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TEAM LEVEL ANTECEDENTS OF INDIVIDUAL USAGE OF A NEW TECHNOLOGY [1]

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Abstract

Prior research on individual usage of a new technology has essentially approached the issue through framework solely based on individual level, while literature on teams points out that team level characteristics may affect individual behaviors. Therefore, in this study we investigate how team-level variables influence individual usage of a new technology. Using data from 350 team leaders and team members belonging to 60 teams, we test cross-level hypotheses by adopting hierarchical linear modeling (HLM). Results indicate that team autonomy negatively affects individual usage, while team learning culture has a positive influence on individual usage. Moreover, our results point out that team cohesion does not have any moderation effects between team variables and individual usage. Theoretical and practical implications are offered.

Keywords: technology usage; team autonomy; learning culture; technology introduction.

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TEAM LEVEL ANTECEDENTS OF INDIVIDUAL USAGE OF A NEW TECHNOLOGY

1. INTRODUCTION

Many organizations operate in a hyper-competitive environment (D'Aveni, 1995) that requires the capacity to quickly respond to new technology opportunities offered by the Information and communication technologies (ICT) market. Indeed the organizational capacity to interact with technology innovation represents a condition for survival and success (Ahuja and Thatcher, 2005). In order to exploit strategic and organizational change opportunities related to innovations (Orlikowski, 1992), it is necessary to understand which factors influence the adoption process of such innovations (Fichman, 2000).

The interest generated by the ICT adoption field has driven academic and managerial communities to develop several theoretical and empirical models in order to understand the main drivers underlying such adoption processes (see Venkatesh et al., 2003 for a literature review). Indeed, the introduction of technological and other innovations into the workplace constitutes a significant source of uncertainty for employees (Spender et al. 1995). Previous research suggests that social factors – which contribute to the shaping of beliefs and behaviors – play a pivotal role in helping individuals resolve this uncertainty (Lewis et al. 2003).

The current study contributes to this research stream in two ways. First, prior research considering social factors primarily focuses on the individual level of analysis, which suggests that users' behaviors toward a target technology are shaped by their perceptions about the consequences of using the technology (see Venkatesh et al. 2003 for a literature review). A more comprehensive cross-level analysis of adoption, including team-level influences has yet to be conducted. The importance of studying the influence of team-level characteristics on individual behavior toward technology use is twofold: 1) teams are progressively becoming an important structural form for enabling organizational flexibility in rapidly changing environments (Ancona 1990; Mohrman et al. 1995), and 2) teams provide the most immediate contextual environment for individuals, thus imparting significant influence on their behaviors (Hoegl et al. 2003). Thus, studying team-level social antecedents of individual technology is likely to provide important insights associated with the introduction of a new technology, which ultimately can be used by managers to craft more effective teams by altering their structure and composition. Second, our dependent variable – usage of a new technology – has been less studied in prior literature. Despite the system usage construct has played a central role in information systems (IS) research since the 1970's, the system usage construct has received scant theoretical and empirical treatment to date (Burton-Jones and Straub, 2006). Thus, relying on the work by Burton-Jones and Straub (2007) we develop our research adopting a new conceptualization of usage which provides a more comprehensive and richer measurement of system usage. Moreover, extant research grounded on traditional acceptance models (such as TAM) primarily adopted a technology-centric perspective for studying individual behaviors and organizational context during the introduction of a new technology, limiting the understanding on individual usage of technology. Our research departs from the previous theoretical foundations of TAM adopting a lens based upon team processes and characteristics.

We develop our hypotheses about the influence of the team level factors on individual usage, relying on theoretical arguments that can be traced back to team autonomy and culture theories. We test our cross-level hypotheses using appropriate analytical techniques (i.e., hierarchical linear modeling – HLM) on data from 350 employees belonging to 60 teams, using a new integrated communication technology within two large organizations.

The remainder of this paper is structured as follows. First, we present a literature review with particular focus on individual usage, and team level antecedents (i.e. team autonomy and culture).

This is followed by the hypotheses development. Next we discuss the methodology, including data collection, subjects, and analyses. We conclude with a discussion of our results and implications for theory and practice.

