The Role of Employees in Digital Transformation: A Preliminary Study on How Employees' Digital Literacy Impacts Use of Digital Technologies

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Abstract

Even though digital technologies such as cloud technologies are prevalent in transforming businesses, the role of employees and their digital skills in the process is, to a large extent, neglected. This study brings forward the novel concept of digital literacy to explore the role of employees in understanding the wide variety of opportunities of digital technologies and their actualization. By treating digital literacy as the antecedent of cognitive behavior of employees in utilizing cloud technology at companies, we apply the Theory of Planned Behavior (TPB) for analyzing preliminary empirical data collected from 124 Australian employees' technology use intentionality and behavior. The quantitative analysis shows that the TPB holds for the utilization of cloud technology and there is a positive relationship between employees' digital literacy and the utilization of cloud technology at companies. Overall, the study contributes to the technology management literature by offering a workable construct to measure the digital skills of employees in the form of digital literacy. Further, it expands the TPB framework by introducing digital literacy as a perceived behavior control variable that helps to examine the role of employees in digital transformation. The paper ends with implications and limitations of our preliminary study, followed with suggestions for future studies.

Keywords: digital literacy, cloud technology, digital transformation, Australia, Theory of Planned Behavior

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I. INTRODUCTION

Digital transformation refers broadly to the change associated with digital technologies (such as the Internet of things, artificial intelligence/machine learning, augmented reality, in-memory computing) in an organization [1]. Once these technologies are adopted, organizations go through changes in their activities, organization, infrastructure, and people that improve organizational performance [2, 3]. The existing literature on digital transformations, to a large extent, focuses on customers while it ignores the role of employees in this process [4]. A recent study [5] mentions that the greatest challenge in many organizations for digital innovation is finding a way of effectively engaging employees with technologies. The significant themes related to employee engagement seem to be related to the use of technologies [6, 7]. These themes refer to "using digital tools to facilitate collaboration across boundaries, develop skills, or share knowledge across the organization" [8, p.6]. Since the literature neglects the role of employees and their digital skills in the actualization of digital technologies, there are calls for researchers to shift their focus from the features of digital technologies to how people and organizations could engage with them in organizations [9, 10]. Some studies do not limit the scope to digital technologies and extend the invitation to researchers in the knowledge management field so that the relationship between human resource management and technology could be better understood [11].

Organizations need to equip their workforce with digital skills to meet their organizational objectives if they want to benefit from their investments in technologies [4, 9, 12]. That is why this paper aims to explore the role of employees in understanding the wide variety of opportunities of digital technologies and their actualization [13, 14]. We assert that digital literacy, a competence consisting of the abilities of employees in utilizing digital technologies in work-related practices, could enhance the utilization of digital technologies at the firm level. This assertion is drawn on the Theory of Planned Behavior (TPB) [15] that allows to explore the interactions among employees' technology use intentionality and behavior.

The research focused on one type of digital technologies, cloud technology (CT) such as Office 365 and DropBox. These technologies refer to a wide range of on-demand availability of computer system resources without direct active management by the user [16]. A study [17] pointed out that cloud computing can bring benefits to organizations in terms of cost saving, efficiency improving, agility enhancing, and so on. In fact, Omar et al. [18] and Sari et al. [19] found that IT cloud technology enhances productivity in the context of government service work and manufacturing, respectively. Thus, if CTs could be fully adopted, they can become effective tools in increasing overall work efficiency and productivity, increasing organizational competitiveness.

In our study, we developed a workable construct to measure the digital literacy of employees at organizations. Inspired by a European Union study on a general construct developed for assessing individuals' digital literacy [20], we adapted and customized it to measure digital literacy of employees at the organizational level. Then, we surveyed Australian employees working across different sectors and companies, resulting in a collection of 124 responses. The fact that almost half of the Australian businesses use some CTs [21] makes Australia a feasible country to observe the behavior of adoption. We chose cloud technologies, as opposed to other contemporary digital technologies such as blockchains and artificial intelligence, CTs are more widely being used, and employees have had a larger exposure to and understanding of them. We also made this choice in line with the findings of Tabrizi et al. [22] that digital transformation is not about technology. The above authors argue that most digital technologies provide *possibilities* for the organization. However, if employees lack the right mindset and skills to change and if there are defects in the organization's practices, digital transformation will magnify those defects. Thus, this study focuses on the role of employees in digital transformation so that managers could accurately realize the potential of IT cloud technology in increasing productivity and development of products in the workplace.

The paper has six sections. After this introduction, the theoretical background section introduces key theoretical concepts of digital technologies & transformations, CT, and digital literacy. Section 3 presents the TPB and uses it to develop a model to explore the relationship between employee and utilization of CT. Section 4 explains the survey, data, and method used in this study. Section 5 presents the data analysis and findings. The final section concludes the paper by pointing out its contributions to theory and practice as well as by giving suggestions for future studies.

II. BACKGROUND

Digital Transformation

Digital transformation is a process of improving an entity by triggering significant changes to its properties through combinations of information, computing, communication, and connectivity technologies [1]. Digital transformation is widely affecting various industries, particularly healthcare, telecommunications, automotive, banking, and manufacturing sectors [23]. It is an ongoing process of using new digital technologies in everyday organizational life [10]. It enables innovation practices, improved designs, and new business models, and shapes how organizations create value on the Internet.

Digital transformation relies on digital technologies whose key characteristics affect companies by increasing firms' three core capacities: openness, affordance, and generativity [24]. Because of these capacities, digital transformation has the power of transforming companies and industries on a large scale if and only if employees could actualize these capacities [2, 12]. Defining these core capacities could undermine the employees' role in this transformation process.

