The Moderating Role of Democratization Culture: Improving Agility through the Use of Big Data Analytics

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Abstract

Big data analytics (BDA) is considered an enabler of agility by helping organizations perform more informed and faster decision making. To achieve agility, firms need a backbone of stability, such as organizational culture. However, there is a dearth of research examining the relationship among agility, BDA use and organizational culture. In this regard, considering increasing attention given to data democratization in business, this paper introduces 'democratization culture' which values sharing of knowledge and acceptance of diversity. Assuming organizational culture as a contextual factor, our research examines the moderating effect of democratization culture on the relationship between BDA use and agility. Also, BDA use is classified into advanced and basic use based on functions and BDA types. Research model is empirically validated through data collected from 304 senior-level managers, confirming that democratization culture has different moderating effects, depending on whether agility is influenced by advanced or basic use of BDA.

Keywords: Agility, stability, organizational culture, democratization culture, BDA use

Introduction

In today's volatile business environment, agility is considered as a critical capability to identify and effectively respond to threats and opportunities with speed (Goldman et al. 1995; Sambamurthy et al. 2003; Tallon 2008). To achieve agility, big data analytics (BDA) has recently been employed by organizations to speed up decision making, facilitate communication and respond quickly to changing conditions (Chatfield and Reddick 2018; Ghasemaghaei et al. 2017; Mandal 2018). BDA is known as a holistic approach to managing, processing and analyzing the 5V data-related dimensions (i.e., volume, variety, velocity, veracity and value) (Wamba et al. 2017). As firms face an unprecedented explosion of big data with the growth of the Internet, social media and mobile devices (Liu et al. 2016), the importance of BDA has gained considerable significance. Hence, firms have attempted to improve agility by taking advantages of BDA which helps them better understand market and support more informed and faster decision making (Brown et al. 2011; McAfee et al. 2012).

On the other hand, in order to achieve agility, firms need to build a backbone of stability because it strengthens the reliability of the organizations and allows them to effectively handle the swift pace of change (Aghina et al. 2015; Ahlbäck et al. 2017; Dany and Hasan 2017; Gregory et al. 2015). In this regard, recent studies have denoted organizational culture as a source of stability that helps firms change their structures, processes and resources in the pursuit of agility (Aghina et al. 2015; Nold and Michel 2016). The importance of organizational culture is also emphasized in the realm of BDA; for example, some industry reports regarding BDA have attached importance to a data-driven culture that encourages effective decision making based on data (Chin et al. 2017; Davenport 2006; Kiron et al. 2011).

However, there is a dearth of research which has looked at the relationship among agility, the use of BDA and organizational culture. Though some studies try to explain the impact of organizational culture on data analytics or agility, they usually describe ambiguous accounts of what organizational culture is and how it might influence BDA use or agility (Crocitto and Youssef 2003; Davenport 2006; De Smet et al. 2018; Germann et al. 2013; Kiron et al. 2014; Nold and Michel 2016). For these reasons, it remains unclear what kind of organizational culture effectively relates to BDA use and agility. To reduce this void, our paper attempts to provide an enhanced understanding about organizational culture by explaining under what cultural conditions BDA use will lead to agility.

'Democratization of data' has recently come into discussion in multiple industry reports suggesting that data should be democratized to facilitate the use of data analytics (Díaz et al. 2018; Kiron et al. 2011), which in turn, is likely to improve agility (Kitchens et al. 2018). In order to realize the democratization of data, this paper assumes that firms should implement organizational culture that values the sharing of ideas, opinions and insights across the company. In this light, the present study introduces 'democratization culture' based on extensive literature review related with topics of democratization. Through the literature review, the study has deduced consistent meanings of democratization, which is the extended access to information, and readiness to accept diverse opinions in an organization. Hence, 'democratization culture' in this study is defined as an organizational culture that values the sharing of knowledge and willingness to accept diversity on the basis of new knowledge.

In addition, collectivism is employed as an additional organizational culture in this research. Since the cultural pattern of collectivism has been verified to be conducive to cooperation which is a critical element of agility (Gligor and Holcomb 2012; Palmer 2000; Wagner III 1995), prior studies have examined the impact of collectivism on agility or flexibility (Lin et al. 2015; Liu et al. 2015). However, to our knowledge, there have been no studies that investigate the role of collectivism in the link between BDA use and agility. Also, a comparison between democratization culture and collectivism in a single model setting is expected to clearly identify the characteristics and role of democratization culture, from which the study will further elaborate later.

