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TRUST IN VIRTUAL TEAMS: A SYSTEMATIC REVIEW OF INFORMATION SYSTEMS LITERATURE

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ABSTRACT

The issue of trust development among members of virtual teams is gaining increasing attention from Information Systems (IS) scholars due to the advancement of virtual collaboration in organizations. The objective of this study is to evaluate the issue of trust development in virtual team research from the perspective of main IS journals, and to consolidate the contributions made by IS researchers. To this aim, a systematic review of the literature has been conducted, supported by bibliometric and Social Network Analysis (SNA). An IS-centric review of trust concepts and research paradigms has been presented along with opportunities for future research.

Keywords: Trust, Virtual Teams, Information Systems, Systematic Literature Review, Social Network Analysis.

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INTRODUCTION

Trust is widely recognized as fundamental for human affairs and social interaction (Brown, Poole & Rodgers, 2004; Söllner, Benbasat, Gefen, Leimeister, & Pavlou, 2016), and, therefore, has gained attention of researchers from different disciplines over the years, such as psychology (Frost, Stimpson, & Maughan, 1978), sociology (Lewis & Weigert, 1985), and management (Meyerson, Weick, & Kramer, 1996). From the perspective of organizational studies, mutual trust between individuals or teams at the workplace has been described as a key element for effective collaboration (McAllister, 1995; Mayer, Davis, & Schoorman, 1995).

The importance of scientific debates about trust continues to increase with the advancement of usage of information and communication technologies (ICT) for collaboration at the workplaces. This is justified as the social change represented by the usage of virtual collaboration or virtual teams at the workplace has introduced, probably, the most challenging barrier for trust development in the history of human society so far: the lack of physical proximity between individuals (Altschuller & Benbunan-Fich, 2013; Sarker, Ahuja, Sarker, & Kirkeby, 2011; Powell, Piccoli & Ives, 2004; Jarvenpaa, Shaw, & Staples, 2004; Dubé & Robey, 2009; Lowry, Zhang, Zhou, & Fu, 2010; Söllner et al., 2016). Interestingly, this context has created an apparent paradox: whereas trust is fundamental for effective virtual collaboration, the constrained social transactions between virtual work partners can make virtual collaboration an extremely challenging activity (Brown et al., 2004; Cheng, Fu, & Drukenmiller, 2016; Dubé & Robey, 2009; Kanawattanachai & Yoo, 2002; Piccoli & Ives, 2003). This is an issue that can be studied via the lens of information systems (IS) research.

Traditionally, IS research extrapolates a focus primarily on the information technology (IT) artifact and involves the intersection of people, processes, technology, and organizations to improve results at the individual, team, and organizational levels (Lowry et al., 2010). As practical examples, Gao et al. (20111) indicate that IS researchers can adopt a behavioral and psychology focus when studying the interaction between people and IT; or a collaboration and communication focus when investigating the issues related to collaboration via IT and virtual team performance.

Being the subject of virtual teams already a major IS research field, and trust an emergent and important topic for the IS domain (Altschuller & Benbunan-Fich, 2013; Söllner et. al, 2016), the following research questions arise: Has the latent importance of trust for virtual team research been reflected in the IS literature? If so, what knowledge about this issue has been accumulated and what knowledge still needs to be acquired from the perspective of the IS domain?

For a better understanding of these questions, this study conducts a systematic review of IS literature supported by bibliometric and social network analysis (SNA) techniques. The specific goals of the review are:

- to evaluate the relative importance of the issue of trust development in virtual team research from the perspective of main IS journals;
- to consolidate the contributions made by IS researchers to the investigation of this issue; and summarize the knowledge acquired so far, as well as the opportunities for future research.

This paper is structured in five sections. The description of the research steps is covered in section 2. The section 3 contains the main results; and in the sections 4 and 5, respectively, the discussions and conclusions of the research are presented.

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RESEARCH METHODOLOGY

In contrast to the usual process of literature review, systematic reviews can be used to consolidate and evaluate the available evidences concerning specific research topics. This goal can be achieved with relatively reduced bias by following a precise and strict sequence of methodological steps that relies on a well-defined protocol. Such a protocol encompasses the topic being investigated in a very specific and focused structured question, as well as instructions for the selection, analysis, and summarization of relevant papers. By using a trustworthy, rigorous, and auditable methodology, systematic reviews can, therefore, provide a fair evaluation of a research topic and increase the likelihood of detecting effects that individual smaller studies are unable to detect (Kitchenham, 2004; Steinmacher, Chaves, & Gerosa, 2013).

The systematic literature review presented in this study was supported by bibliometric and SNA techniques. According to Gumpenberger and Gorraiz (2012), bibliometrics is a discipline of the library and information sciences, being developed to measure and monitor scientific production. The bibliometric analysis has broad applications in several areas of research with the purpose of increasing the performance of scientific production by evaluating their metadata such as authorship, research sources, themes, geographical origins, citations, and co-citations (Small, 2003). SNA can be utilized to process the bibliometric metadata, such as publication authors and cited references, to establish relationships among entities and depict patterns and implications from these relationships (Watanuki, Nadae, Carvalho, & Moraes, 2014). According to Sarker et al. (2011), the SNA perspective enables the researcher to study individual entities within their larger structural configuration context, and its strength lies in the connection built between the attributional and structural aspects of the entity, instead of simply focusing on the entity itself in isolation.