Openness refers to open innovation practices. Digital technologies decouple the form and function of products and services, resulting in the modularization of tasks at granular levels [25]. For example, Amazon's Mechanical Turk platform attracts vast numbers of contract workers or volunteer contributors from all over the world [26]. Additionally, digital technologies make it possible to manage complex relationships among multiple stakeholders, resulting in many benefits to customers and other network stakeholders [25]. However, open innovation becomes effective and efficient only when employees within organizations have digital skills to engage with these open innovation practices.

Affordance refers to action possibilities or opportunities for action. This capacity points out how digital technologies' realization depends on actors creating and implementing them [27]. For example, Google Maps might become a different innovation for a different user. A hotel would use it as a service to provide directions while integrating into a self-driving car to find the route [28]. If employees are equipped with digital skills, they could make sense of opportunities available to them and turn digital artifacts, digital platforms, or digital infrastructures into different innovations relevant to them and to their company.

Generativity is a capacity of producing unprompted changes through the mechanisms of blending or recombination with the help of many stakeholders [27]. An interesting example is Amazon's Kindle [28]. This digital book device exemplifies how such a product & service bundle has become a reality through the computer industry's complex ecosystem consisting of consumer electronics, Internet search, online retailing, book retailing, telecommunications, and publishing firms' alliances.

In sum, digital technologies offer many opportunities for highly complex products/services and simple products/services into complex ones. That is why any organization investing in digital technologies should prepare their employees to take advantage of digital technologies' capacities.

Digital Literacy

The vast literature seems to ignore a critical pillar of digital transformation in organizations: employees. Understanding the crucial role of employees in digital transformation is essential only because digital technologies are not hardware but involve a wide range of soft aspects that trigger organizational changes [29]. Employees need to be not only ready for change but also become a part of the change. As a study [30] highlights, the main challenge for companies is to adapt their culture, mindset, and competencies to the new, digital way of working rather than technological trends, disruptive innovations, nor new customer behavior. The shift towards culture, mindset, and competencies demands a focus on employees. If they are not digitally literate, it could be highly challenging to survive digital transformations [31]. For example, an article by Meister [32] presents the increased use of chatbots as the digital co-workers, meaning a piece of software that works alongside you at your job and participates in the day-to-day activities of your company as an active and engaged member of the team. However, if employees are not ready for this kind of digital technology applications, the practices related to employee experience will not create a personalized, compelling, and memorable environment for employees. It will instead generate information overload on employees [33].

The notion of digital literacy is increasingly being used in academia and practice for referring to employees' skills, knowledge and abilities to interact with digital technologies [5, 31]. Hence, digital literacy is beyond traditional literacy perception limited purely to the ability to read, write and use printed texts in various contexts [34]. UNESCO [35] describes digital literacy as a set of basic skills required for working with digital media, information processing and retrieval.

Despite the increasing interest in understanding people's digital literacy, it has mostly been studied at the individual level and used widely in the education sector [20], leaving the organizational level with little attention [4]. Few studies that recognize the role of digital literacy at the organizational level highlight the embeddedness of literacy practices in culture, knowledge, and action [36]. However, these studies are mostly conceptual rather than empirical studies [4, 34, 37, 38]. An interesting empirical study is Bartolomé et al. (2018) which uses the European model [20] called “The Digital Competence Framework for Citizens” (DigComp) to assess digital literacy at the organizational level. However, all these efforts limit the idea of digital literacy to a constellation of computer skills. For example, the ECDL Foundation runs an end-user computer skills certification program for individuals searching for jobs based on the DigComp model [20].

Given the above, this paper considers digital literacy as a competence that consists of the abilities of employees to utilize digital technologies to perform their work [39]. By doing so, it perceives digital literacy as a synonym for expressions such as knowledge, competence, and learning rather than traditional literacy perception limited purely to the ability to read, write and use printed texts in various contexts [34]. Nevertheless, more importantly, as highlighted by Messick [40], competence shows a capacity reflecting what a person knows and can do under ideal circumstances. However, within a company context, this potential might never be realized. That is why it is important to understand how a person’s knowledge could become a situated behavior.

Theoretical underpinning

Employee actions/individual behavior is actively constructed by technology users in their everyday practices through both doing and interpreting in their workplaces [30]. Previous studies on technological usage focused on attitudes and perceptions of technologies themselves. However, considering this theme in terms of technology management in an organization, it should be important to consider technology from a socio-technological perspective. The theory of planned behavior (TPB) provides a useful framework for considering how people form their perceptions, attitudes, and behaviors [15].

This study adopts the concept of TPB and analyzes the process of corporate employees' use of cloud technology. Our proposed model offers a set of concepts related to human behavior that is widely used to analyze various phenomena, ranging from entrepreneurial behavior [41], crowdfunding investments [42], online public service use [43] to cloud computing classroom [44]. The current paper seeks to address the gap between digital literacy and the utilization of cloud technology by introducing a cognitive perspective into understanding employees' technology utilization behavior. Such an approach recognizes that everything we do is influenced by mental processes through which we acquire, transform, and use technologies. In other words, we pursue that the utilization of technology at the workplace is a planned behavior where the role of the employee is as important as the senior management, who decides on investing in the technology in the first place [42]. Here, the assumption is that individuals, in our case employees, using CT are subject to preliminary conditions such as their digital literacy. Further, we answer calls to strengthen the role of employees in digital transformation literature [1, 10]. To date, research has mostly ignored the prospective influence of digital literacy/digital skills of employees as a cognitive antecedent in employees' behavior, the use of digital technologies.