2. THEORETICAL FRAMEWORK AND HYPOTHESES

2.1 Research on new technology usage

Adoption and use of new technologies are core constructs in Information Systems (IS) research (Fichman, 2000; Burton Jones and Straub, 2006). The adoption of a new technology is the decision to adopt an innovation by specific actors (individuals, organizations, etc.) (Rogers, 2003). Some authors distinguish the concept of "primary adoption" from the concept of "secondary adoption". Primary adoption is the organizational decision to adopt the innovation, while secondary adoption is the individual decision by users inside the organization to adopt the innovation (Leonard-Barton and Deschamps, 1988; Gallivan, 2001). The present study focuses on secondary adoption (i.e. it focuses on new technology usage by employees).

Recent literature (e.g. Lassila and Brancheau, 1999; Orlikowski, 2000; Burton Jones and Straub, 2006) shows that users may choose to (1) adopt the new technology or (2) not to adopt the new technology. In the former case, users may choose to use the new technology (a) in a way consistent with managers and developers' intentions, or (b) in a way not anticipated by the managers and developers.

The structurational perspective (Orlikowski, 1992; Orlikowski 2000) proposes a practice lens through which analyze technology usage in organizations. According to this perspective, technology structure is not embodied in a given technological artifacts, but it is enacted by recurrent social practices of a community of users (e.g. work team, organizational department, etc.). Therefore, technology usage is influenced by users' understandings of the properties and functionality of a technology and these are strongly influenced by the discourse (e.g. images, descriptions, rhetoric, ideologies, and demonstrations) presented by technology intermediaries (vendors, journalists, consultants, champions, trainers, managers, and 'power' users) (Orlikowski et al. 1995). According to this perspective: (1) it is important to understand how technology usage is structured by the rules and resources implicated in their ongoing action; (2) there are three different human agents influencing technology usage (managers, developers, and users).

Early studies adopting a critical perspective toward technology introduction and shaping (Braverman, 1974; Edwards, 1979; Perolle, 1986) pointed out that (1) only managers and developers have the authority and means to shape the technology, and (2) users are relatively powerless and their actions and cognition are determined by technology. Conversely to this perspective, more recent research grounded on the structurational model of technology criticizes the tight distinction between power human agents (i.e. managers and developers), and powerless human agents (i.e. users). According to this point of view users can shape and change the social dimension of technology (i.e. how technology is interpreted and operated) (Orlikowski, 1992), but this social malleability of technology is not infinite: "*saying that use is situated and not confined to predefined options does not mean that it is totally open to any and all possibilities. The physical properties of artifacts ensure that there are always boundary conditions on how we use them.*" (Orlikowski, 2000, p. 409).

Previous research shows that both individual and collective variables influence the user's decision whether to adopt the new technology, and how to use it (Lewis et al. 2003; Burton-Jones and Straub, 2006). Some of these variables are situated at the level of community of users. Users draw on their knowledge of and experiences with the institutional context in which they work, and the social and cultural conventions associated with participating in such context in order to use technology (Orlikowski, 2000). Following this perspective, the objective of this study is to analyze how team variables influence individual use of new technologies. Focusing on work teams can be traced back to the fact that team members represent the most immediate social entities through which individuals

obtain resources (Faraj and Xiao, 2006; Hoegl et al. 2003). In particular, we propose that two team level variables directly influence individual usage of new technology, i.e. team autonomy and learning culture, and we propose that team cohesion moderates the relationships between team autonomy, team learning culture and individual usage. Figure 1 depicts our research model.

