Understanding Collaborative Technologies Adoptive and Post-Adoptive Outcomes: a Longitudinal Study

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ABSTRACT

Numerous studies in the Information Systems (IS) domain explain what *determines* user adoption of collaborative information technology (IT) in the workplace. Few, however, explain what the influences of collaborative IT adoption on behaviors are over time. Partly based on DeLone and McLean (2003), this paper fills this knowledge gap by formulating and testing a model positing that IT adoption (system usage and satisfaction) influences perceived benefits (flow and collaborative performance) and post-adoptive behaviors (trying to innovate and creativity). In order to test the research model, a longitudinal survey has been conducted over a 6 months period of time with actual users of a collaborative platform based on the Google Apps Service in an insurance company. The results show that; as expected, IT adoption does influence perceived benefits, which in turn influence post-adoptive behaviors. This latter influence is mediated by trust in the IT. The results are discussed and contributions to theory and practice are emphasized.

KEYWORDS

Collaborative systems, creativity, flow, trying to innovate, trust, adoption.

INTRODUCTION

In a context of very tough competition, organizations seek to implement Information Technologies (IT) that will support business objectives, help reducing costs and increasing productivity among others (Luftman and Ben-Zvi 2011). They also seek to promote systems that support novel working strategies, especially through renewed collaborative practices in the workplace. For this, companies increasingly use social networks and other Web 2.0 tools to promote collaboration among workers, with business partners, or with customers (Culnan et al. 2010). Prior research offers great insights into the understanding of the use (Brown et al. 2010), appropriation (Brown et al. 2004; Orlikowski 2000), or for example influence of these technologies on team performance (Bélanger and Allport 2008; Xiaojun et al. 2011) and communication patterns (Bélanger and Allport 2008). However, even though researchers recognize that collaborative technology use and antecedents may evolve over time (Brown et al. 2010), we know very little on post-adoptive outcomes of collaborative IT adoption. The purpose of this article is therefore to fill in this knowledge gap by examining the influence of collaborative IT adoption and benefits, on user post-adoptive responses.

The rise of Web 2.0 collaborative applications, supported by social networks contributes to changing the way managers consider collaboration in the workplace (Culnan et al. 2010). They consider it a part of more comprehensive initiatives, aiming at changing work practices and mental schemes within their company. Relying on the Unified Theory of Acceptance and Use of Technology (UTAUT) theoretical framework, Brown et al. (2010) identify four key types of factors that influence individual intention to use and subsequently the use of collaboration technology, namely 1) individual (e.g., technology characteristics, self-efficacy) and group (familiarity with communication partners) characteristics factors, 2) task characteristics (e.g., idea generation and decision making), 3) situational characteristics (e.g., influence of peers and superiors), and 4) technology characteristics (e.g., social presence, immediacy of communication, tasks concurrency). Differently, with a six months longitudinal, qualitative case study, Bélanger and Allport (2008) suggest that the way people communicate after the implementation of a collaborative technology changes over time. In fact, the researchers

show that users adapt their use of the technology to their specific needs over time. Arguably, these kinds of manipulations reflect users' propensity to innovate and the development of creative capabilities at work at the post-adoptive stage. Ahuja and Thatcher (2005) found in particular that trying to innovate with IT, or users' attempts to find new IT usages could also be viewed as responses to work constraints such as overload. While the longitudinal approach of Bélanger et al. (2008) offers extremely interesting results, it does not offer a measure of the post-adoptive outcomes of collaborative IT use.

Further consideration is also needed with regards to IT trusting beliefs in the context of collaborative IT post adoption. Indeed, users are primarily social actors, who participate in the social dynamics of their organizations (Lamb and Kling 2003; Vaast and Walsham 2005). Very often, information and knowledge sharing through collaborative technologies are not neutral in that users will often make a tradeoff between what they may win and what they may lose before sharing their ideas, knowledge, information (Vaast and Walsham 2005). For this, trust will be an essential variable to understand post-adoptive behaviors with collaborative IT. We expect that users will accept developing new usages and be more creative with the system, if they trust the IT. All these are important issues. This study attempts to address them by answering the following research questions (RQ):

> RQ1: How much does the adoption of collaborative technologies influence collaborative performance and flow?
>
> RQ2: What are the influences of these benefits on individual innovation processes, in the post-adoptive phase?