Our proposed model in Figure 1 is driven from the TPB, a theory that "predicts and explains human behavior in specific contexts" [15, p.181]. It is proposed that intentions are involved in behavior, and that three factors (Attitude toward the behavior, Perceived behavioral control, and Subjective norm) affect the intentions [15]. Attitude toward the behavior refers to a person's (favorable/unfavorable) evaluation of the behavior in question. Perceived behavioral control refers to the perception of the ease or difficulty of performing a behavior. Subjective norm refers to the perception of social pressures that influence the implementation of a behavior.

We argue that perceptions of employees about the technology shape the “attitude” in the minds of employees, which is technology readiness in our case. In other words, employees develop an attitude towards cloud technologies based on their cognitive evaluations. Then, this attitude produces the formation of a desired “behavior,” the actual act of using cloud technology. That is why our model depicts how the actual use of technology as an “activity/behavior” is a complex outcome of perceptions and attitudes where being literate on technology makes a difference.

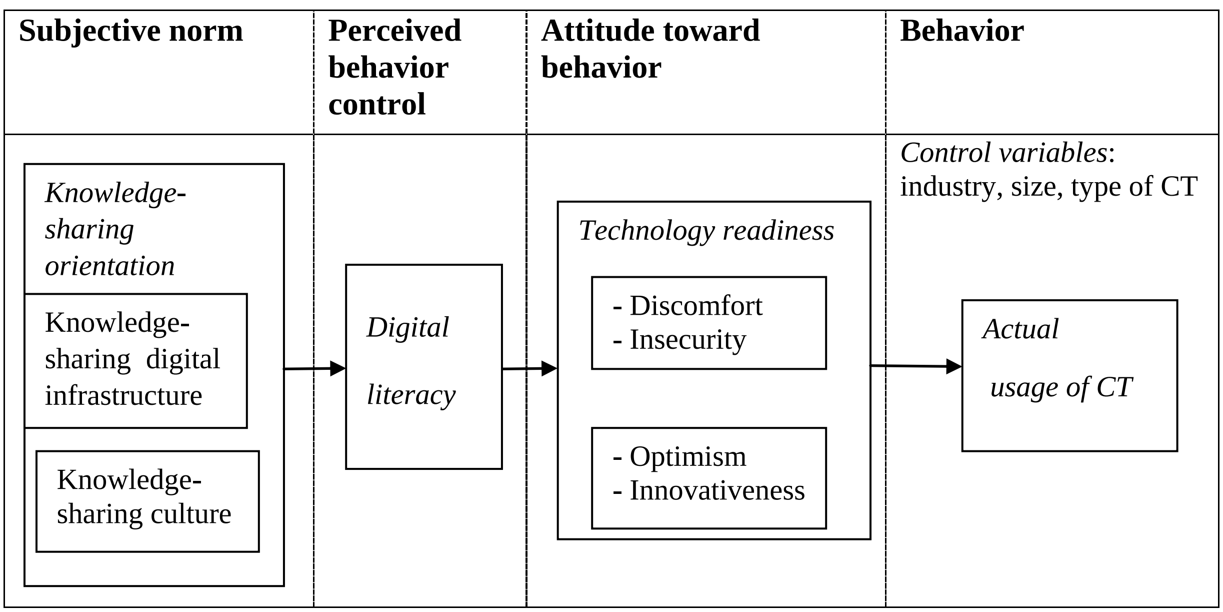

Figure 1. The TPB on employees’ cloud technology usage.

III. THE MODEL AND HYPOTHESIS DEVELOPMENT

Knowledge-sharing orientation- *Subjective norm*

Knowledge-sharing means the propensities that help firms facilitate knowledge management efforts through a process whereby individuals, teams, business partners exchange knowledge [45]. Knowledge and ideas are intangible, so individuals should interact and share knowledge and ideas to establish new routines and mental models (Davenport & Prusak, 1998) [46]. A firm that promotes employees to contribute knowledge within groups and organizations is likely to generate new ideas and develop new business opportunities, thus facilitating innovation activities [47]. When a firm has a high degree of knowledge-sharing capabilities, it is expected that it will more likely develop unique and rare knowledge that is difficult for rivals to replicate [48]. Similarly, when employees are willing to cooperate with colleagues to contribute knowledge to the firm, they can generate collective learning and synergistic benefits through exchanging knowledge and resources, thereby increasing the potential for process improvement or novel products [49]. Knowledge-sharing could be carried out either through values, encouragement, and motivations. In other words, as knowledge-sharing culture or through the supply of supporting mechanisms (such as IT practices building knowledge databases) enabling knowledge-sharing to become possible [45, 50]. Hence, drawing on Lin's study [45], knowledge-sharing has two pillars: 1) the IT practice regarding the knowledge repository (such as shared databases) that facilitates employees to search, store, retrieve & use and communicate knowledge, and 2) the perceptions about the process for sharing knowledge,
Given the above, this study hypothesizes the following:

H1: A higher level of knowledge-sharing orientation will lead to a higher degree of digital literacy of employees.

H1a: Knowledge-sharing infrastructure has a positive effect on the degree of digital literacy of employees.

H1b: Knowledge-sharing culture at an organization positively affects the degree of employee digital literacy.

