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Why virtual teams work – State of the art

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Abstract

Teams in most work contexts work virtually to different degrees, for example in three-dimensional virtual environments. Regarding the development of new information and communication technology, an important question is, what influence the pervasion of innovative electronic devices, virtual and augmented reality as well as the respective software have on individual behavior and as a consequence on working processes. Industry as much as research embraces and analyzes processes and factors that influence virtual teamwork. In this paper a literature review is presented in order to merge findings of factors that influence the performance of virtual teamwork, such as the degree of virtuality and the presence of shared mental models. Results are presented as synthesis of these findings and a research agenda is derived.

Keywords: Virtual team, Teamwork, Team management, Digitalization

1. Introduction

Even though digitalization might very well be referred to as hype, we see some quite real fundamental changes driven by it. Interestingly enough, these changes do not only emerge in the context of information and communication

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technology (ICT), but also, and to a considerable degree, in society, its individuals and institutions[1]. Many of these changes influence the way we work and how we organize the value added. Relevant topics have been discussed in context of computer supported collaborative work (CSCW) since the 1980s[2]. But the current trend and new opportunities to virtualize whole work processes and the teams involved induce the need for up-to-date research. The aspects of influencing factors on the performance of virtual teamwork have up to now not been analyzed and structured to a sufficient degree.

Work in virtual teams (VTs) has long been a relevant topic due to different reasons. On the one hand, VTs can be a means for saving money when cost cutting is a major concern in organizations[3]. On the other hand, global companies with a dispersed workforce need VTs to be quick and agile. But for the current workforce, face-to-face communication, at least from time to time, appears to still be of major importance[4]. Moreover, most of the people are not familiar with working productively in a virtual environment. Research on the behavior of future generations already shows that growing up with virtual reality might lead to an easy adoption of virtuality as a "normal" working environment[5]. That might lead to an increasing efficiency of VTs, since its members' concentration to the task at hand is not deterred due to the environment.

For specific contexts, work in VTs seems to be advancing and can even be the dominant logic of work organization, which some prominent examples show: Basecamp†, which has a head quarter but most of its employees work remotely and FlexJobs‡ being a completely virtual company with no central office at all. According to the observations of past challenges and the present development[6,7], this paper seeks to define the state of the art on factors influencing the performance of VTs. We use the structured instrument "literature review" to first of all find out, whether the results concerning the already researched factors are in line and how they can be synthesized. Thus, the goals of this paper are to present an overview of factors influencing the performance of VTs and to deduce a research agenda with special respect to the manifestation of digitalization as a comprehensive process of change.

The overall problem to be solved starting with this first step is to understand what makes VTs work efficiently considering the degree of virtuality and technology adoption of the workforce. From a research point of view this is relevant, because an interdisciplinary approach of psychology, sociology as well as information systems research (ISR) is necessary to gain results. This study is set up from an ISR perspective to be a first step to form such a team for further research. From a practical problem solving point of view this is relevant, because companies might gain from making good use of VTs with respect to organizational guidance and attracting a workforce, as it might be a style of work, which is appealing to the younger generation that is native in digital environments.

The following section provides the foundation for this paper, defining the research questions. Then the research method is explained in detail and relevant concepts are defined. The findings of the literature review are analyzed and structured to provide new insights. The results are discussed and serve as initiation for the derived research agenda in in the final section.

2. Research method

Past research concerning VTs shows that there is profound research enlightening certain aspects of virtual teamwork, such as studies about work-motivation, trust in VTs, etc. Thus, a very heterogeneous body of literature exists that now is included in this literature review in order to provide a synthesis. The literature review can be positioned as shown in Table 1.

Table 1. Positioning of literature review following the taxonomy by[8]

characteristics	*categories*			
focus	research outcomes	research methods	theories	practices or applications

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† https://basecamp.com/ Basecamp developed the project management software of the same name.
‡ https://www.flexjobs.com/ FlexJobs is a job board with focus on communicating remote job offers.

goal	integration	criticism	identification of central issues		
perspective	neutral representation		espousal of position		
coverage	exhaustive	exhaustive with representative citation	central citation	representative	central or pivotal
organization	historical		conceptual	methodological	
audience	specialized scholars	general scholars	practiners	policy makers	general public