As for the use of BDA, this paper classifies the use of BDA into two categories: advanced and basic use of BDA based on functions and the types of BDA being used (Barton and Court 2012; Chatfield and Reddick 2018; Chin et al. 2017; Díaz et al. 2018; Sivarajah et al. 2017). Prior research has broadly defined the use of BDA as a single factor and examined its impact on agility (Chatfield and Reddick 2018; Ghasemaghaei et al 2017). However, since different kinds of BDA are built for their respective purposes, it is assumed that the impact of BDA use on agility would differ by functions and the types of BDA being utilized. Thus, this classification of BDA use is expected to provide a more in-depth understanding about how each BDA use affects agility.

In the pursuit of understanding the relationship among agility, the use of BDA and organizational culture, this study assumes organizational culture as a moderator in explaining the relationship between BDA use and agility. This is because organizational culture is often posited as a contextual factor that moderates the relationship between technology use and the consequence of use (Lee and Lee 2003). In this light, the present paper raises three research questions: (1) Does advanced use of BDA and basic use of BDA respectively improve agility and if so, is there any difference concerning the impact of each BDA use on agility?; (2) Is there the moderating effect of democratization culture on the relationship between the use of BDA (i.e., advanced and basic use of BDA) and agility?; and

(3) Is there any difference between the moderating effect of democratization culture and that of collectivism? By empirically identifying these research questions, this paper is expected to provide meaningful insight about the role of democratization culture in explaining the mechanism where the use of BDA (i.e., advanced and basic use of BDA) affects agility.

To examine the research questions stated above, this study performed quantitative research with data collected from 304 senior-level managers and executives. The rest of this paper proceeds as follows: after a review of the literature, hypotheses and research model are suggested. Then, methodology and data collection are described. Along with result, conclusion, discussion and implications are followed. Lastly, limitations and future research are proposed.

Literature Review and Hypotheses

Agility

In complex and volatile environments, agility has emerged as a firm's ability to detect and seize market opportunities for business success (Dove 2002; Roberts and Grover 2012; Sambamurthy et al. 2003). The study generally defines agility as an organizational capability to identify and respond to competitive market opportunities by assembling requisite assets, knowledge and relationships with speed (Goldman et al. 1995; Sambamurthy et al. 2003). With increasing amount of data continuously flowing in real time from many different sources (McAfee et al. 2012; Wamba et al. 2015), firms recently have tried to improve agility by taking advantage of BDA (Ghasemaghaei et al. 2017; Mandal 2018). The utilization of BDA is known to help organizations better and more quickly understand their markets, make timely business decisions and rapidly leverage opportunities by effectively analyzing data (Chen et al. 2012; Zhou et al. 2018). In this respect, this paper attempts to examine the mechanism where the use of BDA influences agility.

The Use of Big Data Analytics

With the growing torrent of big data, BDA has evolved to implement a range of tasks from the production of management reports to advanced data-driven analyses (Chatfield and Reddick 2018; Kamioka et al. 2017; Sivarajah et al. 2017). Since each type of BDA is built for respective purposes and functions, organizational outcomes may differ depending on what kind of BDA is utilized. However, to our knowledge, prior studies have broadly defined the use of BDA as a single factor (i.e., the use of a single analytics tool), and examines its effect on agility (Chatfield and Reddick 2018; Ghasemaghaei et al. 2017). Hence, based on functions and types of BDA being used (Barton and Court 2012; Chin et al. 2017; Sivarajah et al. 2017), our study divides the use of BDA into two categories: advanced use of BDA and basic use of BDA. The rationale behind this classification is explained as follows.

Previous literature often identifies and classifies BDA into three groups such as descriptive analytics, predictive analytics and prescriptive analytics (Joseph and Johnson 2013; Sivarajah et al. 2017). Descriptive analytics are the simplest and most commonly used form of BDA that processes historical data to create management reports (Sivarajah et al. 2017). Predictive analytics use statistical modeling to determine future possibilities, and prescriptive analytics assist analysts in decisions by optimizing their business process models (Sivarajah et al. 2017). Based on types of BDA applications, recent industry reports and studies often categorize BDA into two types: advanced analytics that utilize predictive and prescriptive analytics, and basic analytics that mainly indicate descriptive analytics for business reporting (Barton and Court 2012; Chatfield and Reddick 2018; Chin et al. 2017; Díaz et al. 2018). Hence, the study defines advanced use of BDA as the degree of using predictive and prescriptive analytics, and basic use of BDA as the degree of using descriptive analytics.

As previously discussed, since BDA is known to play a critical role in improving agility (Chen et al. 2012; Mandal 2018; Zhou et al. 2018), this paper assumes that both advanced and basic use of BDA positively affect agility. Also, our study focuses on the differences between advanced and basic use of BDA. Basic use of BDA is primarily concerned with standardized processes, acting as a central function to maintain firms' efficiency and make speedy decisions (Aghina et al. 2015; Sivarajah et al.

