct is measured by its assigned indicators. However, as argued by Diamantopoulos and Siguaw (2006), when employing formative measured items/constructs, such techniques are inappropriate because they are only valid for reflective constructs. Use of such statistics for the formative item/construct could mislead the analysis and interpretation of results (Cenfetelli and Bassellier (2009); Jarvis et al. (2003)).

According to Diamantopoulos et al. (2008), there is an ongoing debate over how necessary the reliability and validity measures are in formative design. Bagozzi (2007b), for example, believes that reliability testing of the formative measure by statistics is not actually required as the results of the research can be supported by theory and expert opinion. Nevertheless, a procedure for establishing the internal consistency and validity of formative items/constructs is always an important gauge for the reliability of results. With this in mind, as the IRFM was designed formatively, the measurement model adopted for this research was estimated in two steps. The first step was an estimation of the quality of the measurement model using significant weights as the indicator. The second step was an assessment of the validity and reliability of all formative items and constructs using a multicollinearity and nomological approach.

5. RESULTS AND DISCUSSION

5.1 Sample distribution and characteristics Assessment of measurement model

A variety of cohorts was included in the sample population because technology implementation can affect different levels of employees within an organization (e.g. cadets, interns, trainees and experienced employees) in different ways. An invitation to participate and copy of the questionnaire were sent by email to a comprehensive list of construction organizations, relevant software developers in Australia and the Heads of Department in Australian schools of the built environment. A total of 88 valid samples were analyzed. Sixty respondents described themselves as professionals. Professional disciplines included in this study were varied and employed as architects, building surveyors, CAD operators, construction managers, project managers, project coordinators, document controllers, risk managers, human resources managers, procurement officers and IT managers. Twenty eight of the respondents who participated in the survey were enrolled in university as a student and were involved in a cadetship, internship or graduate program. Students or cadets were in the broad roles of contract administrator, engineer, surveyor, architect and site supervisor.

5.2 Assessment of measurement model

5.2.1 Spearman's correlation coefficient

There are two potential directions in which items/measures can relate to a construct, termed reflective and formative (Chin (1998b); Jarvis et al. (2003); Diamantopoulos and Siguaw (2006)). The reflective measures are also called "effect" measures because they influence the underlying construct they represent and they are expected to correlate reasonably to each other. This is because, all reflective measures manifest the construct and share a common theme. As a consequence, omitting any individual reflective measure should not significantly alter the conceptual meaning of the construct, based on internal consistency. Formative measures, on the other hand, are not expected to influence the construct. Rather, they are expected to define the characteristics of the construct. The consequence of this is that formative measures are not expected to correlate with each other and internal consistency is less significant. Omitting any individual formative measure could therefore jeopardize the overall model by causing a unique element of the conceptual domain to be removed.

Adopting this principle in the context of the formative design of the research model, high correlation will imply potentially overlapping items or items that measure the same thing. More particularly, the threshold correlation between items can be expected to be low and the threshold correlation needs to be adjusted accordingly. In other words, where an item registers a high value on the Spearman's correlation analysis, a lower threshold of statistical significance can be applied than would otherwise be acceptable. Whilst the relevance and application of this procedure/ technique has not been demonstrated beyond doubt in the PLS domain, it has been used previously by others (Haenlein (2004)).

5.2.2 Significant weights

According to Chin (1998b), the most appropriate statistic for assessing the validity or significance of a formative indicator is "weight" or "path coefficient". The signifi- cance of weights is usually built in such a way that each indicator/item is positively correlated to a construct. The weights, coupled with the associated t-value and p-value, provide evidence for the extent to which particular indicators are statistically significant and explain the variance in the formative items of the model. Conventional cut-off values for significant weights in t-values are 1.65, 1.96 and 2.58 at significance levels (p-values) of 0.1, 0.05 and 0.01, respectively. In a social science context, the ideal p-value is generally taken to be 0.05 (at t-value 1.96) and 0.01 (at t-value 2.58). However, when the study is more exploratory than confirmatory in nature then a more conservative p-value of 0.1 (at a t-value of 1.65) is still viable. Given the nature of the research presented in this paper, the more conservative p-value is applied.