The *focus* is on research outcomes in order to find relevant factors. The focus on research methods is not highlighted, even though case studies are analyzed separately. The outcome of the case studies is of interest, but not the method as such. *Goals* are to integrate and synthesize research outcomes, as in most studies[8] and to identify central issues in order to achieve the aforementioned and catalyze future research. It is aspired to take a neutral position for this literature review and thus provide a *neutral representation* of the findings. Concerning the scope of research the category of being *exhaustive with central citation* appears promising for this review. Since the topic has a long scientific history in many fields, an exhaustive review is not viable for this study. Thus, certain constraints apply as shown further below. The *organization* of the literature reviewed follows conceptual aspects, as the literature is structured into categories referring to their focuses. This review addresses a broad *audience*, as implications are provided for scholars and practioners alike, performing future research or applying the insights to their work.

Gilson et al. performed two extensive literature reviews concerning the research on VTs providing hints to research gaps[6,9]. A lot of substantially specialized studies were performed over the last years focusing on peculiarities of virtual teamwork, such as changing requirements concerning communication via ICT[10] and the effects virtuality has on job-related stress sensitivity[11]. These examples are representative for the degree of abstraction most of the studies have. The goal to synthesize these findings leads to following research questions:

RQ 1: What are the main findings of research on VTs with respect to influencing factors on performance?

RQ 2: What are open aspects, which have to be addressed in a research agenda?

Virtuality and *team* are defined in order to understand virtual teamwork. For this study, VTs are distinguished from voluntarily collaborating virtual communities that are not bound to a specific organization. A team is considered to be a group of people that follows a shared goal[12]. The team's degree of virtuality can be located on a continuum between two extremes, a completely VT and a traditionally face-to-face operating team. In this context, virtuality is defined by the teamwork's asynchrony and geographic dispersion[13]. Asynchronous and disperse teamwork is supported by ICT. Each technology that somehow facilitates the exchange of information between people can be considered ICT, including transmission and storage. The goal to provide a good technology-task fit for VTs influences the choice of ICT and the degree of virtuality. Today, VTs use a range of ICT (media richness) or just few ICT (feature richness)[14] to perform their tasks. Thus, for the following analysis, *a VT is defined as a group of geographically dispersed people working together in an organizational work environment using ICT*.

The literature was searched on the database EBSCO to include scientific journals containing peer-reviewed articles. On EBSCO the databases Business Source Complete and the eBook Collection were taken into account. Databases such as PsychINFO and SocINDEX were not included in the search. These databases and others are resources presenting the fields of psychology and sociology and provide further relevant insights for the studies on VTs. In order to narrow down the search and focus on the domain of ISR, these databases are excluded for the moment. The search was furthermore advanced by only including literature with full text availability. Journal articles, articles in conference proceeding, and books are included in the search. News articles, blog articles and other not peer-reviewed results were also excluded. A forward search was not performed due to the selected time span (2014-2016, see below). The results from the databases were cleared from doubles and a backward search was performed, checking the titles, abstracts and references. The search terms and combination are shown in Fig. 1.
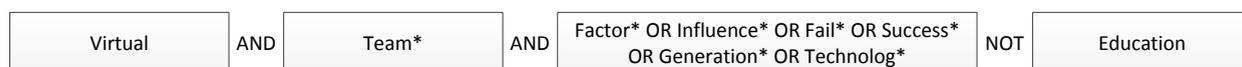
Virtual	AND	Team*	AND	Factor* OR Influence* OR Fail* OR Success* OR Generation* OR Technolog*	NOT	Education

Fig. 1. Search terms and their combinations

The exclusion of the keyword "Education" is justified by the assumption that VTs operating in companies differ to study groups in several factors, e.g. concerning their goals and their obligations towards employers versus teachers. The research on virtual study groups is nevertheless important and tackled in future research.

The database EBSCO provided 265 results for all search term combinations, 65 remained in the sample after the first check of title and abstract. AISeL and IEEE were browsed for conference proceedings. The HICSS proceedings were additionally studied as the conference contains a mini track specialized on virtual teamwork, resulting in 23 more findings. This resulted in a total of 88 contributions. Performing a backward search resulted in six more findings. Through an additional search in a variety of databases eight more contributions with the focus on technological influence on virtual teamwork could be added to the sample. The sample then consisted of 102 articles and books. These were checked again regarding their content-related fit and whether they comply with scientific standards. Sorted by year, a peak in quantity could be made out around 2011 and 2012, followed by fewer articles in 2013. This did not relate to certain topics. Studies from 2014 to 2016 built upon this era including and updating its findings. Thus, as final sample papers from 2014 until 2016 were selected, resulting in a final sample of 30 scientific articles (2014: 17, 2015: 8, and 2016: 5).