To conduct this study, a search in the main collection of ISI Web of Science was made in June of 2017 by entering the following search terms: *virtual team(s), dispersed team(s), distributed team(s), global team(s), and international team(s)*; which correspond to common terms utilized for indexing virtual team publications at electronic databases (Caya, Mortensen, & Pinsonneault, 2013; Schiller & Mandviwalla, 2007; Watanuki et al., 2014). The word *trust* was not included as a search term itself, as the authors wanted to let the topic emerge naturally from the sample of publications, and, therefore, be able to compare its relative importance against other important topics to virtual team research. This primary search resulted in 1,269 artifacts published by journals from diversified areas of knowledge.

In an attempt to narrow the focus of this initial sample into the IS domain, a subsequent filter was applied to only consider articles published by the Association for Information Systems (AIS) Senior Scholar´s Basket of Journals (Association for Information Systems, 2011). The AIS represents the main international professional association focused on research, teaching, practice, and study of information systems; and its College of Senior Scholars considers the following eight journals as top outlets in the IS field, in alphabetical order:

- *European Journal of Information Systems*
- *Information Systems Journal*
- *Information Systems Research*
- *Journal of the Association for Information Systems*

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- *Journal of Information Technology*
- *Journal of Management Information Systems*
- *Journal of Strategic Information Systems*
- *Management Information Systems Quarterly*

Although the decision to apply this filter has potentially excluded journals from multidisciplinary or specialty areas, it is consistent with the focus of this study, which is to assess the importance of trust in virtual team research within the IS domain. It is important to highlight that there are other journals that have published articles relevant to the study of virtual teams; however, since they typically do not publish IS-centric research, and are thus not included in the AIS Senior Scholar´s Basket of Journals, they were not considered in this study.

Based on these criteria, 112 articles were found and represent the initial sample of this study. To support the first step of the bibliometric analysis, the metadata of this sample of articles, such as title, abstract, authors, keywords, among others were exported from the ISI Web of Science database to a plain text file. From the plain text file, a Microsoft Access database file containing all the metadata was generated by using the Sitkis software (Schildt, 2002).

Once the metadata was properly stored in a database file, SNA techniques available in Sitkis (Schildt, 2002) and UCINET (Borgatti, Everett, & Freeman, 2002) software's were utilized to perform various analysis from both a qualitative and quantitative perspectives. From a qualitative standpoint, two graphical network diagrams were built representing, respectively, the relationships among keywords and cited references from the sample of articles. From a quantitative perspective, the normalized centrality degree (C_i) values of the entities composing the network diagrams were calculated. The C_i value of a particular entity within a network can be calculated according to the formula proposed by Wasserman and Faust (1994) and presented in equation 1:

$$C_i = \sum_{j=1}^{n} L_{ij} \Big/ (N-1) \quad (1)$$

where N is the number of entities within the network, and Lij is the number of connections between the entities i and j. Lij=0 if there is no connection between the entities.

The C_i value was selected as the key numerical attribute to support the SNA as it evaluates the number of connections a specific entity in the network shares with other entities, and, therefore, provides evidences of that specific entity's prominence within the network. In practical terms, the higher the C_i value of a specific entity, the higher its relative importance within the network (Sarker et al., 2011; Watanuki et al. 2014).

RESULTS

This section presents the results obtained after the analysis of the metadata from the sample of articles. It starts with the presentation of results that highlight the raise of trust as an important topic in virtual team research within the IS domain, followed by an analysis of the trust-related publications contained within the sample of articles.

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The importance of trust in virtual team research

The first analysis of the metadata grouped the keywords from the articles of the sample in pair of occurrences (i.e., keyword co-occurrence analysis). The goal of this analysis was to display the connections between keywords based on the frequency that two keywords were listed together by the articles of the sample. By analyzing the connections between the keywords along with the magnitude of these connections, it is possible to conduct a visual assessment of the main topics covered by the sample of articles (Watanuki et al., 2014). As a result of this analysis, a graphical network diagram with four groups of keywords was elaborated (Figure 1).