2017). On the other hand, advanced use of BDA often relates to decision making closer to the point where frontline businesses are actually carried out, responding to market needs in an agile and adaptive way (Bose 2009; Chatfield and Reddick 2018). For example, advanced use of BDA directly addresses challenges occurred in sales, service and product management, precisely responding to market needs (Ahlbäck et al. 2017; Kitchens et al. 2018). Hence, this paper assumes that, compared to basic use of BDA, advanced use of BDA is more closely related to agility.

H1: *Advanced use of BDA gives a positive effect on agility.*

H2: *Basic use of BDA gives a positive effect on agility.*

H3: *Advanced use of BDA gives a more significant and positive effect on agility than basic use of BDA.*

Democratization Culture

Recent industry reports regarding BDA often emphasize democratization of data to effectively utilize BDA and drive positive organizational outcomes (Chin et al. 2017; Díaz et al. 2018; Kiron et al. 2011). With democratization of data, employees could readily draw on information across an organization, which enables them to be better positioned to create seamless interaction with customers and effectively handle market changes across channels (Kiron et al. 2011). For this approach to work, our paper assumes that it is necessary to create an organizational culture that encourages the sharing of ideas and opinions across the enterprise, because culture is a primary determinant of people's attitudes that influence organizational behavior (Gordon and DiTomaso 1992). With foundation of an organizational culture that values the sharing of opinions and ideas, employees may be encouraged to democratize data across functions and departments.

In this light, the study introduces 'democratization culture' which is defined as an organizational culture that values the sharing of knowledge and willingness to accept diversity on the basis of new knowledge. The definition is based on extensive exploration of prior studies suggested in the following paragraph. Moreover, the research employs collectivism as an additional organizational culture that is often recognized as a cultural pattern in relation to agility or flexibility (Lin et al. 2015; Liu et al. 2015). Democratization culture and collectivism seem to share common characteristics in that both values the active interaction among members (Triandis et al. 1988). However, while democratization culture accepts the concept of diversity that arises from new and progressive, or sometimes different opinions, collectivism emphasizes conformity and communal behavior, which is likely to restrict the diversity to some extent (Triandis et al. 1988; Triandis and Gelfand 1998). Therefore, a comparison between two cultures in a single model setting is expected to clearly articulate the features and role of democratization culture.

From political and historical perspectives, the cultural explanation of democratization relates to intellectual exchange and the extension of self-expression values – the extent to which individual choices and freedoms are appreciated. These cultural features of democratization contribute to high levels of citizen participation (Capoccia and Ziblatt 2010; Dahlum and Knutsen 2016; Putnam et al. 1994). Also, information technology (IT) literature asserts that under a democratization agenda, extended access to information is a cornerstone of modern democracies (Svärd 2016). The opening of data leads to the readiness of public agencies for an opening process that regards the exchanges of information as constructive and accepts new progressive ideas or opposing views (Janssen et al. 2012; Kassen 2017). Thus, open data provides new opportunities to promote civic engagement (Kassen 2017). In information systems (IS) literature, research describes democratization as extended access to IT infrastructure that helps businesses actively innovate and compete in digital economy (Joe-Wong and Sen 2018). Moreover, Dutton (2011) suggests that IT research processes should be democratized to facilitate creative and productive bottom-up participation by researchers. This democratization of IT research processes allows them to engage in collaborative research networks and successfully adapt to changing research practices (Dutton 2011). Lastly, the studies related to culture, media and communication explain that democratization of communication could point toward democratization of political culture and social norms, as it increases the opportunities for democratization of governance and knowledge exchange (Da Silva Lopes 2014; Powell 2012; Wu 2012).

Considering the above studies related to democratization, this paper has deduced that democratization implies the meanings of extended access to information and readiness to accept diverse opinions, which in turn, promotes participation. In this light, our study introduces democratization culture that values the sharing of knowledge and willingness to accept diversity on the basis of new knowledge.

Democratization Culture, the Use of BDA and Agility

Today, advanced use of BDA is often employed to support business decision making close to the point where frontline business is actually carried out, enabling firms to respond to market needs in an agile and adaptive way (Chatfield and Reddick 2018; Kitchens et al. 2018). In order to successfully support frontline businesses through advanced use of BDA, it seems important to create organizational culture where employees are encouraged to freely share data and insights across diverse functions. The sharing of data enables employees to readily extract appropriate data and better utilize advanced use of BDA (Ransbotham and Kiron 2017). For example, by applying all the necessary data to advanced analytics modeling, it becomes possible to make more precise predictions about market (Bose 2009; Ransbotham and Kiron 2017). Moreover, by sharing new, progressive and diverse views about what the data and analyses mean, employees could better understand market based on advanced analyses (Kitchens et al. 2018). This could allow employees to gain valuable and actionable insights about market needs (Ransbotham and Kiron 2017). In this light, democratization culture, which values both diversity and the sharing of knowledge, may help employees engage in more precise and informed decision-making processes (i.e., be agile) through advanced use of BDA.

