Technology Acceptance Model 3 and a Research Agenda on Interventions

Viswanath Venkatesh & Hillol Bala - 2008

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Outline

- Introduction
- Background of TAM3
- Development of TAM3
- Method
- Result
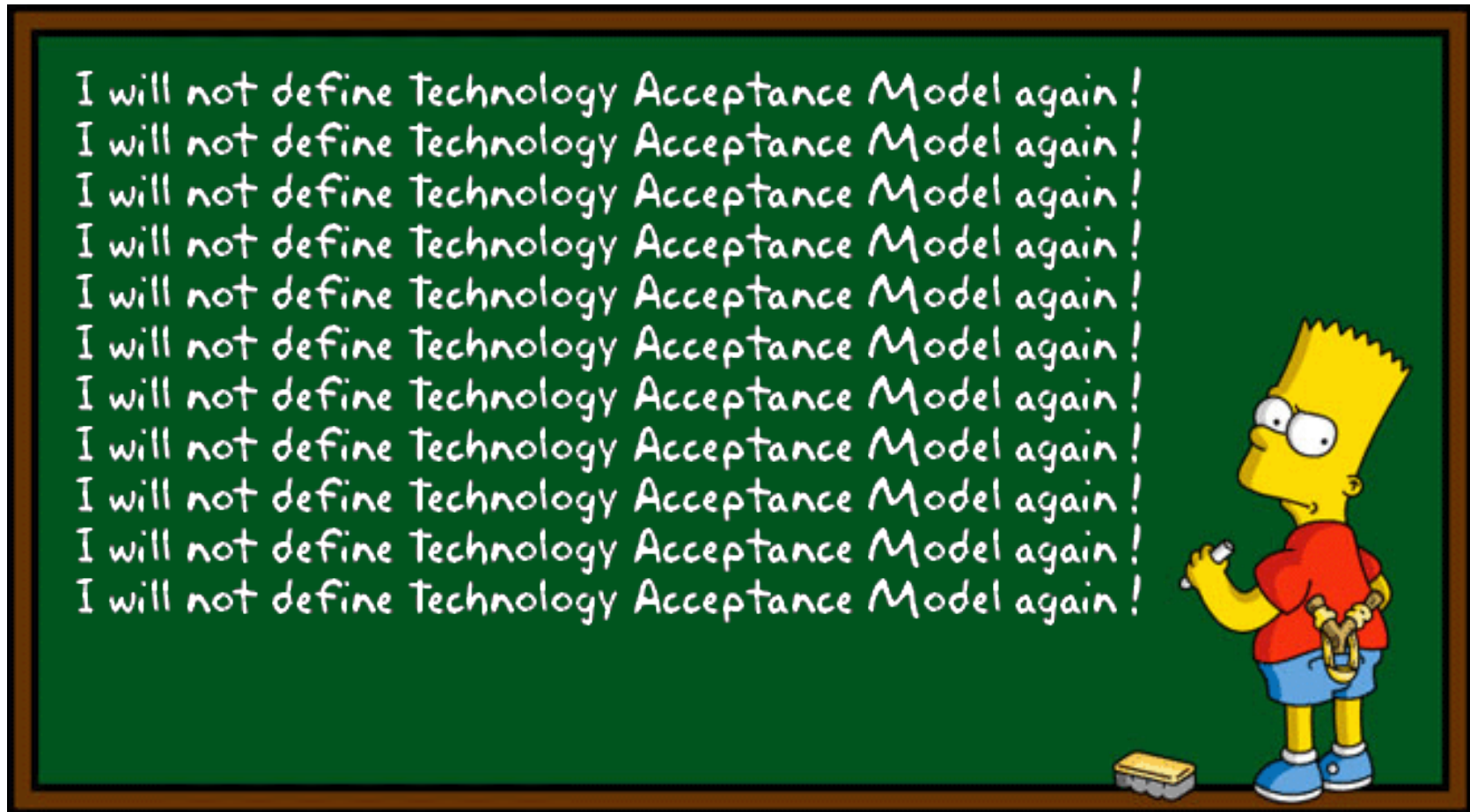- Interventions
- Theoretical Contributions
- Conclusion
- Q & A

Objectives

- Developing a comprehensive nomological network (*integrated model*) of the determinants of individual level (IT) adoption and use;

- Empirically *testing* of the proposed integrated model

- Presenting a research agenda focused on potential pre and post-implementation *interventions* that could enhance employees' adoption and use of IT.