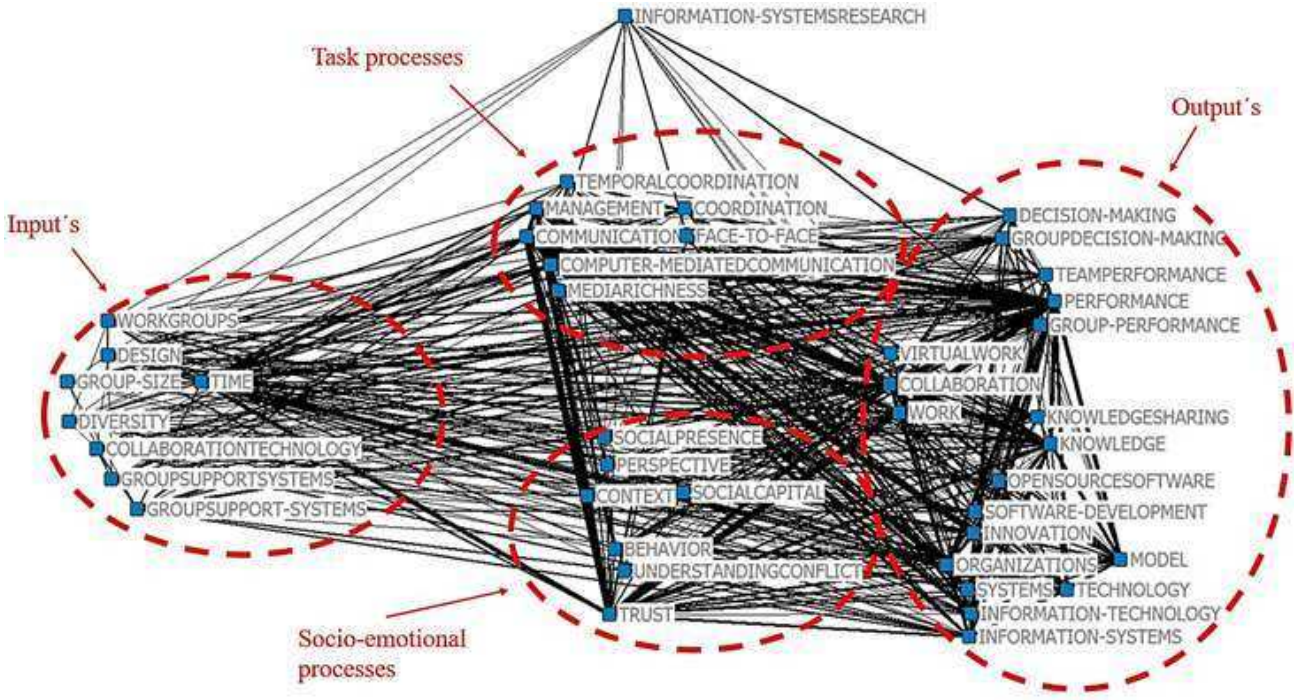

Figure 1. The keyword co-occurrence network*.

***Note**: The blue squares represent the keywords from the articles, and the thickness of the lines connecting the blue squares represents the magnitude of the connection between the two keywords, based on its frequency of occurrence. Due to the large amount of data this type of analysis usually involves, and in order to provide a clearer view of the relationships within the network, a filter was applied in this graphical network to only display the keywords from articles of the sample that possessed more than five citations in ISI Web of Science on the date of the metadata extraction. The cutoff value of five citations was determined after starting the analysis with no citation cutoff value and increasing the citation cutoff value by one unit until it became visually practical to group the keywords in a graphical diagram.

To build this graphical network diagram, the keywords were manually grouped based on their semantical and conceptual similarity. For instance, the keywords *group performance*, *team performance,* and *performance* were grouped together as they all share semantical similarity and refer to the basic idea of performance in virtual teams. Second, the keywords were grouped by using the Input, Process, and Output (IPO) framework as a high order conceptual similarity structure. The IPO framework was originally proposed by Hackman and Morris (1975) to explain the functioning of collocated teams and was further leveraged for the study of virtual teams (Martins, Gilson, & Maynard, 2004; Powell et al., 2004). The IPO framework establishes three key elements for the

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functioning of work groups: a) the initial conditions of the team, which influence the manner these teams operate and execute their tasks; (b) the interaction processes, defined as the means or methods that the teams utilize to attain their goals; and (c) the team outcomes, representing the consequences of the group functioning. Consistent with previous virtual team's work, the interaction processes can be split into two main categories: task processes, which occur as team members work together to accomplish a group task; and socio-emotional processes, which refer to the relationship building processes that foster team effectiveness (Powell et al., 2004).

Therefore, keywords representing the structural characteristics and composition of the virtual teams, such as *diversity*, *group size*, and *design*, were grouped together under the *Input's* high order conceptual group. The keywords representing task processes, such as *communication* and *coordination* were grouped under the *Task processes* high order conceptual group; and keywords, such as *trust* and *understanding conflict* were grouped under the *Socio-emotional processes* high order conceptual group. Finally, the keywords representing the outcomes of the group functioning, such as *decision-making, collaboration*, and *knowledge sharing* were grouped under the *Output's* high order conceptual group.

By visually assessing the graphical diagram displayed in Figure 1 from the perspective of the *trust* keyword, and based on the thickness of the lines connecting to this keyword; it is possible to identify the following stronger ties, by decreasing order of the magnitude of the tie: *communication* and *trust; trust* and *performance*; *trust* and *collaboration*; and, *time* and *trust*.

To complement the visual assessment of the diagram, and to help evaluate the relative importance of the keywords, the C_i values from each keyword in the network were calculated, and the first ten keywords with highest C_i values are displayed in Table 1.