In order to answer these research questions, we conducted a quantitative study in an insurance company in France. We adopted a longitudinal approach over a period of time of six months to observe the adoption of a collaborative technology, based on the Google Apps Service. The research model aims at investigating the influence of IT adoption (system usage and satisfaction) on perceived benefits (flow and collaborative performance) and post-adoptive behaviors (trying to innovate and creativity).

The structure of the paper is as follows. First, we review some of the literature on technology adoption and post-adoption. Second, we present the research model and hypotheses. Third, we introduce the methodology and design implemented to conduct this research. Fourth, we present the results of the study and discuss contributions and avenues for future research. We conclude with the key implications of the study.

THEORETICAL BACKGROUND

IT adoption is now one of "the most mature research streams in the IS field" (Jasperson et al. 2005, p. 527). For this, researchers such as Jasperson et al. (2005) encourage to further examine the less known post-adoptive behaviors, which they define as "the myriad feature adoption decisions, feature use behaviors, and feature extension behaviors made by an individual user *after* an IT application has been installed, made accessible to the user, and applied by the user in accomplishing his/her work activities" (p. 531).

Furthermore, as highlighted by Jeyaraj and Sabherwal (2008), our understanding of the behaviors, processes, and social influences related to IT adoption is still incomplete because prior research has mainly focused on a 'narrow' set of adoption factors. A similar observation was made by Benbasat and Barki (2007) and Jasperson et al. (2005) who explained that research on IT adoption has principally addressed cognitive processes like perceived ease of use and usefulness. In response to these limitations, Benbasat and Barki (2007) call for for perspectives that include "users' adaptation, learning, and reinvention behaviors around a system" (p. 215). Consequently, a better acknowledgement of innovation processes, such as trying to innovate and creativity offer an important contribution to research and practice.

MODEL FORMULATION AND HYPOTHESES

The research model for this study is shown in Figure 1 below. Following Delone and McLean (2003), it posits that system usage and satisfaction impact performance and flow, which in turn have an impact on trying to innovate with IT and creativity. This impact is mediated by trust.

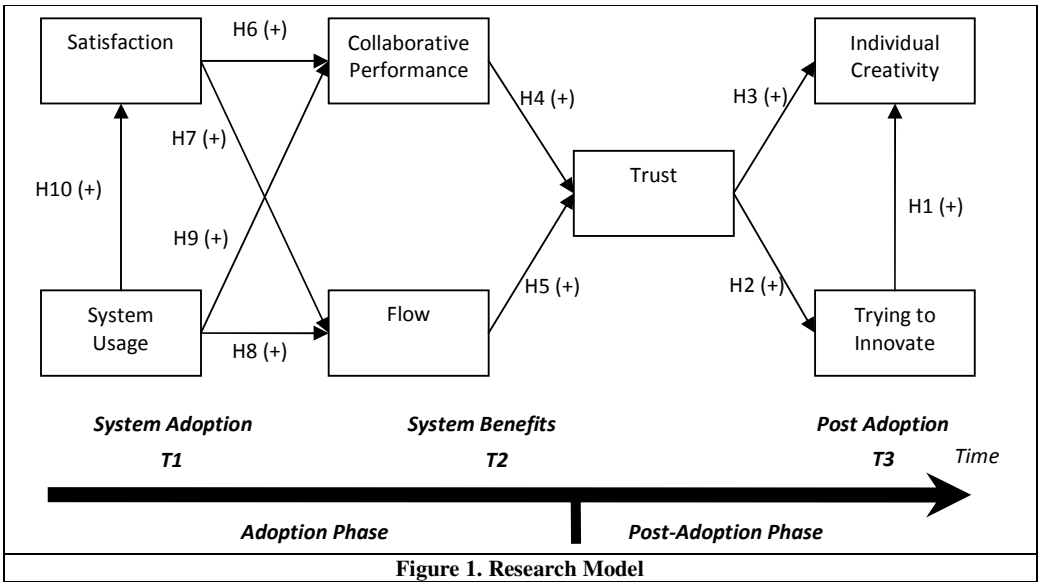

Figure 1. Research Model

Creativity

Knowing how to foster individual creativity has become a great concern for organizations. Indeed, individual creativity can lead to productivity, higher performance and even competitive advantage (Mainemelis 2010). While some researchers view creativity as a process, others conceptualize it as a psychological trait (Couger et al. 1993). Proponents of the process view consider that individuals rely on cognitive processes to reach creativity (Couger et al. 1993). For instance, human thinking or problem solving can lead to creativity. The second perspective puts the emphasis on creativity as a natural disposition or innate talent. In our research, we consider creativity as being the result of a process, namely IT adoption over time. "Creativity has been defined as ―the creation of a valuable, useful new product, service, idea, procedure, or process by individuals working together in a complex social system (Woodman et al. 1993, p. 293)"[1]. Following this, in the context of IT usage, the focus is on how the collaborative IT supports the creation of new ideas, procedures, and processes into individuals' work practices.