3. Literature analysis and synthesis

The sample of 30 articles was first structured concerning the respective main focus into seven categories. The categories are derived from the definition of VTs from above as follows: A VT is a group of geographically dispersed people (categories 3. and 5.) working (4.) together (2.) in an organizational work environment (6.) using ICT (7.). Category 1. was added after a first review of the sample as proposed by[15]. The articles are sorted by main focus and only assigned to one category.

1. Examples from real life presented as *case studies*: 3
2. *Communication* patterns or information processing: 5
3. *Distance* in time, space or culture: 3
4. *Goal* comprehension and shared mental model: 3
5. *Group* properties and individual traits: 5
6. *Management* and roles: 5
7. Use and properties of information and communication t*echnology*: 6

3.1. Lines of Research

The first category consists of the three *case studies* by (Fister Gale 2016)[16], (Salminen-Karlsson 2014)[17] and (Sampath 2014). These studies represent overviews as none of them focuses just single influencing factors on the group's performance. These case studies are taken into account in this moderate extent, as they promise up-to-date ideas and provide relevant insights.

Studies by (Aten 2016)[18], (Bartelt and Dennis 2014)[19], (Morgan, Paucar-Cacares and Wright 2014)[20], (Minas et al. 2014)[21] and (Swaab, Phillips and Schaerer 2016)[22] that identify *communication* patterns and aspects concerning the processing of information influencing group performance are assigned to the second category. Studies by (Hanebuth 2015)[23], (Magnusson, Schuster and Taras 2014)[24], and (Sivunen, Numi and Koroma 2016)[25] in the third category address aspects concerning *distance* as geographic factor having impact on teamwork concerning time lags and thus resulting asynchronous work processes. The other dimension of distance that is discussed here is called "psychic distance" tackling cultural aspects (Magnusson, Schuster and Taras 2014). Studies by (Maynard and Gilson 2014)[26], (Orhan 2014)[27] and (Ferreira Peralta et al. 2015) are categorized by the focus on shared mental models regarding the *goal* and the tasks for achieving that goal. The fifth category of studies has the focus on *group* characteristics and individual traits of single members, such as the affiliation to certain generations (Boughzala 2014)[28], trust (Cheng, Yin, Azadegan and Kolfschoten 2016)[29], virtuality of teams (Krumm et al. 2016)[30], innovative behavior (Riedl, Marion and Picot 2014) and possible influences of offline on online culture (Riedl et al. 2015)[31].

Influencing factors regarding *management* of VTs are clustered in the sixth category. Currently discussed factors are roles and responsibilities (Dunn et al. 2015)[32], top-down communication and reliability (El-Sofany, Alwadani and Alwadani 2014), use of incentives to motivate the workforce (Fuller and Harding 2015)[33], the option to deploy

artificial leaders (Gladden 2014)[34] and to properly train the leaders on skills for managing VTs (Politis 2014)[35]. The seventh category contains studies that address different *technological* factors that influence the performance of virtual teamwork. This category presents very diverse aspects and provides sufficient ideas to be discussed thoroughly in future research. Technological factors are standards of ICT use (Ahmad and Lutters 2015)[36], technology-task-fit (Alahuhta 2015)[37], feature richness (Gupta and Wingreen 2014), the design of virtual workplaces (Minas, Dennis and Massey 2016), the design and use of 3DVE (Schott 2014)[38] and (Sivunen and Nordbäck 2015)[39]. No category shows any correlation with a certain time span. Thus, it is safe to assume that research is not driven by "hype" movements.

3.2. Influencing factors

The following Table 2 provides insights regarding the findings of the studies reviewed. For each category several factors are extracted. These factors are aimed to answer RQ1 as explained above.