When adopting a more conservative approach to significance testing, as suggest by Chin (1998b), the estimation of the structural model can be improved by using a re-sampling technique called bootstrapping. Bootstrapping uses the approximate distribution of any sample as a surrogate population from which a large number of further samples can be derived and compared with the original sample in simple statistical terms. The significant weight results for all measurement items derived in this way are shown in Table 1. The results reveal that 16 of the estimated formative indicators are not statistically significant, because the t-value is less than 1.65 and the p-value is greater than 0.1. However, as noted previously in Sec. 5.2.1, the Spearman's correlation test corroborates where the low statistical significance might still be acceptable. Combining the statistical significance and conceptual relevance tests identified a total of six items that fail both statistical significance and conceptual relevance test thresholds, and these constructs need to be removed from the model, as noted in Table 1.

Table 1: Formative constructs, indicators, items and significant weights.

Constructs and Items	PLS weight	t-statistic	p-value
Resistance			
Indicator1 (Time Adoption) -> Resistance	0.84	4.16	0.00
Indicator2 (Usage Level) -> Resistance	0.55	2.01	0.05
Leaders			
Leaders1 -> Leaders	0.35	1.18	0.24
Leaders2 -> Leaders	0.88	3.14	0.00
Peers			
Peers1 -> Peers	0.74	2.53	0.01
Peers2 -> Peers	0.70	2.61	0.01
Affiliates			

Affiliates1 -> Affiliates	0.92	4.82	0.00
Affiliates2 -> Affiliates	0.33	1.28	0.20
Knowledge of ICTs			
Knowledge1 -> Knowledge of ICTs	1.15	3.36	0.00
Knowledge2 -> Knowledge of ICTs	0.21	0.66	0.51
Knowledge3 -> Knowledge of ICTs	***-0.45***	***1.36***	***0.18*****
Use of ICTs			
Use1 -> Use of ICTs	0.95	2.96	0.00
Use2 -> Use of ICTs	-0.53	1.65	0.10
Use3 -> Use of ICTs	***-0.35***	***1.00***	***0.32*****
Motivation			
Motivation1 -> Motivation	***-0.27***	***0.75***	***0.45*****
Motivation2 -> Motivation	0.46	1.67	0.10
Motivation3 -> Motivation	***0.00***	***0.00***	***1.00*****
Motivation4 -> Motivation	0.80	2.86	0.00
Efficacy			
Efficacy1 -> Efficacy	1.17	4.51	0.00
Efficacy2 -> Efficacy	-0.27	0.86	0.39
Anxiety			
Anxiety1 -> Anxiety	0.32	0.75	0.45
Anxiety2 -> Anxiety	0.76	1.84	0.07
Power			
Power1 -> Power	0.91	4.54	0.00
Power2 -> Power	0.18	0.75	0.45
Advantage			
Advantage1 -> Advantage	0.95	2.19	0.03
Advantage2 -> Advantage	0.31	0.95	0.34
Advantage3 -> Advantage	***-0.26***	***0.72***	***0.47*****
Compatibility			
Compatibility1 -> Compatibility	0.84	2.42	0.02
Compatibility2 -> Compatibility	0.22	0.58	0.56
Complexity			
Complexity1 -> Complexity	0.90	3.72	0.00
Complexity2 -> Complexity	0.18	0.69	0.49
Learning			
Learning1 -> Learning	1.30	3.90	0.00
Learning2 -> Learning	-0.48	1.09	0.28
Trialling			
Trialling1 -> Trialling	-2.08	2.37	0.02
Trialling2 -> Trialling	2.68	3.15	0.00
Visibility			
Visibility1 -> Visibility	0.68	2.29	0.02
Visibility2 -> Visibility	***-0.53***	***1.24***	***0.22*****
Visibility3 -> Visibility	0.89	2.26	0.02

*** Items for deletion*

5.2.3 Multicollinearity analysis

Multicollinearity refers to unwarranted or redundant items/indicators in the formative model. The multicollinearity analysis was performed using a multiple regression procedure in SPSS. The degree of multicollinearity was examined by calculating the variance inflation factor (VIF). According to Diamantopoulos and Siguaw (2006), VIF values in the range of 3.5 to 10 and a condition index greater than 10 suggest critical values. VIF values below 3.5 are considered excellent values.