Trying to Innovate with Information Technologies

Following the theory of trying (Bagozzi and Warshaw 1990), Ahuja and Thatcher (2005) developed the concept of Trying to innovate with IT (TIIT). TIIT is a volitional post-adoptive variable, which has been defined as "an individual's goal of finding novel uses of Information Technologies" (Ahuja and Thatcher 2005, p. 435). As intention to use IT is often considered a necessary pre-adoption condition to IT use in adoption models (Davis 1989), TIIT is a necessary post-adoption condition to innovation with IT in post-adoptive contexts. Ahuja and Thatcher (2005) emphasize that while trying is under volitional control, the related innovation behavior may be constrained by a number of impediments met in the workplace. Nevertheless, it can be expected that TIIT will increase the creativity of individual users who become more knowledgeable of the technology and of its capabilities through greater explorations. Therefore:

H1: Trying to innovate with IT positively influences individual creativity.

Trust

Various definitions of trust have been provided by researchers. Mayer et al. (1995) define trust as the "willingness of a party to be vulnerable to the actions of another party based on the expectations that the other will perform a particular action important to the trustor, irrespective of the ability to monitor or control that other party" (p. 712). McKnight et al. (2002) adopt an integrative approach of trust that includes institution-based trust, trusting intentions, trusting beliefs, and disposition to trust. In this study, we focus on trusting beliefs toward the collaborative IT artifact or "whether or not people perceived the IT artifact to possess dependable/useful characteristics" (Vance et al. 2008, p. 76). Trust has become of great interest in research dealing with IT collaboration. For example, recent research relate it to knowledge sharing behaviors (Chai et al. 2011), willingness to collaborate to virtual teams (Brown et al. 2004), IS continuance behaviors (Venkatesh et al. 2011) and individual performance (Saonee et al. 2011). When users participate in collaboration, they expect

[1] Cited in Seidel et al. (2010)

reciprocity in the exchange of information and knowledge (Chai et al. 2011). When they trust the IT and the relations with others through IT they are more likely to share information and knowledge. We therefore expect that they are also more willing to try to identify new IT usages, because they are confident that it will be beneficial to them in the future. Trust will also foster creativity because users will feel more confident in it. Indeed, they will be more knowledgeable of the consequences of its use on them, and willing to depend on it. Therefore:

H2: Trust will positively influence trying to innovate with the collaborative IT.

H3: Trust will positively influence individual creativity.

Collaborative Performance

Collaborative performance refers to the effectiveness of the support of the IT to collaboration-based activities. We expect that increased effectiveness in collaboration activities will increase the confidence of the user in the IT. Indeed, because the technology is dependable, the individual feels that he / she can trust it in the course of the completion of work tasks. We hence posited:

H4: Collaborative Performance positively influences trust

Flow

Flow can be defined as the "holistic sensation that people feel when they act with total involvement" (Csikszentmihalyi 1975, p. 36). It is a multidimensional concept composed of control, attention focus, curiosity and intrinsic interest (Webster et al. 1993). Flow is also an affective reaction that impacts user behavior in several ways. For instance, prior research notes that flow increases learning (Hoffman and Novak 1996; Skadberg and Kimmel 2004) and contributes to positive affect (Trevino and Webster 1992). Since trust has been conceptualized as an affect ("emotional trust" by Komiak and Benbasat (2004)), it is reasonable to posit that the positive influence of flow on affect applies to trust as well.

H5: Flow positively influences trust.

Satisfaction

Satisfaction can be perceived as a pre-requisite of flow. Indeed, it is necessary for users to be satisfied with their IT to experience flow. Therefore, we hypothesize the following:

H6: Satisfaction positively influences flow.