Table 2. Extraction of factors influencing the performance of virtual teamwork

category	factors	sources
1. case studies	• social online activities	(Fister Gale 2016)
	• non-hierarchy	(Salminen-Karlsson 2014)
	• non-hierarchy • social online activities	(Sampath 2014)
2. communication	• routines	(Aten 2016)
	• routines	(Bartelt and Dennis 2014)
	• routines	(Morgan, Paucar-Cacares and Wright 2014)
	• dedication to teamwork	(Minas et al. 2014)
	• dedication to teamwork	(Swaab, Phillips and Schaerer 2016)
3. distance	• psychic distance	(Hanebuth 2015)
	• psychic distance	(Magnusson, Schuster and Taras 2014)
	• time lap • psychic distance	(Sivunen, Numi and Koroma 2016)
4. goal	• goal specification • shared mental model	(Maynard and Gilson 2014)
	• shared mental model	(Orhan 2014)
	• goal specification	(Ferreira Peralta et al. 2015)
5. group	• individual properties • culture	(Boughzala 2014)
	• virtuality of team • culture	(Cheng, Yin, Azadegan and Kolfschoten 2016)
	• virtuality of team • individual properties	(Krumm et al. 2016)
	• individual properties	(Riedl, Marion and Picot, 2014)
	• virtuality of team • culture	(Riedl et al. 2015)
6. management	• technology use • management skills	(Dunn et al. 2015)
	• management skills	(El-Sofany, Alwadani and Alwadani 2014)
	• management skills	(Fuller and Harding 2015)
	• management skills • technology use	(Gladden 2014)

	• management skills	(Politis 2014)
	• technology use	
7. technology	• technology properties	(Ahmad and Lutters 2015)
	• team support	(Alahuhta 2015)
	• technology properties	(Gupta and Wingreen 2014)
	• team support	
	• technology properties	(Minas, Dennis and Massey 2016)
	• technology properties	(Schott 2014)
	• team support	
	• technology properties	(Sivunen and Nordbäck 2015)
	• team support	

Recommendations for action that the authors of the reviewed studies provide on how to address the influencing factors are explained in the following. The case studies suggest that social activities, especially online activities, such as regular yoga-classes (Fister Gale 2016) or games (Sampath 2014) are well appreciated by the workforce and support social bonding, which then again is essential for teamwork and work results. Regular bidirectional feedback, both on social events and work, is regarded as crucial. The second factor extracted from the real world case studies concerns hierarchies. If the team is distributed across nations or continents, hierarchies between locations should be avoided, especially but not only if the locations share a colonial history (Salminen-Karlsson 2014) and (Sampath 2014). The relations of these supporting factors and the influence factors explained further below are shown in Fig. 2.
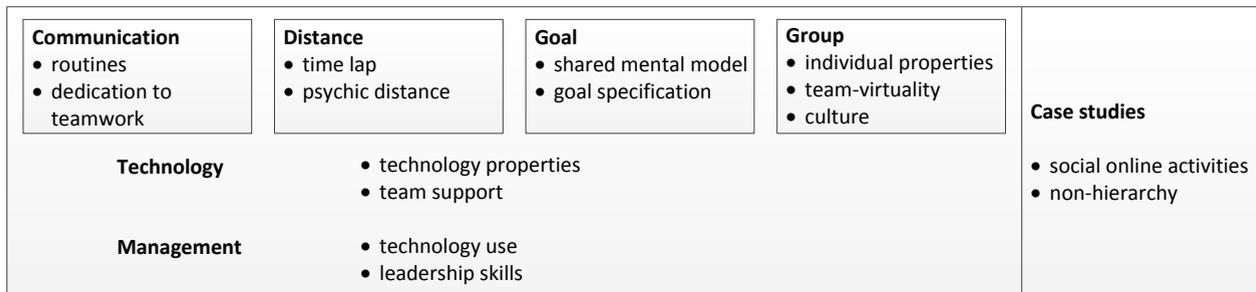

Fig. 2. System of factors influencing the performance of virtual teamwork

Communication and information processing seem to be important when analyzing VTs and teamwork in general. As in traditional teams the dedication to teamwork and willingness to support the functioning of the team are crucial virtues. Some challenges from traditional teamwork, such as communication behavior in group discussions and the appreciation of different positions also apply for VTs and need support (Minas et al. 2014), (Swaab, Phillips and Schaerer 2016), and (Ferreira Peralta et al. 2015). This support consists of technological solutions and of the contribution by each team member. To secure well-functioning teamwork, standards and routines are rated as vital. These standards include the how and when to communicate, the choice of communication tools and the ways and frequencies to use them (Bartelt and Dennis 2014), (Morgan, Paucar-Cacares and Wright 2014), and (Cheng, Yin, Azadegan and Kolfschoten 2016). These standards appear to differ between teams and can thus not be transferred easily.