As shown in Table 2, all VIF values for the formative variables can be classed as excellent values or are well within the threshold. This indicates that no multicollinearity issues apply, and confirms the reliability of the indicators.

Table 2: Multicollinearity analysis.

Construct Name	VIF
Leaders	1.357
Peers	2.154
Affiliates	2.064
Knowledge of ICTs	1.215
Use of ICTs	1.319
Motivation	2.593
Efficacy	2.144
Anxiety	1.666
Power	2.472
Advantage	2.334
Compatibility	3.879
Complexity	2.653
Learning	2.134
Trialling	1.764
Visibility	2.131

5.2.4 Nomological Validity

Nomological validity is a back-end procedure, applied after the other significance tests and adjustments to the items have been completed. Nomological validity is examined through the standardized path coefficient (or PLS weights) and the significance level of the estimated structural path between the independent constructs and dependent construct (Diamantopoulos et al. (2008)). For this test, Resistance was specified as the dependent construct and all other constructs were deemed to be independent.

In Table 3, several constructs are found to be not statistically significant relative to Resistance: Peers, Affiliates, Knowledge of ICTs, Use of ICTS, Motivation, Efficacy, Anxiety, Power, Advantage, Learning and Visibility. For example, the path coefficient (PLS weight) between Affiliates and Resistance was found to be 0.07, with a p-value of 0.45. Such a result would indicate that the support network from Affiliates (e.g. technical staff), identified as important in the conceptual model, is not statistically significant relative to Resistance. However, the data is specific to OPIMS. Whilst there is no statistical support for Affiliates being a critical factor in influencing Resistance toward OPIMS, further consideration is warranted before concluding that Affiliates are not significant to the IRFM model more generally. The fact that all independent constructs have been included based on the robust underlying theory is sufficient justification to retain them as potential factors in the generalized model.

Table 3: Nomological validity.

Independent -> Dependent Construct	PLS weight	t-statistic	p-value
Leaders -> Resistance	0.24	2.26	0.02
Peers -> Resistance	0.17	1.60	0.11
Affiliates -> Resistance	0.07	0.76	0.45
Knowledge of ICTs -> Resistance	0.01	0.05	0.96
Use of ICTs -> Resistance	-0.06	0.73	0.47
Motivation -> Resistance	-0.08	0.35	0.73
Efficacy -> Resistance	0.12	1.08	0.28
Anxiety -> Resistance	0.16	1.34	0.18
Power -> Resistance	0.07	0.60	0.55

Advantage -> Resistance	0.17	1.47	0.14
Compatibility -> Resistance	0.27	1.70	0.09
Complexity -> Resistance	0.38	2.37	0.02
Learning -> Resistance	-0.05	0.41	0.68
Trialling -> Resistance	0.37	1.94	0.05
Visibility -> Resistance	-0.06	0.54	0.59

5.3 Assessment of structural model

5.3.1 R-squared

The value of R^2 is in the range of 0 to 1. An R^2 near 1.0 indicates that a regression line fits the data almost exactly. An R^2 closer to 0 indicates that the regression line is a very poor fit and/or predictor of the data. No generalizations can be made about what constitutes an acceptable value for R^2 in all contexts. The appropriate R^2 value depends on the individual study, although Chin (1998b) suggests that R^2 values of 0.67, 0.33 and 0.19 in the PLS path model can be considered substantial, moderate and weak, respectively. Certainly the higher the value of R^2 the better, as a low value indicates that a variable is relatively inconsequential in determining the value of the dependent variable. The results of the analysis revealed that the proposed IRFM has a performance R^2 value of 0.484, which is sufficient to conclude that the values are significant (Chin (1998b)), and overall that the structural model is verified as adequate. A value of 0.484 demonstrates that the IRFM explains a reasonably large and acceptable proportion of the variance in all the constructs identified to predict resistance.