Background of TAM3

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Determinants of PU

Determinants	Definitions
Subjective Norm	The degree to which an individual perceives that most people who are important to him think he should or should not use the system.
Image	The degree to which an individual perceives that use of an innovation will enhance his or her status in his or her social system.
Perceived Ease of Use - PEoU	The degree to which a person believes that using an IT will be free of effort
Job Relevance	The degree to which an individual believes that the target system is applicable to his or her job.
Output Quality	The degree to which an individual believes that the system performs his or her job tasks well.
Result Demonstrability	The degree to which an individual believes that the results of using a system are tangible, observable, and communicable.

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Social Influence instrumental processes

Cognitive instrumental processes

Determinants of PEoU

- Building on the *anchoring* and *adjustment* framing of human decision making, Venkatesh (2000) developed a model of the determinants of PEoU.

- individuals will form early perceptions of PEoU of a system based on several anchors related to individuals' general beliefs regarding computers and computer use.

  - ✓ computerself-efficacy,
  - ✓ computer anxiety,
  - ✓ computer playfulness,
  - ✓ perceptions of external control

Determinants of PEoU

- Two system characteristics–related adjustments—that is, *perceived enjoyment* and *objective usability*—were suggested by Venkatesh (2000) to play a role in determining PEoU after individuals gain experience with the new system.

Determinants of PEU

- Venkatesh(2000) theorized that even with increasing experience with the system, the role of two anchors—*computer self-efficacy* and *perceptions of external control*—will continue to be strong.

- However, the effects of the other two anchors—*computer playfulness* and *computer anxiety*—were theorized to diminish overtime.

Determinants of PEoU

Determinants	Definitions
Computer Self-Efficacy	The degree to which an individual believes that he or she has the ability to perform a specific task/job using the computer.
Perception of External Control	The degree to which an individual believes that organizational and technical resources exist to support the use of the system.
Computer Anxiety	The degree of "an individual's apprehension, or even fear, when she/he is faced with the possibility of using computers"
Computer Playfulness	"…the degree of cognitive spontaneity in microcomputer interactions"
Perceived Enjoyment	The extent to which "the activity of using a specific system is perceived to be enjoyable in its own right, aside from any performance consequences resulting from system use"
Objective Usability	A "comparison of systems based on the actual level (rather than perceptions) of effort required to completing specific tasks"

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Anchors

Adjustments

TAM3

- TAM3 presents a complete nomological network of the determinants of individuals' IT adoption and use.

- Determinants of PU will not influence PEoU and the determinants of PEoU will not influence PU.

- PEoU has been theorized to be closely associated with individuals' self-efficacy beliefs and procedural knowledge, which requires hands on experience and execution of skills