Digital literacy- *Perceived behavior control*

The integrated relationship between users and the technology takes place in a social context [51]. Employees not only can conceive possibilities arising from digital technologies but also put them into use and learn from interactions to adapt their behavior and find new ways of using technologies through their daily practices. Thus, increasing the digital literacy of employees could allow them to take advantage of one or more affordances through their use of digital technologies [14, 47]. In other words, a digitally literate employee becomes motivated, willing to engage with technology. Studies show how digital native employees result in better technology use than digital immigrant employees [52]. If managers could understand the level of digital literacy of their organizations, they could improve it and prepare their workforce for future needs related to digital transformations. Given that the utilization of technology at the workplace is a planned behavior, the digital literacy of employees is the first antecedent for its realization. As we learned from TPB, digital literacy could be treated as the perceived behavioral control, in other words, the person's perception of his/her ability to perform a behavior results in technology readiness, a propensity to use technology [15, 53]. Thus, we conclude the following hypothesis:

H2: A higher degree of digital literacy has a positive impact on technology readiness for CT.

H2a: A higher degree of digital literacy results in a higher level of positive approach/attitude to CTs; and

H2b: A higher degree of digital literacy results in a lower level of negative approach/attitude to CTs.

TR-attitude to behavior

Technology readiness is defined as “people’s propensity to embrace and use new technologies to accomplish goals in home life and at work” [54, p.308]. Regardless of the type of adoption theories, the topic of intention to use technology has been widely discussed in terms of people’s perception of technology and their propensity toward using it [43, 44, 55]. These studies point out that a utilitarian attitude toward technology will positively affect using that particular technology. For example, Parasuraman [53] points out that technology readiness results in a motivational effect on employees through its role in optimism and innovativeness, two sub-dimensions used to refer to positive technology readiness. This is because optimism relates to a positive view of technology and a belief that it offers people increased control, flexibility, and efficiency in employee’s work, while innovativeness relates to a tendency to be a technology pioneer and thought leader. Using the same logic, the original theory developed by Parasuraman (2000) [53] expects that negative attitudes described as discomfort and insecurity, known as negative technology readiness, toward a technology hinders individuals engaged with it. Another study [56] argued that the four dimensions are distinct in terms of the positive side and negative side, and this has been empirically demonstrated in the context of IT usage in financial company [57], self-service technology usage [58], online public services [43], and so on. Therefore, it might be undermined for a better understanding of how the incentive-behavior link works unless we distinguish the positive and negative sides of technology readiness.

Hence, we hypothesize:

H3: A higher level of technology readiness results in a higher use of technology at work.

H3a: A higher level of positive technology readiness has a positive impact on the use of technology at work; and

H3b: A lower level of negative technology readiness has a positive impact on the use of technology at work.

Control variables

This paper has chosen two control variables: the type of CTs and company size to understand how the behavior of employees in our sample that might mitigate any potential spurious interpretations of the findings. The type of CTs could be any one of the three most widely available and used software, namely IaaS (Infrastructure-as-a-Service such as Amazon Elastic Compute cloud, Vmware, Google Compute Engine, or Azure virtual machines), PaaS (Plaform-as-a-Service such as Google App Engine or Microsoft Azure), and SaaS (Software-as-a-Service such as Office 365, DropBox, GSuite, SalesForce, or Slack) [16, 59]. Firm size refers to the number of employees.

IV. METHOD

Sample and data collection procedure

We conducted an online survey and reached out to Australian employees with at least five years of work experience, who resided in Australia and aged above 20. An online survey ensured that respondents had prior experience with using digital technologies in their workplace. We used the online survey infrastructure of Qualtrics, considering the inclusion of questions related to computer use. It has been reported that using a survey service company with an online survey panel is more demographically diverse than otherwise, and that the reliability of the data is comparable to other methods [60]. Moreno et al. [61] conducted a study to understand the use of interactive digital tools among Adolescents. Another work [62] analyzed the relationship between social influence and personality through social media. In light of these previous studies, it is appropriate to use Qualtrics to collect data on the use of digital technology.

Before running the survey, we assessed its readability by receiving feedback from three experts outside the research team. As a result, 124 valid responses were received.

As shown in Table 1, the respondents reported 31 (25%) in the age group of 20-29, 47 (38%) in the age group of 30-39, 23 (19%) in the age group of 40-49, 16 (13%) in the age group of 50-59, and 7 (6%) in the age group of 60 years or older. The gender was male in 65 cases (52%), female in 58 cases (47%), and other in 1 case (1%). Concerning the size of the companies that the respondents belonged to, 31 (25%) were between 5-20 employees, 45 (36%) were between 20-199 employees, and 48 (39%) were more than 200 employees. Respondents were engaged in 9 (7%) in Accommodation and food services, 13 (11%) in Construction, 15 (12%) in Education, 12 (10%) in Financial and insurance services, and 3 (6%) in Financial Services. Information media and telecommunications, Manufacturing, Retail or wholesale trade, and Others accounted for 17

(14%), 6 (5%), 9 (7%), and 43 (35%) cases, respectively. For industry selection, we categorized respondents with checks in more than one industry as Others because we allow multiple responses. Thus, data were obtained from respondents engaged in a wide range of industries.