H4a: *Democratization culture positively moderates the impact of advanced use of BDA on agility.*

Basic use of BDA is the use of the simplest type of BDA in the pursuit of efficiency and usefulness within existing business models (Sivarajah et al. 2017). By addressing standardized work processes, basic use of BDA could help firms maintain efficiency of key processes and make speedy decisions (i.e., be agile) (Aghina et al. 2015; Ahlbäck et al. 2017). As standardized processes are often defined by companies, they are explicitly clarified in terms of roles, responsibilities and decision-making procedures (Aghina et al. 2015). This kind of standardization allows firms to avoid overlapping roles and respond to changing circumstances with speed (Aghina et al. 2015). However, since democratization culture tends to encourage employees to have open communication and welcome diverse opinions or ideas, employees are likely to get involved in frequent discussions over the issues that have already been standardized or resolved by firms (Aghina et al. 2015). This could lead to loss of employees' important time and more confusion over the work processes. Hence, democratization culture may not encourage employees to effectively engage in standardized work processes (i.e., basic use of BDA) for achieving efficiency and making speedy decisions.

H4b: *Democratization culture negatively moderates the impact of basic use of BDA on agility.*

Collectivism

Collectivism often appears to be one of the most significant cultural patterns in explaining individuals' social behavior, attitude and value (Triandis 2001; Triandis et al. 1988). As collectivistic culture is proven conducive to cooperation (Wagner III 1995), the impact of collectivism on agility or flexibility has often been investigated (Lin et al. 2015; Liu et al. 2015). However, to our knowledge, there has been no research that examines the impact of collectivism on the link between the use of BDA and agility or compares its effect with other cultural moderators. In this regard, our study adopts collectivism as an additional organizational culture in comparison with democratization culture.

An essential attribute of collectivistic culture is that individuals are induced to subordinate their personal goals to the goals of their ingroup (Triandis et al. 1988; Triandis and Gelfand 1998). People in collectivistic culture are interdependent and shape their behavior primarily on the basis of ingroup norms, behaving in a communal way (Triandis et al. 1988). Along with these attributes, social interaction and enduring relationship are emphasized in collectivistic culture, because people belong to ingroup are supposed to get social support, resources and security (Triandis et al. 1988; Triandis and Gelfand 1998). For these reasons, people are inclined to share harmony and try to avoid conflicts

as much as possible (Triandis 2001). Hence, collectivism, in this paper, is defined as an organizational culture that places a priority on group goals and values social interaction based on mutual acceptance.

Collectivism, the Use of BDA and Agility

As assumed previously, advanced use of BDA is expected to better serve organizational objectives, such as agility by sharing data and diverse insights across an organization (Kitchens et al. 2018; Ransbotham and Kiron 2017). However, since collectivism emphasizes conformity and harmony among members (Triandis et al. 1988), employees in collectivism tend to be with low level of freedom (Rokeach 1973). Thus, they may not be able to freely engage in open communication and to bring various, new or sometimes progressive opinions into discussion. In this sense, collectivism could restrict diverse perspectives about what the data and analyses mean across functions and departments. This is likely to limit employees' understanding about market based on advanced analyses (Kitchens et al. 2018); thus, employees may have difficulties in gaining valuable and actionable insights about market needs (Kitchens et al. 2018). Hence, collectivism does not seem to help employees engage in informed and precise decision-making and successfully handle market needs through advanced use of BDA.

H5a: *Collectivism negatively moderates the impact of advanced use of BDA on agility.*

On the other hand, basic use of BDA, concerned with standardized processes, is expected to help firms sustain efficiency and make speedy decisions (i.e., be agile) (Aghina et al. 2015; Ahlbäck et al. 2017). In this regard, collectivism may be able to strengthen the relationship between basic use of BDA and agility. Since employees in collectivism are likely to behave in a communal way and follow ingroup norms (Wagner III 1995), they may not spend much time on discussions or communication over best practices and process frameworks that have already been standardized by firms (Aghina et al. 2015). Instead, employees in collectivism would effectively follow standardized processes through basic use of BDA (Aghina et al. 2015), and cooperate for achieving group goals, such as agility.