Technology Acceptance Model 3 – TAM3
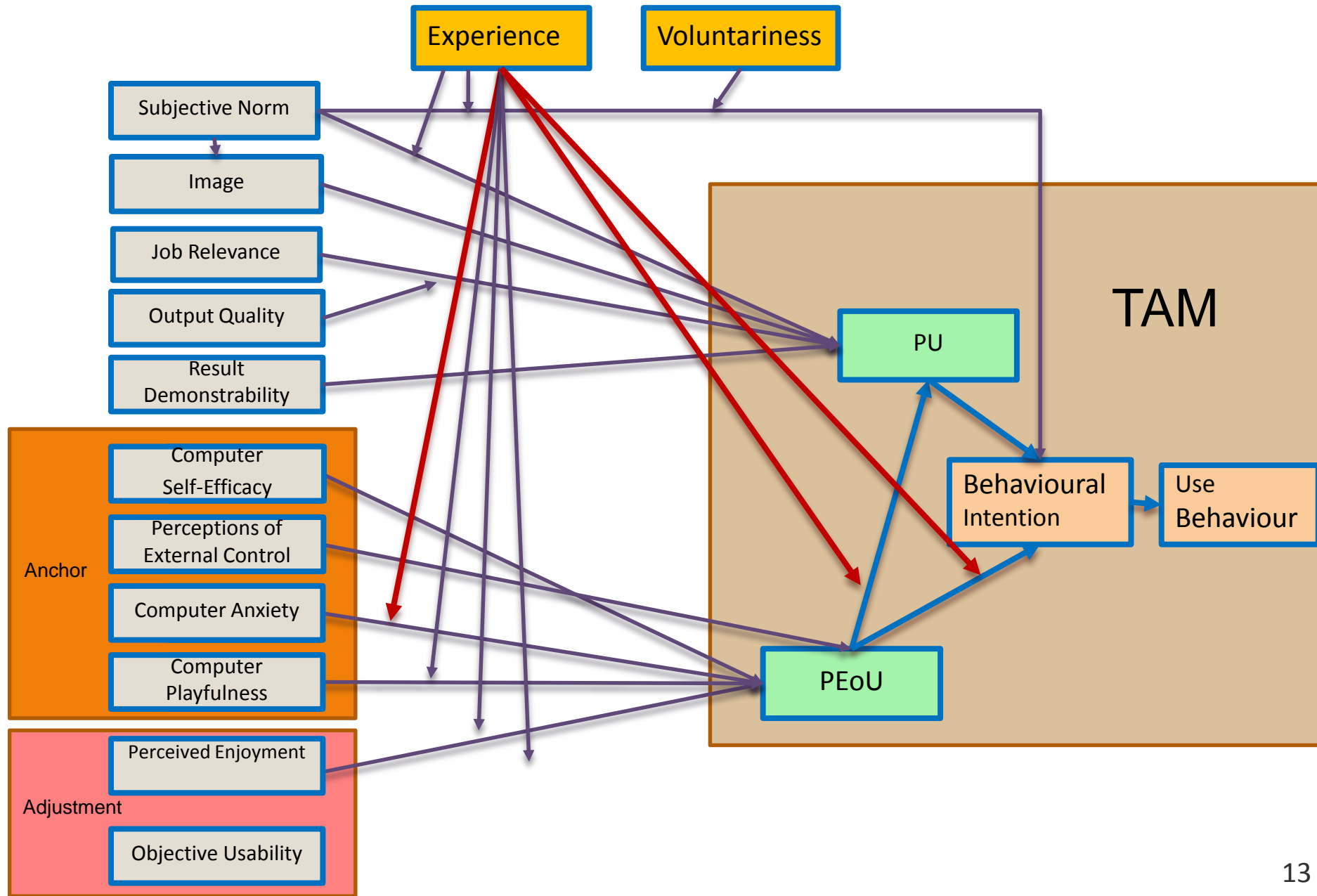
Development of TAM3

- Even if an individual gets information from important referents about how easy a system is to use, it is unlikely that the individual will form stable PEoU based on others' above his or her own general computer beliefs and hands-on experience with the system.

Development of TAM3

- Control over using a system does not guarantee that the system will enhance one's job performance.

- Similarly, higher levels of computer playfulness or enjoyment from using a system do not mean that the system will help an individual to become more effective.

- Therefore, we expect that the determinants of PEoU will not influence PU.

New Relations in TAM3

- TAM3 posits three relationships that were not empirically tested in Venkatesh (2000) and Venkatesh and Davis(2000).

- It is suggested that *experience* will moderate the relationships between

  - PEoU **&** PU;

  - Computer Anxiety **&** PEoU;

  - PEoU **&** Behavioral Intention.

1- PEU & PU

- It is suggested that, with increasing experience, the influence of *PEoU (a low-level identity)* on *PU (a high-level identity)* will be stronger.

- Users will be able to form an assessment of their likelihood of attaining high-level goals (i.e., PU) based on information gained from experience of the low-level actions (i.e., PEoU).

2- Computer Anxiety & PEoU

- The effect of computer anxiety on PEoU will decline with increasing experience as individuals will have more accurate perceptions of the effort needed to use a system.

3- PEoU & Behavioral Intention

- The effect of *PEoU on behavioral* intention will be weaker with increasing experience.