Table 1. Characterization of the survey respondents

Variables		n	%	Variables		n	%
Age	20-29 years	31	25.0	Industry group	Accommodation and food services	9	7.3
	30-39 years	47	37.9		Construction	13	10.5
	40-49 years	23	18.5		Education	15	12.1
	50-59 years	16	12.9		Financial and insurance services	12	9.7
	More than 60 years	7	5.6		Information media and telecommunications	17	13.7
Gender	Male	65	52.4		Manufacturing	6	4.8
	Female	58	46.8		Retail or wholesale trade	9	7.3
	Other	1	0.8		Other	43	34.7
Company size	Between 5-20 employees	31	25.0				
	Between 20-199 employees	45	36.3				
	More than 200 employees	48	38.7				

Instrument

The constructs used in this study are described in detail in Table 2. The questions in the survey came from previously tested and validated instruments in the literature; digital literacy [20], technology readiness [54, 56], knowledge-sharing orientation (Lin, 2015)[50], and actual usage of CT [16]. Considering that the digital literacy construct has been designed for individual evaluation without any company or specific technology connotation, we adapted it to employee context. We changed the expressions to fit with CT, as shown in Table 2. Regarding technology readiness, we changed the expression of technology to cloud-based technology to emphasize the context of this study.

Responses were measured on a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree), or from 1 (extremely incompetent) to 5 (extremely competent) for questions about one’s ability. Frequency questions were measured at 1 (never), 2 (rarely), 3 (about half the time), 4 (often), and 5 (always), and treated as an interval measure in the analysis.

In this paper, control variables are company size and type of CTs. The Australian company size classifications shaped our categorization [63]: Micro firms (less than five employees), Small firms (5-19 employees), Medium-sized (20-199 employees), and Large (200 and more). The question about the use of CTs included a classification of CTs, as shown in Table 2, namely IaaS, PaaS, and SaaS.

As shown in Table 2, all the constructs used in this study yielded consistent results on the indicators of internal consistency (Cronbach's α, Average Variance Extracted (AVE), and Composite Reliability (CR)). First, Cronbach's alpha values are all above 0.7, which means high internal consistency. For AVE, a value of 0.5 or higher is also preferred (Fornell & Larcker, 1981; Joe et al., 2014???) [64, 65]. Our results satisfy the recommendation with AVE values in the range of .572 to .712. Furthermore, the CR values below 0.7 are considered to have low reliability (Grewal, Cote, & Baumgartner, 2004) [66]. The present study results show that CR values exceed that requirement in the range of 0.729 to 0.866. From the above, the data we are dealing with show sufficient reliability and convergent validity for the constructs.

Table 2. Standardized loading and reliabilities for measurement

Construct	**Standardized loading**	**alpha**	**AVE**	**CR**
Digital Literacy		. 928	. 572	. 866
Information and data literacy	. 562	. 811		
I am confident in browsing, searching, filtering data, and information & digital content.				
I regularly use cloud information storage services or external hard drives.				

I verify the sources of the information I find.				
Communication and collaboration	. 663	. 830		
I actively use a wide range of online communication tools at work.				
I choose digital tools and technologies for collaborative processes.				
I have net-etiquette (differentiate behavioral norms) while using CT and interacting in digital environments.				
Digital content creation	. 873	. 818		
I can produce complex digital content in different formats (e.g. images and video).				
I can apply advanced formatting functions of different tools (e.g. mail merge) to the content I or others have produced.				
I respect copyright and license rules and I know how to apply them to digital information and content.				
Safety	. 731	. 830		
I am able to apply advanced settings to some software and programs.				
I periodically check my privacy settings and update my security programs (e.g. antivirus) on the device(s) that I use to access the Internet.				
I am able to select safe and suitable digital media, which are efficient and cost-effective in comparison with others.				
Problem solving	. 898	. 814		
I am able to solve a technical problem or decide what to do when technology does not work.				
I can use digital technologies (devices or services) to solve (non-technical) problems.				
I am able to use varied media to express myself creatively (i.e. images, video).				
Technology Readiness to CT		. 813		
Positive TR		. 855	.712	.835
Optimism	. 840			
CT makes me more efficient in my occupation.				
CT give me more freedom of mobility.				
Innovation	. 853			
Other people come to me for advice on new technologies.				
I find myself have fewer problems than other people in making technology work for me.				
Negative TR		. 711	.579	.729
Discomfort	. 865			
Sometimes, I think that CT are not designed for use by ordinary people.				
When I get technical support from a provider of a high-tech product or service, I sometimes feel as if I am being taken advantage of by someone who knows more than I do.				
Insecurity	. 640			
I do not consider it safe to do any kind of financial business online				
I worry that information I send over the Internet will be seen by other people.				
Knowledge-sharing orientation				
Knowledge-sharing culture		. 849		
My organization shares knowledge…				
between individuals				

across teams				
throughout the organization				
among our business partners				
Knowledge-sharing digital infrastructure		. 877		
My organization builds a knowledge repository (such as shared databases) that facilitates employees to...				
search for new knowledge				
store ideas and knowledge				
retrieve and use knowledge				
communicate with colleagues				
Actual usage of CT		. 826	.610	.824
How often do you use SaaS for work?	. 772			
How often do you use PaaS for work?	. 763			
How often do you use IaaS for work?	. 808			

Note: AVE: Average Variance Extracted, CR: Composite Reliability

Analysis

The data were analyzed using SPSS software, and the hypothetical model was analyzed with AMOS 22, a structural equation modeling (SEM) software. The SEM method helps identify relationships and mediation effects among latent variables that can be defined from the observed variables [67]. Besides, the AMOS's suggested modification feature allows researchers to improve the model fitness (e.g., [68]). For the mediation effect, following Preacher & Hayes' [69] suggestion, we used the bootstrap confidence interval method with 10,000 resample and bias-corrected 95% confidence intervals to test it.