Table 1. Normalized centrality degree from the keywords

Keyword	Normalized centrality degree (C_i)
Performance	17.676
Communication	15.548
Collaboration	13.912
Trust	13.339
Knowledge	10.720
Organizations	9.165
Time	8.347
Model	8.020
Information technology	7.938
Management	7.856

Among the ten keywords with highest C_i values, the keyword *trust* appears in forth position (C_i=13.339); or equivalently, the *trust* keyword establishes approximately 13% of all its possible connections with other keywords in the network. It is interesting to notice that the three keywords whose C_i values are higher than the *trust* keyword are the ones with whom the *trust* keyword shares the strongest ties in Figure 1. Also, *trust* is the only keyword from the high order conceptual group *Socio-emotional processes* listed among the ten keywords with highest C_i values.

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Taken together, the results obtained from the qualitative and quantitative analysis of the keyword co-occurrence network highlight the main topics of virtual team research in the IS domain; in which the issue of trust appears to be the major socio-emotional concern from IS researchers.

The trust-related studies within virtual team research …

Based on these preliminary results, the sample of 112 articles were then carefully evaluated and only the articles that included trust in their research topic were maintained for further analysis. This analysis resulted in a final sample of 13 articles, or approximately 12% of the initial sample. At this point, it was noticed that the article from Jarvenpaa and colleagues published by the Jornal of Management Information Systems (Jarvenpaa, Knoll & Leidner, 1998), and that was previously known by one of the authors, had not been included in the final sample of articles. After a careful investigation, it has been noticed that the reason for the missing article was the fact that its publishing journal had only started indexing their articles in ISI Web of Science after the year of 1999. Except for this occurence, no other journals considered on this study have seemed to adopt similar approach. Given the importance of this missing article (a search in Google Scholar reveals that it has more than 2,300 citations as of March, 2019), the authors have decided to manually include it in the study, thus resulting in a final sample of 14 articles that were published between the years of 1998 and 2016 (Table 2).

Table 2. Final sample of articles selected for in depth evaluation

Publishing journal	Number of Articles Selected	Articles
European Journal of Information Systems	1	Altschuller and Benbunan-Fich (2013)
Information Systems Journal	4	Campbell, Fletcher and Greenhill (2009), Dubé and Robey (2009), Lowry et al. (2010), Dennis, Robert Jr, Curtis, Kowalczyk, and Hasty (2012)
Information Systems Research	1	Jarvenpaa et al. (2004)
Journal of the Association for Information Systems	1	Avgerou (2013)
Journal of Management Information Systems	5	Jarvenpaa et al. (1998), Brown et al. (2004), Zahedi and Song (2008), Sarker et al. (2011), Cheng et al. (2016)
Journal of Strategic Information Systems	1	Kanawattanachai and Yoo (2002)
Management Information Systems Quaterly	1	Piccoli and Ives (2003)
Total	14	1998-2017 (second quarter)

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The careful reading of the 14 articles suggests that they can be grouped into three main research groups, according to their focus on the issue of trust in virtual teams (Table 3):

- Antecedents of trust in virtual settings;
- Nature of the trust development process in virtual settings; and,
- Effects of trust in virtual team outcomes.

Table 3. Distribution of articles by thematic focus

Focal topic	Number of Articles	Articles
Antecedents of trust	9	Jarvenpaa et al. (1998), Piccoli and Ives (2003), Brown et al. (2004), Dube and Robey (2009), Lowry et al. (2010), Dennis et al. (2012), Altschuller and Benbunan-Fich (2013), Avgerou (2013), Cheng et al. (2016)
Trust development process	2	Kanawattanachai and Yoo (2002), Zahedi and Song (2008)
Trust effects in team outcomes	3	Jarvenpaa et al. (2004), Campbell et al. (2009), Sarker et al. (2011)

Examples of trust antecedents or factors being discussed by the articles belonging to the first group are:

- Behavioral attitudes and control factors: studies discussing the effect of positive attitudes from virtual team members for the building of team trust (Jarvenpaa et al., 1998; Dubé & Robey, 2009); or the negative effect of behavior control practices in the trust levels of virtual teams (Piccoli & Ives, 2003).
- Individual personality traits factors: studies exploring the individuals personality traits that facilitate the development of trust, such as an individual's disposition to trust (Brown et al., 2004; Avgerou, 2013). Dennis et al. (2012), for instance, have re-assessed the research findings from Piccoli and Ives (2003) and concluded that the disposition to trust may affect how individuals perceive the effect of behavior control practices on trust development; in the sense that behavior control induces individuals to focus on the behaviors their disposition to trust expects rather than the behaviors that actually occur.
- Social factors: studies investigating the social aspects of virtual teams and their impact on trust development in virtual settings. Among the social elements investigated are the cultural diversity and social presence of team members (Lowry et al., 2010), electronic portrayal and self-disclosure of individuals (Altschuller & Benbunan-Fich, 2013), and facilitation intervention techniques such as collaboration engineering (Cheng et al., 2016).