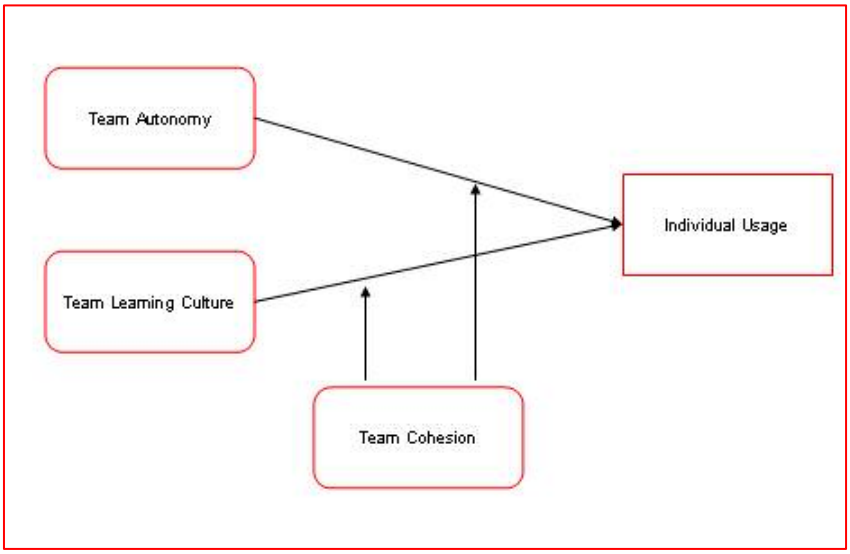

Figure 1: Theoretical model

2.2 Differences in individual usage

Users may differ in their usage of technology concerning the organizational purposes. This deviation in the usage may occur because users may choose to use the technology in a way not anticipated by the managers and developers (e.g. limited use of technology, technology reshaping, etc.). This behavior undermines the use context of new technology, and may shape and change this context. Managers may change their strategy (i.e. schemes, norms, and rules embedded in the technology), and they may authorize developers to modify the technology (Orlikowski, 1992).

The deviation in the usage may occur because of errors (misperception, lack of understanding, slippage) or intent (Lassila and Brancheau, 1999; Orlikowski, 2000). Intent may be based on (1) inertia, (2) emancipation, (3) innovation. Emancipation and innovation require users to play an active role in the secondary adoption process (Alvesson and Wilmott, 1992; Lassila and Branceau, 1999).

Inertia implies the preservation of the status quo, users do not change the new technology and they do not change the old way of doing things. If the new technology is not consistent with the old way of doing things they simply do not use the new technology or they choose to use the new technology in a limited way, i.e. users show little or no interest in integrating new technology use into their ongoing work practices (Orlikowski, 2000). The consequence of this new technology usage is the decoupling between formal primary adoption and substantial secondary adoption (Fichman, 2000).

Emancipation is "*the process through which individuals and groups become free from repressive social and ideological conditions, in particular those that place socially unnecessary restrictions upon the development and articulation of human consciousness*" (Alvesson and Wilmott, 1992, p. 432). In the IS realm, emancipation is the process of reaction of workers against (1) alienation produced by the new technology, and (2) the consequences of this artifact on the conditions of workers (such as deskilling, panopticon control, etc.) (Braverman, H., 1974; Foucault, 1977; Mattelart, 2003; Jackson et al., 2006).

Innovation implies a change in the technology and/or in the way of doing things by users. The objective of the innovation is to improve the use of the new technology and the fit between the technology and the way of doing things (Lassila and Brancheau, 1999; Orlikowski, 2000).

Relying on this perspective concerning differential usage of technology we develop our research hypotheses.

2.3 Team autonomy and individual usage

Work team culture may be consistent or diverse compared to organizational culture. Organizations are most accurately viewed as "multicultural" (Gregory, 1983) and characterized by subcultures and countercultures (Martin and Siehl 1983). Organizations that permit a decentralized diffusion of power, are likely to spawn a "nonconforming enclave", and the counterculture will be likely to emerge within a structural boundary of autonomy (Martin and Siehl 1983). In this sense, an autonomous team may be a fertile locus for the development of a counterculture affecting the individual use of a new technology. Teams vary in the degree to which they have team autonomy, or decision-making authority for their actions (Bruhn, Gibson, 2006). Autonomy may be defined as ''*the degree to which the task provides substantial freedom, independence, and discretion in scheduling the work and in determining the procedures to be used in carrying it ou*t'' (Hackman and Oldham, 1980, p. 79). Team autonomy refers to freedom, independence, and discretion in the task of a team (Cordery, Mueller, andSmith, 1991; Hackman, 1987; Kirkman and Rosen, 1999; Langfred, 2000). Therefore autonomy at team level may induce a limited use of a new technology because of inertia or emancipation at individual level. Following these arguments, an autonomous team may decide to promote individual inertia or emancipation in technology usage. Formally,

Hypothesis 1: Increasing autonomy at team level will have a negative impact on individual usage of a new technology.

2.4 Team learning culture and individual usage

Users may differ in their use of technology not only because of inertia and a purpose of emancipation, but also because of a lack of knowledge or because of a purpose of innovation. In the former case, users would like to use the new technology in a way consistent with managers and developers' intentions, but they could not because of a lack of new technology knowledge. In the latter case users would like to use the new technology in order to innovate the artifact (Orlikowski, 2000).