H5b: *Collectivism positively moderates the impact of basic use of BDA on agility.*
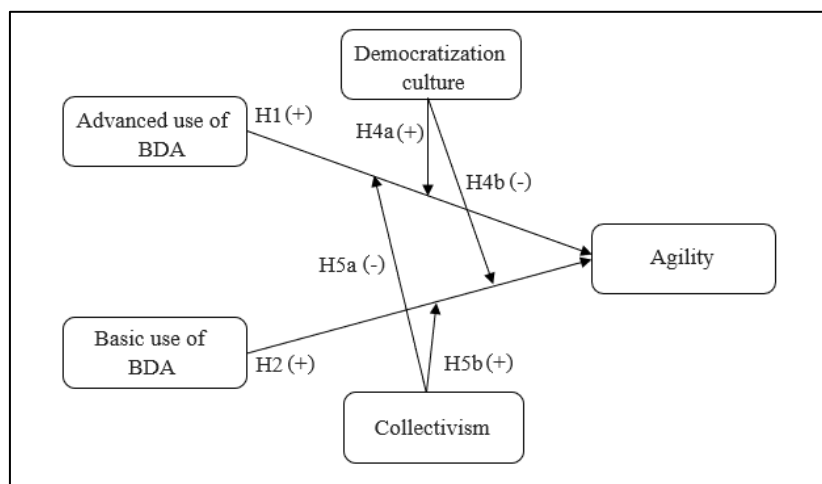
Figure 1. Research Model

Methodology and Data Collection

For each construct in our research model in Figure 1, our study either newly developed or adapted from prior studies. Before the survey, we received advice from IT professionals to ensure that measurement items were valid and reliable, and a few measurement items, especially related to democratization culture, were improved and selected based on their feedback. A questionnaire was first developed in English and translated to Japanese, and then translated back into English. Three researchers who are versed in both languages compared the translations, and slight modifications were

made. All of these measurement items in the model were developed using a 5-point Likert scale. The questionnaire is comprised of ten questions which contain a total of sixty-one measurement items including a set of demographic questions. We outsourced a Japanese online-research company to conduct a web survey in November 2018. First, an online screening survey was conducted on 60,000 participants in order to select subjects who are employed by Japanese organizations that currently utilize BDA for their businesses. On the process of the screening survey, this research selected participants who have titles such as chief executive officer (CEO), head of division and senior manager. This sampling choice was made, because opinions from senior-level managers would reasonably reflect the organizational-level, business-related and technology-related constructs in our research model. Then, the main questionnaire was sent electronically to the selected subjects. Consequently, a total of 304 valid questionnaires was retained. Table 1 indicates the sample distribution by respondent profile, the industry and the size of the organization.

Exploratory factor analysis (EFA) was conducted on the fifty-one measurement items. As a result, we identified five factors (constructs) and a total of sixteen measurement items as shown in Table 3. All these measurement items load most highly on their theoretically assigned factors with a minimum threshold of 0.6 (Gefen and Straub 2005).

Table 1. Respondent Demographic Profile

Demographics	Categorization	Count (N=304)	Percentage (%)
Gender	Females	26	8.6
	Males	278	91.4
Age	Below 30	17	5.6
	30-40	43	14.1
	41-50	68	22.4
	51-60	116	38.2
	Above 60	60	19.7
Respondent's position	Officer (CEO, etc.)	91	29.9
	Head of division/ factory	37	12.2
	Senior manager	176	57.9
Industry	ICT (IT and communication)	57	18.7
	Manufacturing	85	28.0
	Service (hotel, restaurant, etc.)	85	28.0
	Wholesale and retail	38	12.5
	Finance	24	7.9
	Medical and welfare	15	4.9
Size (Number of employees)	<300	144	47.4
	301-1,000	74	24.3
	1,001-3,000	29	9.5
	>3,000	57	18.8

Subsequently, confirmatory factor analysis (CFA) was conducted to test if the five constructs obtained after EFA are reliable and valid. All constructs demonstrated that Cronbach's α coefficients (α) were higher than the commonly accepted threshold of 0.7 (Bryman 2016) as shown in Table 3. In Table 2, the constructs showed that composite reliability (CR) scores were higher than the recommended threshold of 0.6 (Bagozzi and Yi 1988), which assured convergent validity. To test discriminant validity, Fornell and Larcker (1981) tests were employed. The results of all constructs demonstrated that average variance extracted (AVE) values were above 0.5 as shown in Table 2. Also, the square root of AVE value for each construct (the values on the diagonal) was higher than that construct's correlation with other constructs, and AVE values of all constructs were higher than maximum shared variance and average shared variance (MSV and ASV, respectively) values (Table 2), thereby providing evidence for discriminant validity. Overall, the CFA results confirmed that the constructs with the total of sixteen measurement items were reliable and valid. Furthermore, this research conducted Harman's single-factor test on the measurement items to see if there is common method

bias (Podsakoff et al. 2003). The result showed that a single factor did not account for the majority of the variances, indicating that there is a low chance of a common method bias in our dataset.