This first group of articles seemed to support the magnitude of the connection identified between the keywords *trust* and *communication* in the keyword co-occurrence network. This is justified by the fact that the antecedents of trust being approached by these articles, such as an individual's

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behavioral attitudes, personality traits, and social presence have either a dependency or an impact in the communication processes between individuals in virtual settings (Brown et al., 2004; Jarvenpaa et al., 1998; Lowry et al., 2010).

In the second group, the studies tried to approach how the trust development process evolves over time, by focusing on the understanding of the dynamic nature of trust (Kanawattanachai & Yoo, 2002; Zahedi & Song, 2008). Similarly, the identification of this second group of articles has supported the finding of a strong connection between the keywords *trust* and *time* in the keyword co-occurrence network.

In the third group, although there seemed to be a general agreement that trust is important for enabling collaboration and superior performance of virtual teams; some researchers have found opportunities for further refinement of this common understanding. Jarvenpaa et al. (2004), for instance, have proposed and empirically validated that the effect of trust in virtual team outcomes is dependent on the condition and scenario of the team, i.e., trust seems to affect virtual teams differently in different situations. These authors have concluded that, at the early stages of a virtual team´s existence, trust may have direct impact in member´s perceptual outcomes; whereas in later stages of a virtual team´s existence, trust may act as a moderator by facilitating the transformation of task processes in team outcomes.

A similar perspective is proposed by Sarker et al. (2011) by leveraging alternative methodological approaches, such as SNA, to evaluate the impact of trust in the performance of virtual teams. These authors have proposed that trust mediate the relationship between communication and performance of virtual teams, and justify their alternative methodological choices based on the argument that the concept of trust is inherently relational instead of an attribute of individuals.

Lastly, there is one interesting article challenging the traditional assumption that the presence of trust and cohesion are always desirable in virtual groups. The study of Campbell and colleagues demonstrated how conflict between positions of power in online communities can generate positive outcomes by helping align values and ideals of their members (Campbell et al., 2009).

The finding of this third group of articles has also supported the magnitude of the connections identified, respectively, between the keywords *trust* and *performance* and *trust* and *collaboration*, in the keyword co-occurrence network.

… and their theoretical foundations

In an attempt to identify the main theoretical basis of the final sample of articles, a co-citation analysis was conducted based on the cited references of the articles. The goal of this analysis was to display the connections between the cited references based on the frequency that two references were cited together by the articles of the sample. By analyzing the connections between the cited references along with the magnitude of these connections, it is possible to conduct a visual assessment of the key references cited by the sample of articles (Watanuki et al., 2014). As a result of this analysis, nine cited references have emerged, with stronger connections in the area highlighted with red dashes in Figure 2.

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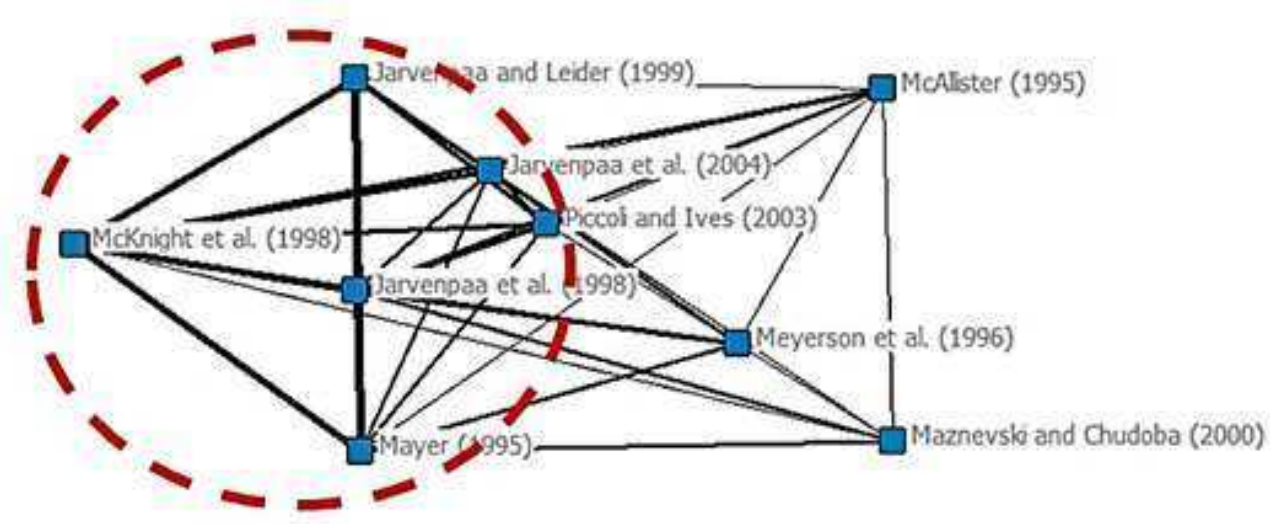

Figure 2. The co-citacion network**.