Users' knowledge influences the adherence between user's behavior and usage of new technology, and the success of the implementation process. In particular, users need to acquire new knowledge to be able to effectively use new technology in order to gain the planned objectives (Attewell, 1992; Nelson et al., 1995; Sein et al., 1999; Lassila and Brancheau, 1999; Rogers, 2003; Sharma and Yetton, 2007).

Two dimensions characterize users' knowledge: an individual one, and a collective one. Information provided by the organization (e.g. training, documentation, etc.) concerning how to use and purposes of a new technology are the main source of knowledge during the process of implementation (Nelson and Cheney, 1987; Agarwal, 2000). This information has effects on both individual cognition, and inter-individual cognition, influencing the implementation success (Sharma and Yetton, 2007). In particular, information provided by the organization influences the implementation process through the creation of a transactive memory system (Argote 2005; Liang et al. 1995) and the development of collaborative task knowledge (Kang and Santhanam 2003-04). The link between training programs, individual cognition, inter-individual cognition, and implementation success is supported by the existence of a learning culture at team level. Learning culture characterizes organizations that are skilled at knowledge generation, acquisition, and transfer, and that modify their behavior to reflect new knowledge (Garvin 1993). Thus, learning culture encourages collaboration and team learning (Garvin 1993) enhancing the exchange of information and knowledge related to the new technology. In particular, learning culture supports both user in his appropriation of the new technology according

to managers' intentions, and user in his deviation from standard use in terms of innovation resulting in a positive influence on new technology usage. Formally,

Hypothesis 2: Increasing learning culture at team level will have a positive impact on individual usage of a new technology.

2.5 The moderating effect of team cohesion

Lee et al. (2002) argue that as a group's cohesiveness and norm strength increase, the culture of the group may be characterized as "tight" (Witkin and Berry, 1975). This "tight" culture exerts a relatively strong and uniform influence across members. Therefore team cohesion tends to reinforce team subculture and/or counterculture, strengthening the negative relationship between team autonomy and individual usage.

Moreover, previous research shows that team diversity and variety by privileging the individual over the community, the dissonance over the consonance, promote team creativity, knowledge creation, and external knowledge sharing (Williams and O'Reilly, 1998; Cummings, 2004; Amabile et al., 2005; Harrison and Klein, 2007). On the contrary, team cohesion tends to privileges the community over the individual, the consonance over the dissonance. Therefore, we expect that team cohesion tend to weakness the effects of learning culture because it limits team diversity and variety.

Formally,

Hypothesis 3a: Team cohesion moderates the relationship between team autonomy and usage of new technology such that increased team cohesion strengthens the negative effect of team autonomy on individual usage.

Hypothesis 3b: Team cohesion moderates the relationship between learning culture and usage of new technology such that increased team cohesion weakens the positive effect of learning culture on individual usage.

3. METHODS

3.1 Research context

Study context

The data to test our hypotheses comes from the introduction of a new communication technology in two large Italian companies. According to Rogers (1986, p. 2) a communication technology is "the hardware equipment, organizational structures, and social values by which individuals collect, process, and exchange information with other individuals". In particular, this study consider a new communication technology as a system that is used to manage all the technology mediated communication among individuals in an integrated fashion such as agenda sharing, personal and organizational information, mobility management, coordinate events. Besides offering a wide set of information that can be accessed and managed by users, such kind of system represents the convergence of different communication means, allowing individuals to communicate with other colleagues with and outside their team in an integrated fashion. This aspect is particularly relevant because individuals, through a unique platform, are allowed to chose among different communication channels according to their sincronicity needs (Maruping and Agarwal, 2004) (i.e. voice, instant messaging, conference call, e-mail,…). In this particular case, while the use of the system was strongly encouraged, there was no policy in place for non-compliance and no actions were being taken as a result of the usage reports, suggesting that system use was voluntary. We tested the research hypotheses with a field study using a survey methodology for data collection. The questionnaire was developed using a multi-stage iterative procedure. First, an initial set of items was constructed drawing upon prior work. Next, we conducted interviews to the IT managers responsible of the implementation

project in order to develop a questionnaire which fit with the organizational setting and technology introduced. The interviews allowed also to indicate those teams that already had available the new system. The two CIOs sent an e-mail memo explaining the importance of participation to all potential respondents 1 week before the launch of the survey.