- Once individuals get accustomed to the system and gain hands-on experience with the system, the effect of PEoU on behavioral intention will recede into the background.
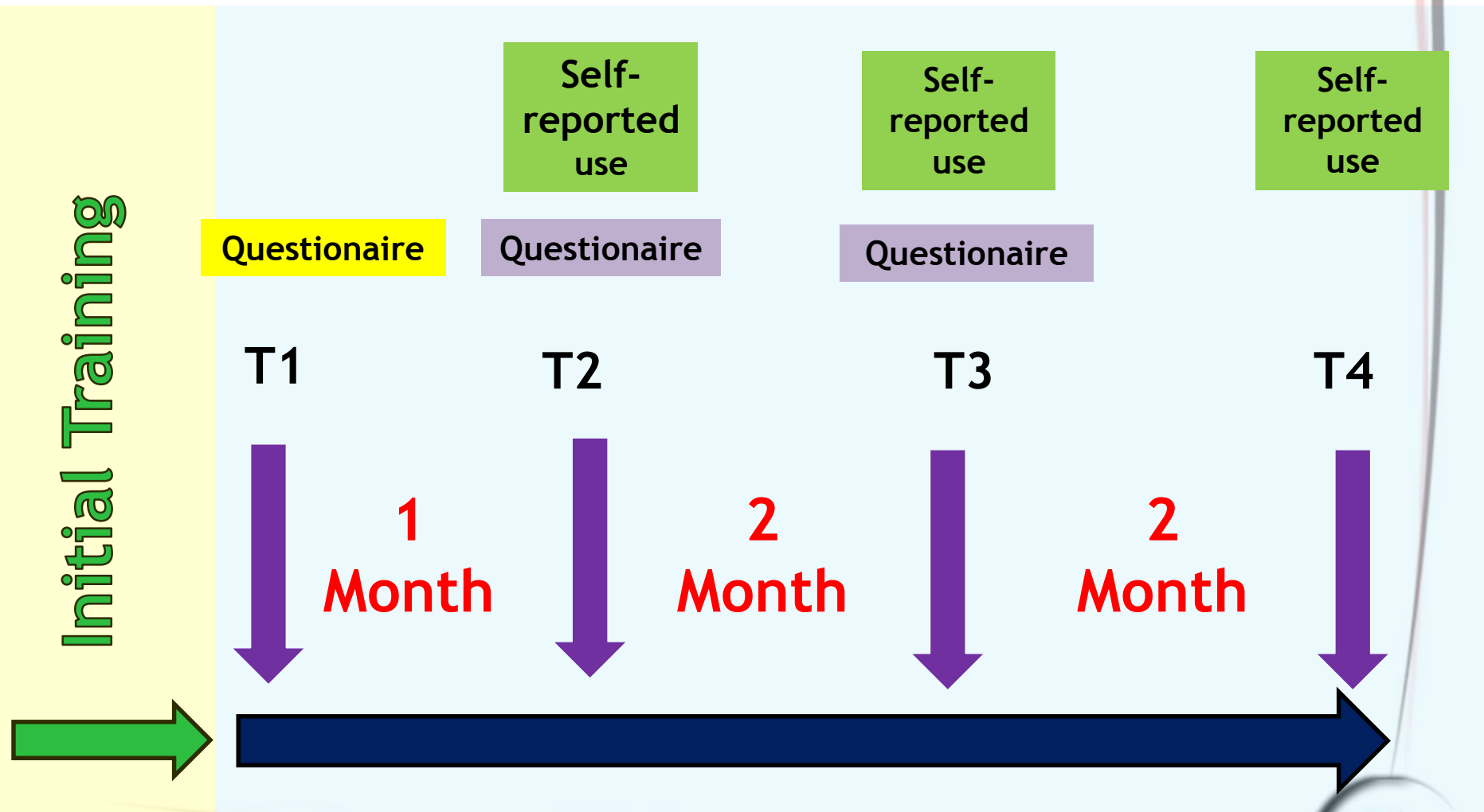
Longitudinal test conducted on

Organization A	Organization B	Organization C	Organization D
Medium	Large	Small	small
Manufacturing	Financial	Accounting services	International investment-banking
a proprietary operational system to manage daily operations	transitioning to a Windows-based environment from mainframe-based IT applications	A new Windows based customer account management system replacing the old systems	a new system to assist in analyzing and creating financially sound international stock portfolios
2 day	1.5 day	1 day	4 hour
38 / 48	39 / 50	43 / 51	36 / 51