When team-members are dispersed across time zones and different cultures, challenges occur that are less obvious when being geographically close to each other and working the same business hours. These challenges are subsumed under the factors psychic distance and time lap. The concept of psychic distance covers differences in (work related) culture, such as gender related discrimination, language barriers, different verbal codes, etc. (Schuster 2013). In order to embrace psychic distance as a chance, a supportive, trustful and open atmosphere needs to be established (Hanebuth 2015), (Ferreira Peralta et al. 2015), and (Cheng, Yin, Azadegan and Kolfschoten 2016). In this context psychic distance can be an asset, as being sensitized for cultural differences also leaves the workforce paying more attention to their colleagues than in traditional teams (Magnusson, Schuster and Taras 2014) leading to better performance

(psychic distance paradox (Schuster 2013)). Working across time zones can be an advantage if asynchronous activities fit the task. The category "distance" is clearly strongly related to the category of communication and information, just as the following category "goals" is.

The category "goals" can be regarded as linkage of the two preceding categories communication and distance. The distances can induce challenges concerning the mutual understanding of goals and of how to achieve those. These distances can only be reduced through communication. Thus, a shared mental model of group structure, roles, goals, processes, (Orhan 2014) and a goal specification (Maynard and Gilson 2014), (Ferreira Peralta et al. 2015), and (El-Sofany, Alwadani and Alwadani 2014) need to be established. Studies in the category "group" characteristics generate three main influencing factors: individual properties (Boughzala 2014), (Krumm et al. 2016), (Riedl, Marion and Picot 2014), culture (Boughzala 2014), (Riedl et al. 2015) and the degree of virtuality of the team (Cheng, Yin, Azadegan and Kolfschoten 2016), (Krumm et al. 2016), (Riedl et al. 2015), being the focus of this article. Individual properties include the skills relevant to virtual teamwork, also across different generations, which are found to be more relevant than in traditional teams (Boughzala 2014), (Krumm et al. 2016) and (Riedl et al. 2015). The affiliation to a certain generation can also be seen as individual property. Generational impacts in VTs apparently still remain a topic not well presented in research as also found by (Gilson et al. 2015), even though studies concerning technology adaption across generations exist, e.g. by (Myers and Sadaghiani 2010). Culture is presented as factor with positive and negative influence on virtual teamwork. Challenges of disparities in online and offline cultures exist (Riedl et al. 2015) but these disparities can also lead to better performance (Magnusson, Schuster and Taras 2014), (Cheng, Yin, Azadegan and Kolfschoten 2016). Virtuality is the third factor in the category "group". The degree of virtuality of teams represents the main characteristic of teamwork analyzed in this article. The degree of virtuality can have an influence on performance as e.g. differences in decision making processes exist (Riedl et al. 2015) and (Dunn et al. 2015). Thus, it is important to define the virtuality of the team in the process of planning.

High requirements are demanded of managing the complex structure and dynamics of teamwork. Findings in the category "management" show two main influencing factors: technology use and management skills. Technology use from the management perspective focuses on a proper technology-task-fit with ongoing evaluation and the deployment of technology also as a management tool. Managers need to be trained on how to use the proper technologies (Dunn et al. 2015), (El-Sofany, Alwadani and Alwadani 2014), and (Politis 2014). Findings by (Gladden 2014) suggest that they can be even replaced by artificial surrogates. In addition to training on technology use, more traditional management skills need to be fostered regarding the categories above, such as cultural and social intelligence (Sampath 2014), (Magnusson, Schuster and Taras 2014), and (Sivunen, Numi and Koroma 2016). Leadership qualifications have to match the team's degree of virtuality concerning aspects like control of results, motivation, reliability, etc. (Dunn et al. 2015), (El-Sofany, Alwadani and Alwadani 2014), (Fuller and Harding 2015), and (Politis 2014).