****Note**: The blue squares represent the cited references from the sample of articles, and the thickness of the lines connecting the blue squares represent the magnitude of the connection between the two cited references, based on its frequency of occurrence. In order to provide a clearer view of the relationships within the network, a filter was applied in this graphical network to only display the cited references from articles of the sample that possessed more than five citations in ISI Web of Science on the date of the metadata extraction. The cutoff value of five citations was determined after starting the analysis with no citation cutoff value and increasing the citation cutoff value by one unit until it became practical to visualize the main cited references in a graphical diagram.

To complement the visual assessment of the diagram, and to help evaluate the relative importance of the cited references, the C_i values from each cited reference in the network were calculated, and are displayed in Table 4.

Table 4. Normalized centrality degree from the cited references

Cited reference	Normalized centrality degree (C_i)
McKnight et al. (1998)	65.625
Jarvenpaa et al. (1998)	64.063
Jarvenpaa and Leidner (1999)	64.063
Mayer (1995)	62.500
Piccoli and Ives (2003)	45.313
Jarvenpaa et al. (2004)	42.188
Meyerson et al. (1996)	40.625
Maznevski and Chudoba (2000)	32.813
McAllister (1995)	32.813

According to Table 4, four cited references have established at least 62% of their respective possible connections in the co-citation network (i.e., C_i greater than 62): McKnight et al. (1998), Jarvenpaa et al. (1998), Jarvenpaa and Leidner (1999), and Mayer et al. (1995).

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Although the visual assessment of the co-citation network combined with the assessment of the C_i values of the cited references have converged to these four cited references, the careful reading of all nine cited references suggests that they can also be categorized into two main groups, according to their thematic origin:

- Propositions of formal trust development models in traditional collocated organizational settings (McAllister, 1995; Mayer et al., 1995; Meyerson et al., 1996, McKnight et al., 1998);
- Studies leveraging the formal trust development models from collocated settings to evaluate their dynamics and/or behavior under specific conditions in virtual settings (Jarvenpaa et al., 1998, 2004; Jarvenpaa and Leidner, 1999; Maznevski and Chudoba, 2000, Piccoli and Ives, 2003).

These results suggest that the research models utilized for studying trust development in virtual teams have been leveraged from base models proposed by organizational studies published in the second half of the 1990s. This interdependence is highlighted in Table 5 where the final sample of 14 articles has been categorized based on the respective trust development model that was leveraged by each article.

Table 5. Trust development models leveraged by the final sample of articles

Article	**Base trust development model leveraged**				
	Mayer (1995)	McAllister (1995)	Meyerson et al. (1996)	McKnight et al. (1998)	None/ Other
Jarvenpaa et al. (1998)	×		×		
Kanawattanachai and Yoo (2002)		×			
Piccoli and Ives (2003)	×				
Brown et al. (2004)	×			×	
Jarvenpaa et al. (2004)				×	
Zahedi and Song (2008)	×			×	
Campbell et al. (2009)***					×
Dube and Robey (2009)****					×
Lowry et al. (2010)		×			
Sarker et al. (2011)	×				
Denis et al. (2012)	×				
Altschuller and Benbunan-Fich (2013)		×		×	
Avgerou (2013)				×	
Cheng et al. (2016)					×

***Note**: Campbell et al. (2009) assessed if the absence of trust in online financial communities has a critical effect on the team functioning, therefore, no formal trust model was used.

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*****Note**: Dubé & Robey (2009) have used a qualitative exploratory approach to map paradoxes in virtual teams and have not defined a formal trust model *a priori*.

Taken together, these results indicate that the trust development models proposed by Mayer et al. (1995) and McKnight et al. (1998) are the most common models leveraged by IS researchers when investigating trust-related issues in virtual teams.

DISCUSSION

Based on the results presented above, this section provides an overview of main definitions of trust, its main research paradigms, and opportunities for future studies from the perspective of virtual team research in the IS domain.

Trust definition and typology

The ubiquity of trust in the everyday life of human society has resulted in a concept of complex definition, with different typologies according to the perspective or approach adopted by the researcher.

Jarvenpaa et al. (1998), in a first approach to the concept of trust, suggest that trust can be analyzed from a social or a rational perspective. In the social perspective, the moral duties or obligations of a particular social group play a prominent role, and trust is established because it is the morally appropriate attitude in the group. This would be the perspective to be adopted, for example, to analyze the trust developed between close members of the same family, such as children, parents, and grandparents. In the rational perspective, the focus is the calculation of self-interest. In this case, the perception that increased trust reduces the costs of maintaining a relationship - since the respective parties need to develop fewer defensive attitudes against the opportunistic behavior of the other - encourages individuals to take risks. This would be the perspective to be used, for example, in the case of an investigation exploring the development of trust between work partners. Being the focus of this study the context of virtual collaboration in the organizational environment, the proper perspective to be adopted onwards is the rationalist.