Satisfaction promotes user propensity to interact favorably with the IT as well. For this, satisfaction influences the benefits that can be brought from the IT. We hence posit:

H7: Satisfaction positively influences collaborative performance.

System usage

Prior research showed that IT characteristics such as interactivity and vividness positively influence flow (e.g., Hoffman and Novak 1996). But IT usage can also generate flow. Indeed, Csikszentmihalyi (1975) explains that flow generally occurs when the level of challenge is high and the level of skill required to perform the task is high as well. Arguably, new IT implementations may represent a source of challenge for workers as these IT offer new functionalities and introduce new work practices. In such circumstances, if users have been successfully trained, have high control over the IT and an advanced usage of it, it is very likely that their interaction with the IT will be a source of flow. Therefore, advanced system usage is likely to positively impact users' experience of flow.

H8: System usage positively influences flow.

Researchers also relate IT usage to user satisfaction and performance (DeLone and McLean 2003). In fact, for IT benefits to be realized, the IT under consideration should be used (DeLone and McLean 2003). The use of a collaborative IT will foster collaborative performance through the variety of features provided, which will be integrated into the work practices.

H9: System usage positively influences collaborative performance.

H10: System usage positively influences satisfaction.

METHODOLOGY

Research Design

A longitudinal survey has been conducted in France, with users of a newly implemented collaborative platform in an Insurance company, Beta. A particular strength of longitudinal surveys is that they allow identifying antecedents and outcomes in more efficient ways than cross sectional surveys (Creswell 2009). Further, they allow avoiding response bias such as recall bias, which may occur when responses are given by participants on a single questionnaire in a single point in time (Podsakoff et al. 2003).

Three companywide online questionnaires were administered from September 2010 to May 2011. In order to track individual responses over time while maintaining respondents' anonymity, individual users were identified through by 32 digits numbers, which served as unique identifiers over the 3 waves. The setting that we selected was thought to be particularly relevant regarding our research questions for several reasons. First, we had the opportunity to conduct the survey over a period of time of 6 months, which covered the initial adoption phase, to the post-adoption one. Second, the IT was still raising many questions from users. It was for many of them considered as a disruptive technology, for the changes it implied into work practices. Third, Beta was considered as a "traditional" company in a traditional, averse to change sector, which made the deployment of a collaborative platform an important challenge. Such a setting was hence particularly appropriate for increasing the variance in user responses. By the time we administered the first survey, the deployment was still ongoing, with 4,500 users having access to it over 7000 workers. Participants from all positions and hierarchical levels were recruited for the study.

Sampling

In total, over the 4500 users from BETA, 1261 (28%) participated in the first survey (T1). 455 users (36% of T1 sample) participated in both the first and the second survey (T2). Finally, 300 users (23%) participated in the third survey (T3), 188 of which participated in T1, T2, and T3 (15% of the overall sample). Of these respondents, 51% were men and 49 % women. All categories were represented, employees (27 %), clerical workers (19%), cadres (50%), and top management (5%). With respect to age, 2% were less than 26 years old, 21% 26-35 years old, 29% 36-45 y.o., 38 % 46-55 y.o, 14% 56-65 years old. With respect to education, 88 % had a university degree, with 26% having a graduate degree. The mean for the number of years of university studies is of 3.83 years. The participants were being working at Beta from 15 years on average (s.d. = 11.83 years), and have been on their position for 6.84 years on average (s.d. = 6.029 years). They were using AlphApps for 2.37 months on average (s.d. = 2.66 months). Overall, hence, the sample was very diverse. It was also representative of the overall workers at BETA.

Measures

Measures were mostly taken from prior studies. Trying to innovate with IT (TIIT) is made of 2 items adapted from Ahuja and Thatcher (2005). Flow was adapted from Agarwal and Karahanna (2000). Collaborative performance is a four items formative construct adapted from the technology interaction construct from Barki et al. (2007). The related questions inquired about the effect of AlphApps on the related technology interactions. Satisfaction was adapted from Wixom and Todd (2005). Following Burton Jones and Straub (2006), system usage has been conceptualized as a rich, formative construct representing the frequency of use of the most relevant features of the collaborative platform, according to the system implementers. Satisfaction, Usage and control variables were measured via the first questionnaire (T1). Collaborative Performance and Flow were measured in the second questionnaire (T2 = T1 + 3 months). Finally, Trust, TIIT and Creativity were measured in the third questionnaire (T3 = T2 + 3 months).