Since we achieved high reliability and validity of all constructs, the subdivisions of digital literacy (information and data literacy, communication and collaboration, digital content creation, Safety, and Problem-solving) are represented by the mean of each observed variable. In the same way, the sub-items of technology readiness (optimism, innovation, discomfort, insecurity), knowledge-sharing culture, and knowledge-sharing digital infrastructure are similarly represented by the mean value of the variables.

V. RESULTS

As shown in Figure 2, the goodness-of-fit statistics were χ^2 = 85.085, *df* = 63 ($\chi 2/df$ = 1.351), *p* = 0.033, GFI = 0.918, RMSEA = 0.053, NFI = 0.924, CFI = 0.979 and TLI = 0.969, which were satisfied the recommendation of [70] and [68].

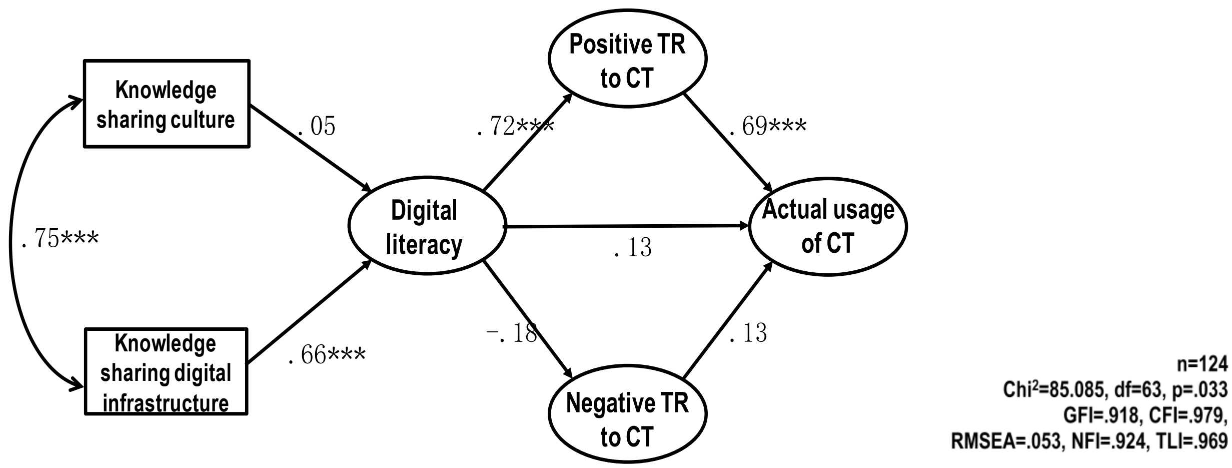

Figure 2. Statistical findings for the TPB on employees' cloud technology usage

Based on TPB model, the characteristics of the path coefficients can be summarized as follows.

- As shown in H-1a (Higher IT practices designed for knowledge-sharing will facilitate higher digital literacy of employees), there is a significant positive relationship between knowledge-sharing digital infrastructure and digital literacy (β = .656, p<.001).
- As shown in H1b (Higher knowledge-sharing culture at an organization will facilitate a higher degree of employee digital literacy), there was no significant relationship between knowledge-sharing culture and digital literacy (β = .048, n.s.).
- For H2 (Higher digital literacy will result in higher levels of technology readiness for CT), digital literacy has a positive effect on positive readiness for CT (β = . 718, p<.001). On the

other hand, digital literacy was negative for negative readiness for CT, but it was not significant (β = -.177, n.s.).

- For H3 (Higher technology readiness result in higher use of CT at work), positive technology readiness had a positive and significant effect on actual usage (β = .689, $p<.001$). On the other hand, negative technology readiness had no significant effect on actual usage (β = . 132, n.s.).

Following the TPB, we have shown the relationships in a chain effect mode. In other words, digital literacy was effective through the mediation of positive technology readiness. However, we wanted to see the reliability of this mediation and the strength of our model. To do so, we statistically checked if there is a direct impact of digital literacy on the actual use of CT. To test this, we did the following analysis and found the following result, as shown in Table 3:

- Improving digital literacy encourages the actual use of CT. However, there was no direct effect from digital literacy to actual use (β = . 132, n.s.). A positive indirect effect via positive technology readiness was found to be reliable (β = .495, $p<.05$, CI[.232, .948]). On the other hand, the indirect effect via negative technology readiness was unreliable (β=-.023, n.s., CI[-.174, .016]). Since the direct effect from digital literacy to actual use was not significant, we show that the indirect effect through the positive technology readiness between digital literacy and actual use.

Table 3. Results of SEM analysis

Parameter	beta	p-value
Knowledge-sharing culture → Digital literacy (DL)	.048	.623
Knowledge-sharing digital infrastructure → Digital literacy (DL)	.656	***
DL → Positive side of TR on cloud technologies (P-TR)	.718	***
DL → Negative side of TR on cloud technologies (N-TR)	-.177	.232
DL → Actual usage of CT	.132	.310

P-TR → Actual usage of CT	.689	***
N-TR → Actual usage of CT	.132	.155
		Bias-corrected 95% CI
	beta	Lower/Upper
DL→ P-TR →AU	.495*	.232 / .948
DL→ N-TR →AU	-.023	-.174 / .016