Totally 156 participants

Test Procedure

Initial Training

| Self-reported use | Self-reported use | Self-reported use |

Questionaire   Questionaire   Questionaire

T1   T2   T3   T4

1 Month   2 Month   2 Month

Measurement

- Partial Least Squares(PLS) is used to analyze the data

- Harmon's single factor test and marker variable test (job satisfaction is used as a marker variable) used in order to avoid method bias.

- No significant common method bias found.

- The item loadings were greater than or at least equal to .70

  (normally above 0.5 - preferably above 0.6)

Constructs vs. Time Periods

Constructs	Items	T1	T2	T3	Pooled	Constructs	Items	T1	T2	T3	Pooled
Perceived	PU1	.88	.84	.90	.88	**Subjective**	SN1	.84	.88	.80	.83
Usefulness	PU2	.84	.88	.90	.89	**Norm (SN)**	SN2	.88	.82	.75	.78
(PU)	PU3	.90	.90	.89	.90		SN3	.80	.77	.75	.77
	PU4	.92	.91	.94	.92		SN4	.80	.78	.70	.76
Perceived	PEOU1	.90	.89	.88	.90	**Voluntariness**	VOL1	.77	.84	.88	.85
Ease of Use	PEOU2	.90	.92	.92	.91	**(VOL)**	VOL2	.85	.90	.92	.88
(PEOU)	PEOU3	.93	.90	.90	.91		VOL3	.83	.85	.90	.88
	PEOU4	.94	.93	.92	.93	**Image (IMG)**	IMG1	.82	.85	.88	.85
Computer	CSE1	.84	.80	.77	.80		IMG2	.86	.78	.79	.82
Self-Efficacy	CSE2	.78	.75	.70	.74		IMG3	.90	.92	.90	.90
(CSE)	CSE3	.73	.73	.72	.72	**Job Relevance**	REL1	.91	.84	.85	.90
	CSE4	.74	.71	.73	.72	**(REL)**	REL2	.88	.90	.81	.89
Perceptions	PEC1	.80	.77	.75	.76		REL3	.84	.84	.80	.82
of External	PEC2	.78	.77	.73	.74	**Output Quality**	OUT1	.90	.88	.84	.88
Control	PEC3	.77	.74	.74	.74	**(OUT)**	OUT2	.83	.80	.70	.79
(PEC)	PEC4	.75	.75	.73	.73		OUT3	.77	.72	.74	.72
Computer	CPLAY1	.74	.78	.79	.77	**Result**	RES1	.80	.82	.84	.80
Playfulness	CPLAY2	.74	.77	.70	.72	**Demonstrability**	RES2	.83	.80	.70	.77
(CPLAY)	CPLAY3	.73	.74	.73	.74	**(RES)**	RES3	.82	.80	.72	.75
	CPLAY4	.80	.84	.70	.78		RES4	.73	.72	.80	.71
Computer	CANX1	.77	.70	.74	.73	**Behavioral**	BI1	.80	.82	.84	.82
Anxiety	CANX2	.70	.74	.75	.74	**Intention)**	BI2	.90	.92	.90	.92
(CANX)	CANX3	.73	.70	.77	.75	**(BI)**	BI3	.90	.88	.84	.87
	CANX4	.76	.76	.74	.74	**Use (USE)**	USE1	1.00	1.00	1.00	1.00
Perceived	ENJ1	.85	.88	.82	.84						
Enjoyment	ENJ2	.84	.85	.82	.80						
(ENJ)	ENJ3	.80	.84	.84	.83						

All item loadings >= .70

[a]The loadings at T1, T2, T3, and pooled respectively are from separate measurement model tests.
[b]All cross-loadings were below .30.

Result

- *PEoU, subjective norm, image, and result demonstrability* were significant predictors of PU at all time periods

- *Experience* moderated the effects of subjective norm on PU such that the effect was weaker with increasing experience.

- Experience, moderated the effect of PEoU *(PEoU × EXP)* on behavioral intention such that with increasing experience the effect became weaker.