R^2 was also evaluated using the t-statistics and p-values of the PLS weights. Path coefficient values should then be in the range of 0.20 to 0.30 or greater (Chin (1998a)). Table 4 gives a detailed summary of the estimated structural path coeffi- cient (PLS weights), the observed t-values from the re-sampling procedure and the significance level of the path coefficient for each individual factor. Eleven constructs did not reach the required threshold of having path coefficients (PLS weights) greater than 0.20, a significant p-value of at least the 0.1 level and a t-value greater than 1.65, they were Peers, Affiliates, Knowledge of ICTs, Use of ICTs, Motivation, Efficacy, Anxiety, Power, Advantage, Learning and Visibility. Once again, the lack of individual statistical significance should not disqualify these factors from the model. The overall predictive performance of the model and strong theoretical basis for including each individual factor in the IRFM is sufficient to warrant they remain as considerations, and those constructs that most require further scrutiny and testing.

Furthermore, an interesting finding in Table 4 relates to hypothesis testing; specifically, what indicates Resistance or identifies resistance behaviour. The research hypothesized that the time of adoption of OPIMS and the average percentage of use of OPIMS daily could be used to measure Resistance. Based on the results, both were verified as appropriate measures to indicate Resistance, with both having t-values greater than 1.65 and reaching a significant level. Thus, the results correspond to Hypotheses 1 and 2, which claim that resistance towards OPIMS is significantly measured by time of adoption and level of use of technology.

Support from Affiliates (such as technical staff and admin staff) and Peers (such as friend and colleagues), has no significant influence on Resistance. The result is contrary to the hypotheses that Affiliates and Peers will have a significant influence on resistance behaviour. However, high-level personnel, such as supervisors and managers (Leaders), do have a significant influence on Resistance: t-value 2.26 (p-value 0.02). Thus, Hypothesis 3, a network that consists of support ties from leaders will have a significant influence on resistance, is supported.

Almost none of the hypotheses related to the knowledge and disposition factor (Hypotheses 611) has a significant influence on resistance towards OPIMS. None of these hypotheses is considered supported, as the relevant path coefficients are below the required value of 1.65 and do not have a significant p-value lower than 0.10. Hypotheses related to integration factors such as Compatibility and Complexity of OPIMS technology do have a significant influence on Resistance. Compatibility has a significant value at the 0.10 level, while Complexity has a significant value at the 0.05 level. Similarly, accessibility related factors such as opportunities to trial before using the OPIMS technology (Hypothesis 16) do have a significance value at the 0.05 level on the Resistance.

Table 4: Structural model path results.

Constructs and Items	PLS weight	t-statistic	p-value	Significance Level

Time Adoption -> Resistance	0.81	3.50	0.00	Significant at 0.00
Usage Level -> Resistance	0.59	2.09	0.04	Significant at 0.05
Leaders -> Resistance	0.24	2.26	0.02	Significant at 0.05
Peers -> Resistance	0.17	1.60	0.11	Not significant
Affiliates -> Resistance	0.07	0.76	0.45	Not significant
Knowledge of ICTs -> Resistance	0.01	0.05	0.96	Not significant
Use of ICTs -> Resistance	-0.06	0.73	0.47	Not significant
Motivation -> Resistance	-0.08	0.35	0.73	Not significant
Efficacy -> Resistance	0.12	1.08	0.28	Not significant
Anxiety -> Resistance	0.16	1.34	0.18	Not significant
Power -> Resistance	0.07	0.60	0.55	Not significant
Advantage -> Resistance	0.17	1.47	0.14	Not significant
Compatibility -> Resistance	0.27	1.70	0.09	Significant at 0.10
Complexity -> Resistance	0.38	2.37	0.02	Significant at 0.05
Learning -> Resistance	-0.05	0.41	0.68	Not significant
Trialling -> Resistance	0.37	1.94	0.05	Significant at 0.05
Visibility -> Resistance	-0.06	0.54	0.59	Not significant

5.3.2 Effect size

The effect size (f^2) was calculated to estimate the strength of each independent construct in predicting the dependent construct. Fifteen sub-models were produced by removing each of the independent constructs in turn, and then generating fifteen R^2 excluded values. The respective f^2 values were then obtained using the following calculation, where R^2 included is the original 0.484 value for the dependent construct:

$$f^2 = \frac{R^2_{included} - R^2_{excluded}}{1 - R^2_{included}}$$

According to Chin (1998b), if f^2 is once obtained, the degree of effect can be determined with reference to criteria as set out by Cohen (1998), where the relevant f^2 values are 0.02 (small effect), 0.15 (medium effect) and 0.35 (large effect). As shown in Table 5, no individual construct has a large effect on the value of the determination coefficient. Trialing (with an effect size of 0.150) has the greatest impact on the predictive performance of the IRFM. On the other hand, removing the constructs for Immediate, Knowledge, Motivation, Learning and Visibility appears to have almost no impact on the predictive performance when each is removed individually.