Construct Validity and Reliability

In order to examine the measurement properties of the data set, we conducted analyses of the convergent and discriminant validity of the constructs. We also examined the reliability of the reflexive constructs through Cronbach's Alphas and composite reliability measures (Fornell and Larcker 1981). Convergent validity was assessed via the examination of a cross loading table (not reproduced in the paper for brevity). The item-to-construct associations were significant, which is evidence of convergent validity.

The item-to-constructs associations are also greater for the intended items than for any other items in the Table. This is evidence of discriminant validity. A further assessment of discriminant validity was assessed through the Average Variance Extracted matrix given in Table 2 below. The values on the diagonal are all greater than any other off-diagonal values. This is a further evidence that items association to their intended construct are greater than items association to other constructs, and hence of discriminant validity.

Table 2. Average Variance Extracted Table

	CR	CA	1	2	3	4	5	6
(1) Creativity	.884	.812	**.849**					
(2) Flow	.974	.960	.307	**.962**				
(3) Personal Innovativeness	.949	.921	.142	.169	**.928**			
(4) Satisfaction	.987	.974	.348	.802	.245	**.987**		
(5) Trust	.944	.881	.400	.665	.082	.678	**.945**	
(6) Trying to Innovate	.941	.875	.308	.499	.423	.521	.420	**.943**

CR= Composite Reliability, CA = Cronbach Alphas

Values in Bold are the square root of the average variance extracted. The fact that they are all greater than any other off-diagonal values is evidence of discriminant validity.

Finally, with Composite Reliability ranging from .884 to .987 and Cronbach's Alphas ranging from .812 to .974, the reliability of the constructs were very good.

Results

A bootstrap analysis with 200 resamples (Chin 2001) has been conducted with SmartPLS (Ringle et al. 2005) in order to test the research model. Perceived behavioral Control (Venkatesh 2000), personal innovativeness with IT (Agarwal and Prasad 1998), education, gender, and age were included in the model as control variables. The variance explained were very good for satisfaction (R^2 = .586), collaborative performance (R^2 =.443), Flow (R^2 =.678), Trust (R^2 = .496), Trying to Innovate with IT (R^2 =.391), and reasonable for Creativity (R^2 =.186). The results are given in Table 3 below.

Table 3. Path Coefficients and Hypotheses Validation

Relationship	OS	SM	SD	SE	T	Hypotheses Validation
Trying to Innovate -> Creativity	.149	.154	.087	.087	1.720	H1 (No)
Trust -> Trying to Innovate	.279	.284	.066	.066	4.210***	H2 (Yes)
Trust -> Creativity	.288	.285	.075	.075	3.840***	H3 (Yes)
Collaborative Performance -> Trust	.314	.327	.077	.077	4.075***	H4 (Yes)
Flow -> Trust	.469	.458	.080	.080	5.900***	H5 (Yes)
Satisfaction -> Collaborative Performance	.413	.369	.084	.084	4.890***	H6 (Yes)
Satisfaction -> Flow	.623	.581	.073	.073	8.526***	H7 (Yes)
Usage -> Collaborative Performance	.293	.349	.092	.092	3.176***	H8 (Yes)
Usage -> Flow	.233	.281	.071	.071	3.294***	H9 (Yes)
Usage -> Satisfaction	.766	.784	.027	.027	28.132***	H10 (Yes)
Age -> Creativity	-.135	-.136	.067	.067	2.006*	CV
Perceived Behavioral Control -> Trying to Innovate	.286	.282	.076	.076	3.790***	CV
Personal Innovativeness -> Trying to Innovate	.251	.255	.070	.070	3.561***	CV

CV = Control Variable

Significance levels: * p<.05, ** p<.01, *** p<.000

Contrary to our expectations, the link TIIT ➔ Creativity was not significant (B= .149). Hence H1 is not validated. All of the other hypotheses are validated. The link Trust ➔ TIIT was found to be positive and significant (B = .279, p < .000), as well as the links Trust ➔ Creativity (B = .288, p < .000), Collaborative Performance ➔ Trust (B = .314, p <.000), and Flow ➔ Trust (B = .469, p < .000). Therefore, H2, H3, H4 and H5 are validated as expected. Trust effectively mediates the influence of Collaborative Performance and Flow on Individual Creativity and TIIT. Then, the links Satisfaction ➔ Collaborative Performance (B= .413, p. <.000), Satisfaction ➔ Flow (B= .623, p. <.000), Usage ➔ Collaborative Performance (B = .293, p< .000), Usage ➔ Flow (B = .233, p <. 000) and Usage ➔ Satisfaction (B = .766, p <.000) are significant in the intended direction. Consequently, H6, H7, H8, H9 and H10 are all validated.