- The effect of PEoU on PU will be moderated by experience.

Result

- None of the determinants of PEoU had significant effects on PU at any point in time or vice versa.

- *Anchors*—that is, computer self-efficacy, perceptions of external control, computer anxiety, and computer playfulness—were significant predictors of PEoU at all points of measurement

- *Behavioral intention* was a significant predictor of use at all points of measurements.

Explaining PU

	T1 (N = 156)	T2 (N = 156)	T3 (N = 156)	Pooled (N = 468)
R^2	.60	.56	.52	.67
Perceived Ease of Use (PEOU)	.22***	.26***	.33***	.08
Subjective Norm (SN)	.40***	.32***	.13*	.04
Image (IMG)	.27***	.20**	.23***	.24***
Job Relevance (REL)	.04	.05	.08	.03
Output Quality (OUT)	.06	.01	.02	.03
Result Demonstrability (RES)	.22***	.26***	.28***	.26***
Computer Self-Efficacy (CSE)	.07	.03	.01	.04
Perceptions of Ext. Control (PEC)	.04	.01	.04	.03
Computer Anxiety (CANX)	.03	.04	.02	.03
Computer Playfulness (PLAY)	.08	.02	.05	.04
Perceived Enjoyment (ENJ)	.02	.05	.02	.04
Objective Usability (OU)	.01	.00	.00	.01
Experience (EXP)				.03
EOU × EXP				.39***
SN × EXP				−.29***
REL × OUT	.37***	.34***	.35***	.35***

[a] Shaded areas are not applicable for the specific column.
[b] *$p < .05$, **$p < .01$, ***$p < .001$.

Explaining PEoU

	T1 (N = 156)	T2 (N = 156)	T3 (N = 156)	Pooled (N = 468)
R^2	.43	.45	.44	.52
Subjective Norm (SN)	.03	.01	.04	.04
Image (IMG)	.04	.04	.00	.00
Job Relevance (REL)	.02	.01	.05	.05
Output Quality (OUT)	.05	.04	.07	.07
Result Demonstrability (RES)	.02	.03	.02	.02
Computer Self-Efficacy (CSE)	.35***	.30***	.28***	.31***
Perceptions of Ext. Control (PEC)	.37***	.30***	.30***	.33***
Computer Anxiety (CANX)	−.22***	−.18**	−.14*	−.18**
Computer Playfulness (CPLAY)	.20**	.16*	.11*	.15**
Perceived Enjoyment (ENJ)	.02	.22***	.24***	.04
Objective Usability (OU)	.04	.19**	.23***	.03
Experience (EXP)				.01
CPLAY × EXP				−.22***
CANX × EXP				.21***
ENJ × EXP				.18**
OU × EXP				.20**

[a]Shaded areas are not applicable for the specific column.
[b]*$p < .05$, **$p < .01$, ***$p < .001$.

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Interventions

- *Interventions*, based on the determinants of PU and PEoU, hold the key to helping managers make effective decisions about applying specific interventions to influence the known determinants of IT adoption and, consequently, the success of new ITs *(Rai, Lang, & Welker, 2002; DeLone & McLean, 2003; Sabherwal, Jeyaraj, & Chowa, 2006).*

Interventions

- *The pre-implementation phase* is characterized by stages leading to the actual roll-out of a system—that is, initiation, organizational adoption, and adaptation.

- *The post-implementation phase* entails stages that follow the actual deployment of the system—that is, user acceptance, routinization, and infusion

Pre-implementation phase stages

- *Initiation*

identification of organizational problems/ opportunities that warrant a technology solution.

- *Adoption*

organizational decision to adopt and install a technology.

- *Adaptation*

modification processes directed toward individual/ organizational needs to better fit the technology with the work setting.