Data were gathered through a web survey containing five-point Likert-type scales. To obtain more reliable ratings of the team-level constructs under consideration, multiple respondents from each team participated: one of whom was the team leader. Of a total of 463 individuals targeted for the survey, 350 usable surveys referring to 60 teams[2] were completed, for a response rate of 75.5%. For considering the surveys usable we required that at least three questionnaires be completed for each team (the team leader and two team members). Data for the team-level independent variables were gathered through the assessment of items formulated explicitly at the team level.

3.2 Measurement model

Team autonomy. Our team-level measure of team autonomy was assessed through a eight-item scale adapted from Langfred (2000). The coefficient alpha was .85. A sample item from the adopted scale is: "The team is free to decide how to go about getting work done."

Team learning culture. A five-item scale adapted from Watkins and Marsick (1997). The coefficient alpha was .76. A sample item is: "My team makes its lessons learned available to all members"

Team cohesion. A four-item scale adapted from Hoegl and Gemuenden (2001) measured the teams' level of cohesion and team spirit. The coefficient alpha was .89 for this scale. A sample item is: "Team members are loyal one another". Show evidence of validity in prior studies

Individual usage. Based on Igbaria (1997), Moores and Chang (2006), and Karahanna et al. (2006), we measured usage through two constructs, i.e. usage intensity, and usage scope. Usage intensity consists of frequency of use, and duration of use. Usage scope consists of percent of system features used regularly by respondents, and percent of interactions managed through the new communication technology (i.e. proportion of use). The coefficient alpha was .67 for this scale.

Control variables. We also included individual level and team-level control variables. At the individual level we controlled for age, gender, education and tenure, as different studies point out that demographic characteristics may influence individual perceptions, as well as the way through which individuals manage a stressful situation such as emergent and unexpected events (e.g., Narayanan, et al. 1999; Treadway, et al. 2005). Table 1 shows descriptive statistics, correlations, and scale reliabilities.

	Variable	Mean	SD	Alpha	1	2	3	4	5	6	7
1	Usage	3.99	.91	.67							
2	Autonomy	3.32	.68	.85	.01						
3	Learning culture	3.30	.73	.76	.19	.40					
4	Cohesion	3.46	.85	.89	.06	.45	.58				
5	Age	41.6	9.1	na	-.10	-.03	-.03	.03			
6	Tenure	na	na	na	-.03	-.07	-.01	-.01	.58		
7	Gender	na	na	na	-.04	-.04	.15	.01	-.05	.04	
8	Education	na	na	na	.05	-.05	-.09	-.15	.02	-.10	-.08

Table 1 Descriptives and correlations (N=350). Values greater than .15 are significant at p<.05.

[2] Each individuals did not belong to multiple teams. In other words, the same person could not be considered a member of more than one team.

3.3 Data Analysis

HLM method. Raudenbush and Bryk (2002) point out that traditional statistical techniques such as multiple regression are inadequate to assess cross-level predictions. As is appropriate for a model that spans multiple levels of analysis, we adopted hierarchical linear modeling (HLM) to test the proposed hypotheses. Others have observed that the fundamentally hierarchical nature of organizations (Hofmann, 1997) has resulted in the increased popularity of HLM as an analytical technique for organizational research (e.g. Seibert, Silver, and Randolph, 2004). In addition to the ability to model cross-level effects, HLM offers the advantage of providing the explained variance for each level rather than estimating the total variance explained (Cullen et al., 2004).

Aggregation of team-level data. Recall that the conceptual model suggested a direct consensus approach and we assumed that team members belonging to the same team had common, shared perceptions of team learning culture, autonomy and cohesion. To verify this assumption as is required in HLM, we first assessed the appropriateness of aggregating team-level data. This included an analysis of variance (ANOVA) to test the between-group variation (Hofmann, 1997), and the computation of ICC (1) to verify the within-group agreement about each variable. The ANOVA performed indicated a significant between group variance for all the team-level variables (autonomy: $F=1.44$; $p<.05$; learning culture $F=1.80$, $p<.05$; and cohesion $F=1.80$, $p<.05$). ICC(1) scores showed significant within-group consensus (0.53 for autonomy, 0.29 for learning culture, and 0.29 for cohesion). According to Schneider et al., (1998), these results support the existence of a significant level of within group agreement and significant between-group variability for both levels of analysis, justifying the aggregation of team-level data.