Studies with focus on ICT in the category "technology" imply two main factors, namely technology properties and team support. The ideas concerning ICT in virtual teamwork are strongly linked to aspects already mentioned above due to the nature of virtual teamwork. Establishing norms and standards for their use (Ahmad and Lutters 2015) while still taking into account individual preferences (Sivunen and Nordbäck 2015), as well as providing feature richness (Gupta and Wingreen 2014) and designing appropriate 3DVEs (Minas, Dennis and Massey 2016), (Schott 2014) are mentioned as significant properties of the deployed ICT. In order to support virtual teamwork, ICT has to facilitate integration across all team members and help to reduce conflicts (Ahmad and Lutters 2015), (Alahuhta 2015), and (Gupta and Wingreen 2014), enable processes, such as innovation, documentation, and communication (Riedl, Marion and Picot 2014), (Minas, Dennis and Massey 2016), (Schott 2014), and (Sivunen and Nordbäck 2015).

4. Discussion and research agenda

Main factors influencing the performance of VTs were derived in the course of this article. A literature review regarding scientific works on VTs was performed providing an overview of influencing factors answering RQ1. The findings can be related to the media synchronicity theory by[40] as several factors extracted from literature can be located in the model of media synchronicity, such as training, shared mental model, and social norms. Thus, future research could proceed to match relevant factors constituting successful virtual teamwork to the media synchronicity model, building on this established theory. Regarding feature richness and rich media experience, subsequent research

focusing 3DVEs and other mixed reality technologies seem promising to understand current trends from a scientific perspective.

Especially the search for generational impacts on virtual teamwork led to only very few results. Assumed socialized differences regarding teamwork, work ethics, technology adoption, etc., are expected for so called generation Xers and C64ers, millennials and now generation Z. In how far these anticipated differences are induced by technological socialization, work socialization, or socialization processes in general and how they shape the virtual workforce of today's children and thus their creation of value is on the agenda of future research as presented in Fig. 3, also serving as concept to answer RQ2.
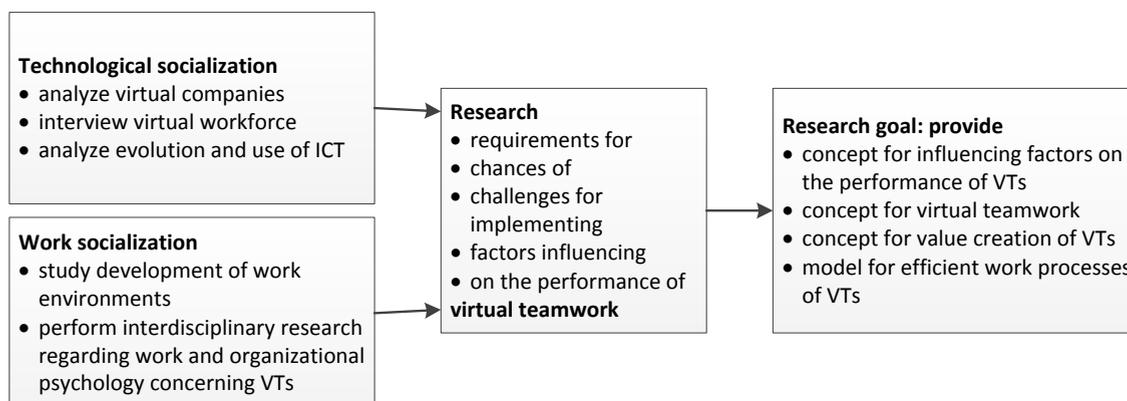

Fig. 3. Research agenda

In order to value the breadth of research already performed concerning virtual teamwork, this literature review followed scientific standards, such as providing the search terms before performing the search and explaining the extraction steps in detail. But perils of performing systematic literature reviews[41] motivate to perform follow up research on this topic applying other methods, including sources that were excluded and reflecting on the implications of this literature review with its limitations.

A lot of assumptions concerning VTs seem to be made in the light and under the influence of knowledge on traditional teamwork. Analyzing these assumptions leads to unexpected insights, such as the example of the psychic distance paradox. A second intriguing example is shown by[31] through the study on how severely online and offline culture can differ within one cultural sphere. This implies that the workforce, including management, needs enlightenment, awareness and training apart from traditional intercultural competencies. Assumptions made on virtual teamwork need thus to be further explored and validated, this literature study being a first step.

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