Table 2. Construct Correlations and Validity Estimation

	Construct Correlations					Validity Estimation			
	1.	**2.**	**3.**	**4.**	**5.**	**CR**	**AVE**	**MSV**	**ASV**
1. Advanced use of BDA	**0.73**					0.77	0.53	0.22	0.17
2. Basic use of BDA	0.47	**0.74**				0.78	0.55	0.22	0.15
3. Democratization culture	0.40	0.36	**0.74**			0.79	0.55	0.25	0.18
4. Collectivism	0.30	0.25	0.41	**0.73**		0.77	0.53	0.29	0.15
5. Agility	0.45	0.43	0.50	0.54	**0.76**	0.85	0.58	0.29	0.23

Note: values on the diagonal are the square root of AVEs

For the measures, the study adapts measurement items of advanced and basic use of BDA from the research by Sivarajah et al. (2017) which suggests the features and functions of BDA based on each type. Measurement items of agility are adapted from Tallon and Pinsonneault (2011) and those of collectivism are adapted from Wagner III (1995). The measurement items of democratization culture are carefully developed based on cultural features of democratization in the literature review section. Also, they are validated through assessment by IT professionals and statistical validity test.

Table 3. Constructs and Measurement items

Construct/ Measurement item	α / SFL	Mean (S.D.)	Reference
Advanced use of BDA	**0.89**	2.38 (0.94)	Adapted from Sivarajah et al. (2017)
In the organization that I am currently involved in…			
1. BDA is used to derive customers' trend and needs.	0.71		
2. BDA is used to predict future possibilities in the market.	0.71		
3. BDA is used to perform simulation optimization analysis.	0.77		
Basic use of BDA	**0.85**	2.35 (0.97)	Adapted from Sivarajah et al. (2017)
In the organization that I am currently involved in…			
1. the process of using BDA is standardized.	0.71		
2. BDA is used only in the scope determined by a firm.	0.71		
3. BDA is used for producing reports and simple statistics.	0.79		
Democratization culture	**0.86**	2.31 (0.92)	Newly developed
In the organization that I am currently involved in…			
1. we value the sharing of ideas and knowledge.	0.74		
2. we value open communication and active interaction.	0.70		
3. we value the acceptance of diverse opinions.	0.79		
Collectivism	**0.85**	2.60 (1.02)	Adapted from Wagner III (1995)
In the organization that I am currently involved in…			
1. we value our group goals more than personal goals.	0.73		
2. we value harmony and consensus among members.	0.71		
3. we value social interaction based on mutual acceptance.	0.73		
Agility	**0.91**	2.45 (1.04)	Adapted from Tallon and Pinsonneault (2011)
The organization that I am currently involved in…			
1. proceeds introduction and implementation of new products and services over a short period of time.	0.87		
2. responds quickly to the changes in customers' needs.	0.77		
3. shows a prompt reaction when a competitor launches new products or services.	0.71		
4. can expand or reduce sales of products and services.	0.70		

Note: α (Cronbach's α), SFL (Standardized Factor Loading), S.D. (Standard Deviation)

Result

Structural Equation Modeling

Amos 25 software was employed to analyze the structural equation modeling (SEM). Figure 2 represents the results from SEM estimation. The results confirm a good fit between the research model and the dataset (χ2=304.56, df=168, [GFI]=0.98; [AGFI]=0.92; [TLI]=0.94; [CFI]=0.97; [RMSEA]=0.06) (Hu and Bentler 1999). The SEM results demonstrated that advanced and basic use of BDA have significant and positive effects on agility, respectively (β=0.168, *p*<0.001; β=0.182, *p*<0.001), which is consistent with hypotheses 1 and 2. To test hypothesis 3, our study adopted the path comparison method proposed by Cohen et al. (2003); however, the result shows that there is no significant difference between the effects of advanced and basic use of BDA on agility; thus, hypothesis 3 is not supported.