3.4 Results

Model 1 contains the individual level control variables without considering any level 2 predictors. Model 2 introduces the cross-level effects related to the relationship of autonomy and learning culture with individual usage, testing hypotheses 1 and 2. In particular, hypotheses 1 and 2 state that team autonomy is negatively related to individual usage, while learning culture is positively related to individual usage. Both the hypotheses are supported: team autonomy (coeff.= -0.12; $p<.01$); team learning culture (coeff.=0.13; $p<.01$). Model 3 introduces the moderating effect of cohesion on the relationship between team autonomy, team learning culture and individual usage for testing hypothesis 3a and 3b. Results do not support the moderating effect of cohesion.

Using HLM, and following Liao and Rupp (2005) we calculated the proportion of within-group variance explained by the specified model in comparison with the null model (R^2_{within}) and the proportion of between-teams variance explained by the specified model in comparison with the null model ($R^2_{between}$). As indicated in table 2 team level antecedents explain a good proportion of variance in individual usage between teams.

DV: Individual usage			
	Model 1	Model 2	Model 3
Individual controls (level 1)			
Age	-.01†	-.01†	-.01†
Tenure	.04	.02	.01
Gender	-.09	-.10	-.10
Education	.04	.04	.02
Team variables (level 2)			
Team autonomy		-.12**	-.07
Team learning culture		.13**	.19**
Team cohesion			-.12
Team cohesion X team autonomy			.06
Team cohesion X team learning culture			-.08
R^2_{within}	.03	.03	.03
$R^2_{between}$		.30	.46

*Table 2: Results of HLM analysis. † p<.1; * p<.05; ** p<.01.*

4. IMPLICATIONS AND FUTURE RESEARCH

This study provides several theoretical and managerial implications. A first major consideration refers to usage of a new technology from a multilevel perspective. In our study we analyze the role of some organizational variables at team level in influencing the individual usage of a new technology. Our results indicate a good proportion of variance explained by team autonomy and learning culture on individual usage. Thus, we state that team-level variables effectively influence the individual usage of a new technology. Moreover, we demonstrate that such influence can be either negative or positive. In particular, team autonomy exerts a negative influence on individual usage of a new technology, while team learning culture exerts a positive influence on individual usage of a new technology. Then, team autonomy limits the individual usage of a new technology. The usage of a new technology by individuals also depends on their ability to have access to knowledge about the use of a technology. In our study, knowledge acquisition and distribution at team-level (i.e. team learning culture) results to be an enabler factor of the individual ability to use a new technology.

Moreover, we analyze the moderating effect of team cohesion on both the two relationships between team autonomy and team learning culture, and individual usage of a new technology. Our findings point out as team cohesion exerts a not significant influence on both the relationships.

These considerations have some direct managerial implications. It is much discussed in the IS literature that organizations who want introduce a new technology must create the appropriate environment to support the users acceptance of it. According to our findings, in this context team variables play a relevant role. From one side, managers should pay attention to the team discretion in its activity and should leverage the team ability to manage knowledge. From another side, managers should enable the culture acquisition and dissemination at the team level. This could reduce the individual resistance of the usage of a new technology, which can determine the failure of the technology introduction process.

As with any empirical field study, this work has limitations. A longitudinal study can provide some more relevant considerations and implications. Therefore, this study should be reiterated over time in

order to catch the temporal effects of collective variables on the individual usage of a new technology. Moreover, we did not have access to the demographic data of not-respondents and we were not able to verify the existence of any significant differences between respondents and not-respondents.

Some issues for future research emerge from this study. Following Fichman's (2004) suggestion it would be interesting to integrate further theoretical perspectives (e.g. mindfulness perspective) in facing the study of technology adoption process, through both collective and individual variables. Despite we believe that the system we considered embodied a set of characteristics that are common to other systems and are not peculiar, future research should validate our results in other settings and adopting different technologies in order to increase the generalizability of our findings and our theoretical framework. Moreover, the results are based on the Italian context suggesting future researches in other national and cultural settings.

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