Post-implementation phase stages

- *Acceptance*

efforts undertaken to induce organizational members to commit to the use of technology;

- *Routinization*

alterations that occur within work systems to account for technology such that these systems are no longer perceived as new or out-of-the ordinary;

- *Infusion*

technology becomes more deeply embedded within the organization's work system

Potential Influence of pre & post-implementation interventions on PU & PEoU

	Preimplementation Interventions				Postimplementation Interventions		
	Design Characteristics	User Participation	Management Support	Incentive Alignment	Training	Organizational Support	Peer Support
Determinants of Perceived Usefulness							
Subjective Norm		X	X	X			X
Image			X	X			X
Job Relevance	X	X	X	X	X	X	X
Output Quality	X	X	X	X	X	X	X
Result Demonstrability	X	X	X	X	X	X	X
Determinants of Perceived Ease of Use							
Computer Self-Efficacy					X		
Perceptions of Ext. Control		X	X			X	X
Computer Anxiety		X			X	X	
Computer Playfulness		X			X		
Perceived Enjoyment	X	X		X	X		
Objective Usability	X	X			X		

X indicates a particular intervention can potentially influence a particular determinant of perceived usefulness or perceived ease of use.

Pre-implementation Interventions

- Minimization of initial resistance to a new system.

- Employees may feel that the new system will threaten their existing routines and habits, change the nature of their job and relationships with others, and degrade their status in the organization

- Employees may perceive that the complexity of a new system will add quantitative and qualitative overload to their jobs and reduce autonomy and control over their work environment

Pre-implementation Interventions

Design characteristics

- information-related characteristics of a system will influence the determinants of PU, while the system-related characteristics will influence the determinants of PEoU.

User participation

- User participation refers to the assignments, activities, and behaviors that users or their representatives perform during the systems implementation process

Pre-implementation Interventions

Management support

- influence users' perceptions of subjective norm and image—two important determinants of PU.

- help employees form judgments regarding job relevance, output quality, and result demonstrability of a system.

- reduce anxiety related to the impact and use of the system and, hence, will influence the determinants of PEoU such as perceptions of external control.

Pre-implementation Interventions

Incentive alignment

- For employees' effective utilization of a system, employees should find that the system features and capabilities are aligned with their interests and incentives.

- If an individual perceives that his use of the system does not benefit the members of his or her work units but rather benefits members from other work units, the user will perceive a lack of incentive alignment that may lead to low user acceptance and use of the system.

Post-implementation Interventions

- During post-implementation stages, employees attempt to cope with the new system in different ways depending on whether they perceive the system as a threat (or an opportunity) and whether they have control over the system

- Post-implementation interventions should make employees feel that a new system is an opportunity to enhance their job performance and they have abilities and necessary resources to use the new system effortlessly.

Post-implementation Interventions

Training

- Since in most cases training is conducted after a system is deployed and ready to be used by potential users, it's considered a post-implementation intervention.

- It has suggested the critical role of training in enhancing IT adoption and use.

- Training can be used to help users develop favorable perceptions of different determinants of PU and PEoU.

Post-implementation Interventions

Organizational support

- Organizations can provide support in various forms—providing necessary infrastructure, creating dedicated helpdesks, hiring system and business process experts, and sending employees to off-the-job training.

- TAM3 posits that perceptions of external control are important and stable determinants of PEoU.

- Organizational support is a key source of perceptions of external control.

Theoretical Contributions

- The key strength of TAM3 is its comprehensiveness and *potential for actionable guidance*.

- TAM3 emphasizes the unique role and processes related to PU and PEoU and theorizes that the determinants of PU will not influence PEoU and vice versa.

- With increasing experience, while the effect of PEoU on behavioral intention will diminish, the effect of PEoU on PU will increase. This clearly indicates that PEoU is still an important user reaction toward IT even if users have substantial hands-on experience with the IT.

Theoretical Contributions

- *Experience* is an important moderating variable in IT adoption contexts because, individuals' reactions toward an IT may change over time.

- Relationships among the suggested interventions and the determinants of PU and PEoU is delineated by providing a comprehensive list of interventions.

- The implementation of interventions is, of course, *not a silver bullet* but it can serve as levers for managers.

Conclusion

- If we can develop a rich understanding of the determinants of IT adoption and use and interventions that can favorably influence these determinants, managers can *proactively decide on implementing the right interventions* to minimize resistance to new ITs and maximize effective utilization of ITs.

- Based on a comprehensive nomological network of IT adoption and use—TAM3—*a set of pre- and post implementation interventions* are presented that should be the object of future scientific inquiry.