According to the IS-centric literature reviewed, three types of trust seem to be important for studying virtual teams:

- Dispositional trust: specific to each individual and associated with their respective personal traits. It is independent of any context and related to the belief of each individual in human nature, i.e., a natural tendency to trust other people (Mayer et al., 1995; McKnight et al., 1998).
- Interpersonal trust: developed from the relationship between two or more individuals and based on the expectation that verbal and written statements of one of the parties can be fully entrusted by the other party (Mayer et al., 1995; McAllister, 1995; McKnight et al., 1998; Meyerson et al., 1998).
- Structural or institution-based trust: it is dependent on a context and on an impersonal system or institution, whose perceived properties can inspire confidence in individuals (McKnight et al., 1998).

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As it can be inferred from the taxonomy above, the phenomenon of trust usually involves two parts: one that trusts (i.e., trustor) and the other that is entrusted (i.e., trustee), the latter being a person, inanimate system or situation. Therefore, the establishment of trust depends not only on the attributes of the trustor (i.e., dispositional trust), but also on the attributes of the trustee (Avgerou, 2013; Mayer et al., 1995; McKnight et al., 1998).

Based on these arguments, the basic definition of trust is proposed by Mayer et al. (1995:712) as: "*the willingness of a party to be vulnerable to the actions of another party based on the expectation that the other will perform a particular action important to the trustor, irrespective of the ability to monitor or control that other party*". By focusing on the interpersonal trust, McAllister (1995:25) proposes another popular definition of trust as: "*the extent to which a person is confident in, and willing to act on the basis of, the words, actions, and decisions of another*."

The main research paradigms

The formal models originally designed to explain the development of trust in traditional collocated organizational contexts still represent an important theoretical foundation for studying trust development in virtual contexts, under various different perspectives. The main base models leveraged by IS researchers so far are the ones proposed by McAllister (1995), Mayer et al. (1995), McKnight et al. (1998), and Meyerson et al. (1998).

The basic model from McAllister (1995) suggests that interpersonal trust is composed by two fundamental dimensions: the affective and the cognitive trust. Affective trust is based on the reciprocal emotional bonds of solicitude and protection between the parties; whereas the cognitive trust is based on the beliefs of competence and responsibility between the parties. Comparatively, cognitive trust tends to be more superficial than affective trust, which is characterized by greater investment of time and emotional ties between the parties. Affective trust relies, for instance, on frequent interaction between the parties, under which personal and social information is exchanged. Based on its defining characteristics, McAllister´s model seems to be particularly useful in investigations focusing the emotional perceptions and feelings from individuals involved in trust development in virtual settings, such as emotional bonds and care (Kanawattanachai & Yoo, 2002), perceived similarity (Lowry et al., 2010), and social presence (Altschuller & Benbunan-Fich, 2013).

The recursive model from Mayer et al. (1995) explicitly considers both the trustor and trustee attributes to explain the development of interpersonal trust over time during a relationship between two individuals. According to these authors, whereas trustor´s attributes – mainly reflected in their disposition to trust – are assumed to be stable during the relationship; the attributes of the trustee, or at least how the trustor cognitively processes these attributes, can change over time as the relationship evolves, in terms of three dimensions: competence, benevolence, and integrity. Competence refers to the trustor´s perception about the abilities, proficiencies, and knowledge of the trustee. Benevolence refers to the trustor´s degree of belief that the trustee is well-intentioned in relation to the trustor. Integrity corresponds to the trustor´s perception that the trustee will adhere to a set of rules or principles established or accepted by the trustor. Given its distinctive characteristics, the model from Mayer and colleagues seems to be particularly useful for virtual team research exploring the development of trust over time with a focus on how individuals cognitively process factors influencing trust development, such as control behavior (Piccoli & Ives, 2003; Dennis et al., 2012) and communication patterns (Sarker et al., 2011).

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Supported by Mayer and colleagues' findings and by using a holistic approach; McKnight et al. (1998) have focused on how trustor´s and trustee´s attributes interact along with institutional-based trust and cognitive processes to shape trustor´s perceptions of competence, benevolence, and integrity at the beginning of a relationship. Their model has specifically focused the process of initial formation of trust between two individuals in an organizational setting: a condition that was particularly useful to understand how trust would develop under virtual settings, in which individuals are frequently new to each other. Therefore, the model from McKnight and colleagues has found applicability at numerous virtual team's works, especially studies approaching trust development at early stages of a relationship (Jarvenpaa et a., 2004; Brown et al., 2004; Altschuller & Benbunan-Fich, 2013) or studies incorporating institutional-based trust elements (Avgerou, 2013; Zahedi & Song, 2008).

Finally, Meyerson et al. (1998) propose that in temporary teams where individuals do not have time to develop trust via a gradual or cumulative process; instead of an affective or cognitive construct, trust becomes a depersonalized form of action. Their main argument is that, under high time pressure, individuals give less emphasis on feelings and information processing, and give more emphasis on action. As a consequence, individuals act as if trust is present and become able to work on interdependent tasks with strangers. Meyerson et al. (1998) have referred to this phenomenon as swift trust, and their model has been particularly useful for studying temporary virtual teams.