Notes: TR- technology readiness; AU - actual usage; DL- digital literacy

As an additional consideration, we examined the relationship between the level of digital literacy and the mean score of CT-actual usage and firm size in ANOVA (analysis of variance), where the level of digital literacy is defined as a factor score, separated by 25%, 50%, 75%, and 100% percentile, with a grade of 1 to 4 for each index. Since digital literacy was found to affect the actual use indirectly, we can assume the linear trend that the higher the digital literacy level, the higher the use of CT. ANOVA helps us to understand how firm size affects this trend. The result of ANOVA revealed a significant difference in the interaction between "Size of the company" and "Level of digital literacy" ($F(6,112)=2.371$, $p<.05$). This finding indicates that two factors, "size of company" and "level of digital literacy," seem to influence the use of cloud technology in an interactive manner. We also found that in the 5-20 and 200-199 firm size groups, the use of cloud technology increased as digital literacy increased, but this was not necessarily the case for firms with 200 or more employees. Note that the Tukey's post hoc test also revealed a significant difference at the 5% level for firms with 200 or more employees compared to those with smaller sizes, as shown in Figure 3. The results of the analysis showed that employees in firms with more than 200 employees did not necessarily have a linear relationship with the actual usage of CT in terms of digital literacy levels. On the other hand, for small firms with 5-20 employees, there is a linear relationship between digital literacy and actual use, which is more compatible with our original assumption.

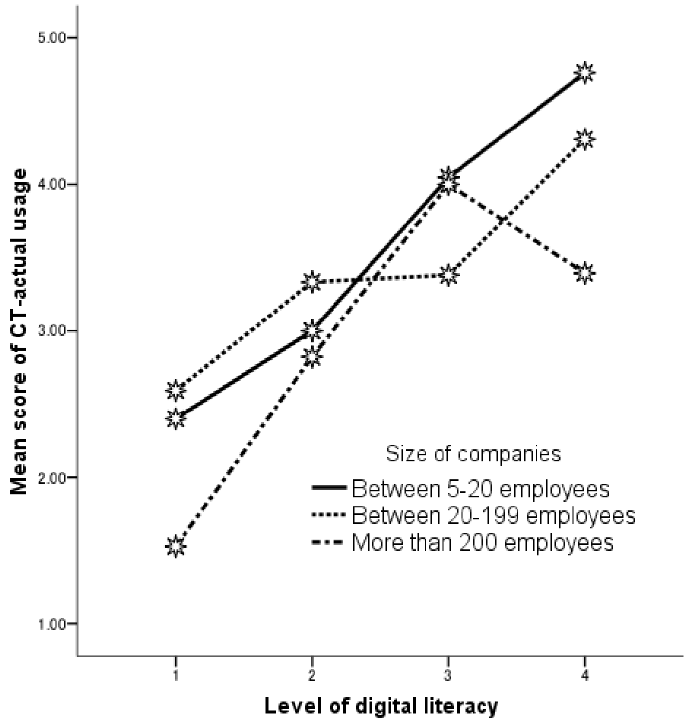

Figure 3. Result of two-way ANOVA

VI. DISCUSSION AND RESEARCH IMPLICATIONS

Key findings

The study is driven by the literature gap in terms of understanding the role of employees in digital transformation. Digital technologies such as CT help organizations to develop capacities of openness, affordance, and generativity. Nevertheless, organizations investing in digital technologies might fail if they cannot simultaneously prepare their employees to use them [7, 25].

Our model depicts the antecedents of the behavior of employees in the context of using CT. We do this by providing support for both the conceptual application of the TPB in a unique context and highlighting the importance of the two perceptional components, namely knowledge-sharing digital infrastructure and digital literacy in predicting actual technology use behavior. While the importance of knowledge-sharing digital infrastructure has been shown in previous studies [38], our study is one of the few studies highlighting the role of digital literacy in CTs use [39, 71]. Under the influence of these perceptions, employees go through cognitive evaluations that help them get ready to adopt and use CTs. That is why we argue that our model offers insights into the role of cognitive antecedents of technology use behavior of employees. In particular, the model helps to link both individual-level employee perceptions of their digital literacy and their perceptions of company-level availability of knowledge-sharing digital infrastructure to the outcome of using technologies. This finding shows the importance of knowledge management practices of companies in digital transformation that can produce high performance by the adoption of new digital technologies as recent work claims [11].

In this paper, five leading indicators (*Information and data literacy, Communication and collaboration, Digital content creation, Safety, and Problem solving*) as digital literacy were adapted to corporate employees' context. In other words, digital literacy includes the ability to gather information, to share ideas creatively with others, and to take control of technologies to do tasks safely and effectively. Since digital literacy is important for CT usage behavior, organizations need to develop their employees' internal perception of those abilities. As for the ability to control technologies, if the problems to be solved are clearly defined, it can be naturally enhanced by increasing proficiency by learning the technique. On the other hand, in a competitive environment with high uncertainty, gathering information and sharing creative ideas with others is essential. To increase the internal perception of these factors, employees must be aware of the uncertainty in their work. It is also necessary for organizations to encourage information seeking and communication with others and to motivate the use of IT for these purposes, as shown by the significant effect of *Knowledge-sharing digital infrastructure* factors on digital literacy in the structural equation modeling analysis.

Implications for theory

The study contributes to theory in two ways. First, it offers a useful novel construct to measure digital literacy at the organizational level that assesses employees' cognition. We define and measure digital literacy as a competence consisting of the abilities of employees in utilizing digital technologies in work-related practices resulting in the use of technologies [4, 20, 23]. Second, our findings show that all TPB [15] antecedents functioned as predicted by the theory, with significant positive effects of technology readiness (attitudes to behavior), digital literacy (perceived behavioral control), and knowledge-sharing orientation (subjective norm) on the use of technology behavior. In other words, as we asserted, digital literacy representing the cognition of employees has a critical role in the outcome of technology adoption. By integrating the concept of digital literacy, our study expands the TPB framework, allowing it to examine the relationships between employee and digital technology utilization [10, 42].