Moderation Analysis

In order to examine the moderation hypotheses (i.e., H4a, H4b, H5a and H5b), this study first multiplied construct scores to create interaction terms and then added the interaction terms to the model (Goodhue et al. 2007; Tanriverdi 2006). To minimize potential multicollinearity, we mean centered the construct scores prior to creating the interaction terms (Aiken et al. 1991). The moderating effect of democratization culture on the relationship between advanced use of BDA and agility was significant (β=0.072, *p*<0.01), supporting H4a; the moderating effect of democratization culture was negative and significant on the relationship between basic use of BDA and agility (β=-0.136, *p*<0.001) as anticipated in H4b; the moderating effect of collectivism on the relationship between advanced use of BDA and agility was insignificant, thereby not supporting H5a (β=-0.06, *p*=0.082); and moderating effect of collectivism on the relationship between basic use of BDA and agility was significant (β=0.141, *p*<0.001), offering evidence for H5b. Taken together, moderation results demonstrated that the moderation hypotheses were supported, except for H5a.
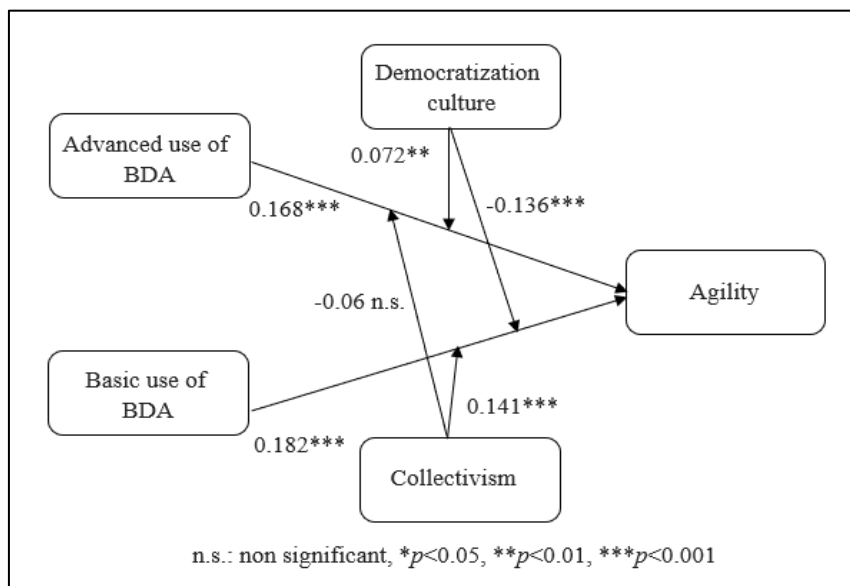

Figure 2. Results

Conclusion, Discussion and Implications

This paper empirically demonstrated that both advanced and basic use of BDA positively influence agility. Although our study hypothesized that advanced use of BDA has a more significant effect on agility than basic use of BDA, it has been proven that there is no statistical difference between the effects of the two usages on agility. This result implies that both advanced and basic use of BDA are

important for achieving agility. Also, according to IT professionals' feedback regarding advanced and basic use of BDA, a possible explanation on this result can be that, some firms, depending on their strategy, maturity level or field of industry, may be able to utilize basic use of BDA for delivering functions similar to those of advanced use of BDA. This is because, even with basic use of BDA, they already know how to draw desirable decision making and actions, which in turn, contributes to agility. Thus, whether advanced or basic use of BDA is more closely related to agility might depend on organization-wide characteristics based on their strategies, skills, age or field of industry.

Also, our findings reveal that the relationship between advanced use of BDA and agility could be further strengthened in democratization culture. Advanced use of BDA is often utilized for the frontline businesses, such as sales forecasting, customer service and product management (Bose 2009; Chatfield and Reddick 2018). In order for frontline employees to successfully respond to market changes through advanced use of BDA, it seems necessary to create organizational culture that allows data and insights to be shared. The sharing of data across functions enables employees to readily extract useful information and utilize advanced use of BDA for more precise decision-making (Chin et al. 2017; Kiron et al. 2011; Ransbotham and Kiron 2017). For example, by bringing all the data together, it becomes possible to build a lot of the more advanced analytics modeling for better predictions about market (Ransbotham and Kiron 2017). Moreover, by sharing different and diverse opinions about what the data and analyses mean, employees could have a deep understanding of market based on advanced analyses (Kitchens et al. 2018). This could help employees attain valuable and actionable insights about market needs (Kitchens et al. 2018; Ransbotham and Kiron 2017). Hence, the result suggests that democratization culture, which values both the sharing of knowledge and the acceptance of diversity, could help employees engage in more precise and informed decision-making processes (i.e., be agile) through advanced use of BDA.

On the other hand, it is also proven that democratization culture exerts a negative influence on the relationship between basic use of BDA and agility. Basic use of BDA is often employed to perform standardized processes to maintain efficiency and make speedy decisions (Aghina et al. 2015; Sivarajah et al. 2017). As standardized processes are often determined by firms, companies explicitly clarify work processes, participants' responsibilities, delegation of direct reports (Aghina et al. 2015). This kind of clarification and standardization allow firms to engage in speedy decision-making and avoid overlapping roles (Aghina et al. 2015). However, since democratization culture promotes the acceptance of diverse opinions, ideas or knowledge, employees may be encouraged to spend too much time on discussion and interaction over the issues that have already been standardized or resolved by firms (Aghina et al. 2015). This could cause loss of employees' important time and more confusion on the process of working. Thus, when basic use of BDA is employed, democratization culture could counteract firms' efficiency and slow down decision-making processes.