Table 5: Effect size.

Independent construct	$R^2_{included}$	$R^2_{excluded}$	f^2	**Extent of effect**
Leaders	0.48	0.44	0.09	Small effect
Peers	0.48	0.47	0.03	Small effect
Affiliates	0.48	0.48	0.01	Nil
Knowledge of ICTs	0.48	0.48	0.01	Nil
Use of ICTs	0.48	0.48	0.02	Small effect
Motivation	0.48	0.48	0.01	Nil
Efficacy	0.48	0.48	0.02	Small effect
Anxiety	0.48	0.47	0.02	Small effect
Power	0.48	0.48	0.02	Small effect
Advantage	0.48	0.47	0.03	Small effect
Compatibility	0.48	0.47	0.03	Small effect
Complexity	0.48	0.44	0.08	Small effect
Learning	0.48	0.48	0.01	Nil

Trialling	0.48	0.41	0.15	Medium effect
Visibility	0.48	0.48	0.01	Nil

Note: f^2 values 0.02 (small effect), 0.15 (medium effect) and 0.35 (large effect).

6. CONCLUSIONS

This is the first study to develop an integrated model of user resistance and to use that model to test the resistance factors of matured technology innovation in the construction. The study is specific to OPIMS technologies that are widely used in the Australian construction industry. The collected data from surveys (OPIMS users) were managed and statistically analyzed using PLS. The major purposes of the PLS method are to investigate the predictive relations between the dependent construct and independent construct, and to determine whether the predictive power of the proposed model is warranted. From the analysis, the results were presented in two parts. First, the measurement model was evaluated. The aim was to address the validity and reliability of the items of the individual variables/constructs. The second step, considered a priority of this analysis, was the evaluation of the whole structure of the IRFM. This was achieved using the R^2 statistic of PLS. R^2 suggests to what extent the variables/constructs help to predict, explain or influence resistance. From the analysis, the IRFM has a R^2 value of 0.484, which is sufficient to conclude that the values are substantial. This explains a reasonably large and acceptable proportion of the variance in all of the constructs to predict the resistance factors.

A particular strength of the IRFM is that it comprises of measurable items, and can therefore be developed and tested as a predictive instrument to gauge and mitigate the level of user resistance likely to be encountered in a future technology innovation. Whilst the sample size of 88 was small, it does provide an effective measure of reliability in the context of such a strong theoretical framework. The bootstrapping technique has been used to improve the measurement model. A further test using Spearmans correlation coefficient has also been included as this can be used to adjust the required statistical significance threshold. The application of Spearmans correlation coefficient is relatively novel in the context of PLS, but proved very useful in this study. When dealing with small sample sizes and a large number of factors, statistical significance can be difficult to achieve. The inclusion of Spearmans correlation coefficient justified the retention of a majority of the items that would otherwise have been rejected, and the overall model that resulted performed well in subsequent tests. We strongly recommend future studies dealing with formative design use Spearmans correlation coefficient to complement validity analysis procedures.

From an industry and practical perspective, the factor that influences resistance and possible hinders the technology implementation process has been identified, and the basic strategy for addressing resistance can be outlined. The study has confirmed that, in the case of OPIMS, leaders can influence the development of resistance, therefore, it could be said that the organization should consider recruiting talented leaders who can offer supportive environment working with technology. The overall learning should change. It is recommended that the management, in implementing new technology considers not just training, but hands-on experience gained through the trial use of technology. It could help reduce uncertainty, create favourable user perception, improve knowledge and enhance quality of user adoption. Time adoption and usage level, are appropriate indicators for resistance, it can be assumed these are manifestations of resistance. It is proposed here that the organization assesses and captures time and usage intention, to understand that the resistance to adoption is fully understood. It is because the time taken for adoption across the users in the organization is different. Some users may require months to adopt OPIMS, while others can easily use it within just a few weeks after training. These differences could also stem from various factors related to, for example, compatibility of the technology for work and ease of use.

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