However, the study observes two key unexpected findings as well, and they might help guide future studies. First, even though perceptions on knowledge-sharing digital infrastructure positively influence digital literacy, social norms defined as a knowledge-sharing culture did not show such an effect on digital literacy. Digital technologies have been a key element of knowledge orientation in companies [38], so it is natural to have a high impact on digital literacy. A potential explanation for not observing a parallel impact of knowledge sharing culture on digital literacy might be company size. As shown by our data, employees are more willing to share knowledge with their peers in small firms. Hence a stronger knowledge-sharing culture can be observed. That is why we argue that in small firms, digitally literate employees tend to use digital technologies themselves and share ideas and know-how of technology usage (that means it is easy to utilize digital literacy) with their peer employees. Deloitte study [72] finds the radical impact of the cloud on small businesses. In contrast, large companies might find it challenging to use culture to influence digital technologies [73]. Anim et al. [74] stated that organizational and human capacity development for effective use of digital technology platforms is essential for digital transformation in SMEs. Our study reinforces that finding and also suggests the importance of improving digital literacy as human capital development.

Second, the study shows that the negative attitude of technologies is not affected by the level of digital literacy of employees and does not influence technology adoption. A study on the attitude of scientists in genomics discipline shows that experts in a discipline are more likely to be an optimist [75]. By making a parallel analogy, digital literacy might contribute to feelings of optimism among staff rather than affecting employees' feelings of discomfort and insecurity. Hence, it increases the mediating role of positive technology readiness in generating the actual use of technologies.

Overall, our study distinguished and clarified the roles of different variables by adopting the TPB into our case, which brings a fresh breath of air to the efforts of solidifying the firm-level digital transformation phenomenon. This distinctive formulization and refinement might also provide a more vibrant and more robust contribution to the literature in terms of the role of employee (as the level of digital literacy) in the utilization of digital technologies and increasing company performance [8, 76]. We hope that simultaneously addressing the technical and social elements of organization design are needed to ensure that human beings are the masters of technology, not its slaves [77].

Implications for practice

We adapted a construct initially developed to assess individuals' digital literacy and applied it to organizational context by measuring the digital literacy of employees related to CTs. The construct's high statistical explanatory power allows us to offer it as an empirical contribution to future studies.

However, more importantly, we believe that our contribution could bring many advantages to companies. Since the focus is on employees, our model shows how employees' values/perceptions determine their technology use behavior. Explicitly, understanding digital literacy and its antecedents could give managers a tool to understand the learning, adaptability, and absorptive capacity of their workforce to improve their knowledge management. Literature shows that prioritizing employees' focus on organizational practices results in innovations [78]. Besides, generating a learning and agile organization environment promotes employee empowerment, increase collaboration, and build relational coordination [79]. Many work practices in digital organizations include team-based design, information sharing, aggregate compensation strategy, flexible job design, and employee training [80, 81]. In order to carry out this kind of activity, companies need to assess the digital literacy of their employees. Also, they need to understand gaps in their digital capacities to design and implement their work practices allowing the utilization of digital technologies.

Limitations and suggestions for future studies

This study has four limitations. First, it was conducted in one country, Australia, by studying across industries. It is necessary to be cautious about generalizing the findings to different countries, particularly countries with immature IT infrastructure. Future studies might consider conducting in-depth studies in particular industries to see if contextual features might change behavior. Second, the study collected data from 124 individual Australian employees. Although the results of the analysis are statistically good, we acknowledge that our sample size is relatively small. That is why researchers could conduct large-scale surveys to verify the findings further. In these large samples, it could become possible to have numerous fine-tuned analysis for each variable. For example, 39% of employees in the existing study has indicated that they work in large (200 and more) organizations, however there is no possibility to make comparisons for various levels of largeness. Being able to have more data on company size could help to resolve our conflicting results as well. For example, we find out that even though perceptions on knowledge-sharing digital infrastructure positively influence digital literacy, social norms defined as a knowledge-sharing culture did not show such an effect on digital literacy. Large data sets might help to tackle with these kind of unexpected results mentioned above. Third, the study examined only one technology, CT. However, many other digital technologies, such as the Internet of Things or Big Data, should be considered for future studies [47]. Fourth, the study focuses on a linear chain of relationships based on TPB model, leaving aside any potential feedback that might occur through behavior. A study analyzing the impact of PaaS on software engineers [82] has shown that the use of cloud computing technology can transform technology-mediated collective learning activities by helping to remove barriers to rapid feedback. Future studies might investigate how feedback mechanisms work among variables representing the TPB model presented in this paper.

VII. CONCLUSION

This study addressed a lack of attention to employees in the digital transformation process at the firm level and sought to explore the relationship between employees' digital literacy and the utilization of digital technologies. Our preliminary findings show that the cognition of employees in the form of digital literacy plays a vital role in the use of CTs.

Overall, our empirical work contributes to the technology management literature in two ways. First, the study develops and tests a workable construct to measure the digital skills of employees in the form of digital literacy [4, 83]. Second, it expands the TBF framework by integrating the novel digital literacy concept. This expansion makes it possible to apply the TBF framework in examining the role of employees in digital transformation, as exemplified with the case of Australian employees' cloud technology use intentionality and behavior. Thus, our findings offer an extension to the recent discussions in the literature by filling the gap on understanding the role of employees in the process of actualization of digital technologies [1, 3].

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