Considering the findings elaborated above, it is important to notice that the moderating effects of democratization culture are significantly different depending on whether agility is influenced by advanced or basic use of BDA. Democratization culture could help advanced use of BDA translate into agility; however, it is not supportive of the relationship between basic use of BDA and agility. These results could make managers challenged to decide how to promote democratization culture within organizations. This is because in the face of rapidly changing environment, companies might have to implement both advanced and basic use of BDA simultaneously. Even though firms could currently sustain their agility through basic use of BDA, as business context gets more competitive and volatile, they might have to employ advanced use of BDA to precisely respond to market needs in an agile way. Hence, based on organization-wide situations, managers should carefully consider how to weave their organizations successfully into democratization culture.

As for collectivism, our study found that collectivism has insignificant moderating effect on the relationship between advanced use of BDA and agility. A possible explanation for this result can be that, the feature of collectivism that encourages interaction among employees (Triandis et al. 1988; Wagner III 1995) may lead to the sharing of knowledge (Arpaci and Baloğlu 2016), which might have helped advanced use of BDA translate into agility. However, since collectivism emphasizes conformity and communal behavior (Triandis et al. 1988), it may also discourage employees from drawing on new, diverse or progressive opinions about the data and its analyses. This could diminish

employees' understanding about market based on advanced analyses (Kitchens et al. 2018). In this respect, collectivism could also weaken the relationship between advanced use of BDA and agility. Therefore, it is assumed that the impacts of collectivism on the relationship between advanced use of BDA and agility might have been offset.

On the other hand, the empirical result has proven that collectivism strengthens the relationship between basic use of BDA and agility. Since employees in collectivism behave in a communal way and care about conformity (Wagner III 1995), they would tend to follow standardized work processes (i.e., basic use of BDA) which are determined by firms, such as decision-making processes, roles and responsibilities (Aghina et al. 2015). Thus, employees in collectivism are less likely to get into frequent discussions or communication over best practices or process frameworks that have already been defined by firms (Aghina et al. 2015). Instead, they would effectively follow standardized work processes through basic use of BDA, and cooperate with members for achieving group goals, such as efficiency and speedy decision-making.

The comparison between democratization culture and collectivism clearly identifies the features and role of democratization culture. For example, both cultures value interaction among members, which could lead to knowledge sharing (Arpaci and Baloğlu 2016; Triandis et al. 1988). However, the acceptance of diversity, which is characterized in democratization culture, but not in collectivism, seems to bring out differences in moderating effects between the two cultures. For instance, while democratization culture positively affects the relationship between advanced use of BDA and agility, collectivism shows no significant effect on that relationship. A possible explanation on these results is that, the sharing of knowledge may not be a sufficient element of culture for the companies that try to attain agility through advanced use of BDA. Along with the sharing of knowledge, companies may also need to create a cultural feature that encourages employees to willingly accept diverse opinions that reside within the minds and experiences of people throughout the organizations (Nold and Michel 2016; Nonaka and Toyama 2005). Hence, when the diversity of knowledge is being actively shared in democratization culture, employees are more likely to gain valuable insights about market through advanced use of BDA, which in turn, could improve agility.

Along with practical implications elaborated above, the findings also provide theoretical implications for information systems (IS) research. First, the present paper examines and empirically demonstrates the relationship among agility, the use of BDA and organizational culture. This addresses an important gap in the literature about the role of organizational culture in shaping the relationship between the use of BDA and agility. Second, our paper introduces 'democratization culture' based on extensive literature review ranging from political history to IS. Our empirical results provide useful steps towards the role of democratization culture and explain how it shapes the mechanism where the use of BDA affects agility. Third, prior studies have broadly defined the use of BDA as a single factor (i.e., the use of a single analytics tool) and examined its impact on agility (Chatfield and Reddick 2018; Ghasemaghaei et al. 2017). However, this paper specifically divides the use of BDA into two categories (i.e., advanced and basic use of BDA) based on functions and the types of BDA being used. This classification provides more in-depth understanding about how each BDA use affects agility.

Limitations and Future Research

Although this paper suggests theoretical and practical insights, there are limitations that provide avenues for future research. First, our research results are based on the dataset from Japanese firms in the areas of big data analytics. The future study should enhance generalizability by using a dataset of a wider range of firms from other countries. Second, the present paper focuses on introducing and demonstrating the role of democratization culture in shaping the relationship between the use of BDA and agility. To clearly identify the features and role of democratization culture, the research employs collectivism as an additional organizational culture. In this regard, future research could consider adding more cultural moderators, which might provide a holistic view of organizational culture and deepen an understanding of cultural implications associated with BDA use and agility. Furthermore, the paper has deduced that there seems to be sub-concepts that comprise democratization culture, such as the sharing of knowledge and the acceptance of diversity. Thus, the future research could further

develop the construct of democratization culture by using a second-order formative construct. This approach is expected to more precisely measure democratization culture and describe its moderating effect on the relationship between the use of BDA (i.e., advanced and basic use of BDA) and agility.

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