Opportunities for future research

After the systematic review of the IS literature on virtual team research, few opportunities for future research have been noticed.

First, the trust-related issues in virtual team research seem to represent an important and ongoing opportunity for research in the IS domain. This has been highlighted not only by the results of the bibliometric analysis and SNA – where the *trus*t keyword has appeared tightly connected with keywords representing popular topics in virtual team research, such as *performance*, *communication*, and *collaboration* – but also by the continuous flow of articles being published by main IS journals in the last two decades. This finding corroborates Söllner and colleagues' assertion that "*trust is one of the popular and well-cited areas of research in the IS literature, especially during the last 20 years*" (Söllner et al., 2016:1).

Second, from a research focus perspective, exploring additional antecedents for trust development in virtual teams seems to be a fertile area of research in the IS domain. As it has been noticed on the sample of articles considered in this study, the majority of them – 9 out of 14 articles, or approximately 64% of the final sample – have focused on investigating how trust development can be influenced by a multitude of behavioral, personality, and social factors. The list of factors potentially influencing trust development in virtual teams should continue to grow as organizations and technology are continuously evolving and affecting the way individuals interact at the workplace.

Interestingly, despite this study constitutes an IS-centric literature review, among the sample of articles reviewed, only two publications (Zahedi & Song, 2008; Altschuller & Benbunan-fich, 2013) have focused on investigating how IT artifacts and its features can impact trust development in virtual teams. By considering that most trust development models emphasize the importance of information about the trustee for the building of trust, and that IT artifacts have largely been enhanced from the perspective of information exchange in the last decades, this calls for additional research exploring how IT artifacts can facilitate trust development in virtual settings. This recommendation is consistent

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with Lowry´s and colleague´s general view about the aims of IS research: explore ways to improve artifacts both from technological and organizational perspectives (Lowry et al., 2010). One example of such approach is the study of Kuo and Thompson (2014) where information from online social networks have been utilized in an attempt to foster interpersonal trust between new virtual work partners. Given the ubiquitous presence of social networking sites in human´s life, the exploration of social media technologies as an IT artifact to promote interpersonal trust between individuals constitutes a very promising research field (Kuo & Thompson, 2014; Cummings & Dennis, 2018).

Third, from a research paradigm perspective, with the exception of the work from Jarvenpaa et al. (1998), no other article from the final sample has tried to develop a formal model for trust development in virtual settings. Most of the papers reviewed in this study have relied upon trust models developed for traditional collocated settings during the second half of the 1990´s. Even the trust development model for virtual settings proposed by Jarvenpaa et al. (1998) is largely derived from a combination of the models proposed by Mayer et al. (1995) and Meyerson et al. (1996). As time goes by and technologies shape new behaviors in society, one should question whether the legacy trust development models from the 90´s are still largely valid to be used in virtual settings or, otherwise, efforts should be made to establish new research paradigms specifically suited for virtual settings. This seems to be, for instance, the approach adopted recently by Cheng et al. (2016): instead of relying on the traditional trust development models, these authors suggest that, in virtual teams, trust can be dynamically assessed via a specific set of conflicting priorities from individuals.

CONCLUDING REMARKS

"*Few would disagree that trust is one of the key behavioral themes of interest to organizational and information systems (IS) scholars today*" (Sarker et al., 2011:274).

The assertion above from Sarker and colleagues is in line with the conclusions of this study. Based on a systematic IS-centric literature review on virtual team research, trust has emerged as the most frequent socio-emotional process being discussed by main IS journals.

The careful evaluation of the sample of articles utilized in this study, expanded to their main bibliographical references, has allowed the identification of formal definitions for the trust concept, the most common trust theoretical models leveraged by virtual team researchers, as well as, opportunities for future research in the IS domain.

Despite its narrow focus, this study aimed at contributing not only to IS researchers, but to academics in general. From a practical perspective, this study provides researchers with a structured methodology for the execution of a systematic literature review. The methodology presented in this paper can support the mapping of knowledge available in a certain thematic area or discipline of science, as well as the identification of trends, gaps and opportunities for future research with reduced bias. From an IS perspective, this study can be used by IS researchers as a repository of information to support and drive future trust-related investigations in virtual team research.

As the main limitation of this study, some criticism can be made to the decision of concentrating the systematic literature review on the eight journals suggested by the AIS Senior Scholar´s Basket of Journals; since these eight journals do not cover all published research in the IS domain. Although this approach excluded some IS journals, the list of eight journals utilized in this study have demonstrated considerable diversity of topics, methodologies, and research institutions. Additionally, these eight journals are internationally recognized for their contribution in the IS domain and, therefore, their

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selection is consistent with the goal of this study.

Another limitation is associated to the fact that, for some specific journals such as Journal of Management Information Systems, ISI Web of Science only provides the metadata from their publications after a certain year. Therefore, it is possible that, in specific cases, older publications may have not been included in the sample of articles reviewed in this study. To mitigate this risk, the authors have made every effort to identify any important article that was potentially missing, and to the best of their knowledge, no publications have been left behind.

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