Regarding the control variables, age significantly influences creativity (B = -.135, p< .05) with elder people having a lower tendency to find that AlphApps helps to become more creative at work. Then, perceived behavioral control significantly impacts TIIT (B = .286, p< .000). Finally personal innovativeness with IT significantly impacts TIIT (B = .251, p< .000). No other influences from control variables were found (in Table 4, non significant control variables results are omitted for brevity).

DISCUSSION AND IMPLICATIONS

The research model was overall well supported. The results confirm that, over time, initial adoptive behaviors do influence individual benefits, and subsequently post-adoptive behaviors. It also shows that the influence of individual benefits from the collaborative IT on post-adoptive behaviors is mediated by trust. Trust is thus an effective conduit through which collaborative IT benefits influence post-adoptive behaviors such as trying to innovate with IT and creativity processes in the workplace. These results are important because individuals often fear using collaborative tools that involve information and knowledge sharing (Chai et al. 2011; Orlikowski 2000; Vaast and Walsham 2005). They suggest that fostering Collaborative Performance and Flow should be influenced not only because they are desirable adoption outcomes, but also because they can influence post-adoption via Trust.

Unexpectedly, however, trying to innovate with AlphApps does not influence individual creativity. This probably means that trying to innovate with the collaborative IT primarily aims at meeting functional needs and work constraints, rather than at discovering the new possibilities that the system offers to improve work tasks. Prior research indeed showed that innovation and reinvention behaviors emerged with new work constraints that follow IT implementation. This result implies that trying to innovate with the collaborative IT, although desirable, should be considered cautiously as it may also reflect the inability of the technology to respond to some work needs.

According to Delone and McLean (2003), system usage and user satisfaction determine net benefits from an implemented IT. Accordingly, our model demonstrates that Collaborative Performance and Flow are relevant "IT benefits" resulting from Satisfaction and System Usage. Flow is most often not considered to be a key attribute of *office* technology. Indeed, the researchers who examined *flow* have mainly focused on *hedonic* technologies (e.g., Chhabra 2005; Skadberg et al. 2005), which "provide self-fulfilling rather than instrumental value to the user" (Van der Heijden 2004, p. 695). Nonetheless, the fact that managers at Beta emphasized attributes such as "innovation", "novelty", "creativity", "enjoyment", - some of which are related to Flow – when talking about the IT makes the examination of Flow meaningful. Furthermore, a few studies indicate that the workplace represents a major source of flow for some workers because it offers a combination of high skill and challenge, a prerequisite for flow to occur (Eisenberger et al. 2005).

In spite of these contributions, like any other research, this study has some limitations. First, we investigated a single facet of trust, the trusting beliefs toward the collaborative IT. Though, trust is a much more complex concept (McKnight et al. 2002), and future research may want to examine whether other facets contribute to explaining the impact of IT adoption on IT post-adoption. Second, even though the longitudinal design helps avoiding the limitations specific to cross-sectional designs, the research model includes only perceptions and no objective measures of behaviors. Though, perceptions and actual behaviors may be different (Straub et al. 1995). Future research may attempt to objectively measure creativity, trying to innovate, and the corresponding innovation behavior. Third, we conducted the study in a single company. While this can be viewed as a strenght for the homogeneity of the sample and the control of the organanizational setting, it can also be considered as a

threat to generalizability. Future research can hence extend the investigation to other organizational and/or cultural settings.

CONCLUSION

Collaborative technology use still poses important challenges to organizations and workers. The present study uncovered the relationships between collaborative IT adoption, system benefits, and post adoption. Through a strong longitudinal survey design with 188 workers, it also shows that the relationship between system benefits and post-adoption over time is mediated by users trusting beliefs about the IT. This study increases our knowledge about collaborative technologies adoption and post adoption, and about the role time plays in this process. Practitioners should thus carefully consider the early IT adoption stages because they impact subsequent post-adoptive processes and behaviors over time.

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