

The Role of Trust in Collaborative Research Settings: Opportunities for Future Research in Graduate Engineering Education

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Abstract

Collaborative research is becoming the norm for science and engineering graduate students as the future of engineering research is increasingly interdisciplinary. However, little research describes the competencies required for graduate student success on collaborative and interdisciplinary teams. In related work, researchers in “science of team science” (usually focused on collaborative medical research settings) have begun to study the factors for success of collaborative and often interdisciplinary teams. One of the least-studied and abstract of these factors is the construct of trust—both within team members and in relation to the team leaders. This paper uses a systematic literature review method to investigate the role of trust within collaborative research settings, with the intention of unveiling future research directions for graduate-level engineering education. The results of this systematic literature review demonstrate that there is not a singular, clear, standard definition of trust within collaborative research and that there is a lack of studies that explore trust and collaboration within research settings and particularly none are aimed at the ways in which people develop these skills. The results of this review are immediately relevant to researchers involved with interdisciplinary and collaborative research, and have implications for those that educate graduate students to be future collaborative and interdisciplinary researchers.

Introduction

In an increasingly global society, collaboration plays an important role in an engineer’s success. Advancements in modern technology allow for truly global teams and more advanced long distance communication. Modern technologies for collaboration and the emphasis on collaboration in competitive industries and academia do not necessarily ensure success, which depends on a number of factors. From here the implications of this grouping are discussed

The “Science of Team Science (SciTS)” is emerging as a research area to explore how large-scale research (initiated in the medical research context) endeavors can be best accomplished across multiple institutions and potentially hundreds of colleagues¹⁻³. The Science of Team Science literature has high value in studying collaborations in engineering and particularly the ways in which students learn to become collaborative members of their research teams. SciTS findings have only recently been introduced in an engineering and graduate engineering student educational context³. Most of these studies promote competency- or logistical- bases for success: that by having the right conditions for success, all teams will be able to be successful. However, other studies identify abstract concepts as being critical antecedents (precursors to) and descendants (results of) having a high-performing team. One of these is trust.

The importance of trust within teams has already been demonstrated through several studies⁴⁻⁸. Efforts to understand trust as a construct have been made since the 1970s, with Driscoll and Scott being some of the first to define different forms of trust in modern terms^{9,10}. However, the majority of the research into team trust has been in business and industry settings^{4,11-15}. While there may be some similarities in research teams and business teams, it is inaccurate to say that these teams may be treated the same due to their different roles within organizations, different objectives, and different outcomes. Several case studies and commentaries have addressed trust and collaboration within research teams but lack experimental validation of their theories and conclusions^{2,14,16,17}. Moreover, these studies lack a clear definition of trust within the context of their observations, leaving the term and thus their findings open to interpretation.

For engineering educators, most of the teaming literature is either conducted with undergraduate students learning to design in teams or in studies that seek to understand the working patterns of practicing professionals. While current engineering “teaming” and collaboration literature explores the factors that can make a successful team^{18,19}, there is an enormous gap in studies in collaborative research settings, especially at the graduate level. Graduate engineering students are immediately expected to assimilate into a laboratory group, usually an interdependent team, with varying degrees of guidance by faculty members. The group dynamics and the role of trust as graduate students learn to conduct collaborative research is underexplored, but may have ramifications for the way in which graduate programs are structured or in how graduate students are matched with potential research advisors.

Other theories and research also seek to understand mechanisms by which experts innovate in professional settings, and many of these have been applied to engineering education. Theories of distributed cognition²⁰ have been employed to understand the ways in which professionals share disciplinary knowledge across teams of diverse expertise^{21,22}, but have to date failed to study the ways in which developing experts (graduate students, as an example) learn to share knowledge efficiently. Similarly, there is much current work in the area of creativity in design research^{23,24}, and how diverse teams result in more innovative solutions to engineering problems; however, most research does not address graduate-level engineering education despite the importance of these researchers to innovation.

As a result of the lack of literature surrounding the development of “collaborative competencies” in graduate-level engineering education, and because of the ambiguous role that “trust” plays in collaborative research contexts, this paper seeks to illuminate the ways in which studies in collaboration across all fields define and study the role of trust. This systematic literature review seeks to identify common issues across studies in trust. The following research questions guide the systematic literature review in order to unveil future directions for the study of collaborative competency development in graduate engineering education:

- (1) To what extent does current literature explore trust within collaborative research teams?
- (2) What are the overarching findings of these studies?
- (3) How is trust defined within research teams and what is its role?

A systematic literature review is a rigorous method of making sense of large bodies of work in order to identify areas where new studies may be needed. Unlike a typical literature review, a systematic literature review is a rigorous and scientific approach to reviewing relevant bodies of literature; traditional literature reviews may be somewhat amorphous and variable in structure while systematic literature reviews are structured prior to performing the actual literature review and strictly adhere to the structured format. This systematic literature review will first address the methods to be used followed by the selection process for the literature. From this selected body of literature, each work is reviewed and grouped appropriately. These groups are then analyzed for themes across the studies. These themes and their implications for the larger area of study (trust in collaborative research settings) are discussed. Finally conclusions are drawn looking towards the future of the field.

Methods

The principals guiding the methods for this systematic literature review are based on those outlined by Petticrew & Roberts²⁵. A systematic literature review follows a rigorous process to ensure a comprehensive and thorough review. A set of methods determined by the reviewer is used to identify, analyze and synthesize relevant studies to answer specific questions or hypotheses. While the goals of a traditional literature review are to reveal the gaps in the research in order to motivate present research, a systematic literature review begins by clearly defining research questions for the literature review itself. After defining research question for the literature review, the researcher must specify inclusion and exclusion criteria for studies. These criteria are applied rigorously throughout the review process to ensure consistency in literature selection. Once all relevant databases have been searched, and preliminary literature collected, all literature is subjected to a methodical selection process. In systematic literature review methods, the researchers catalog the reason for exclusions of any paper. This aids in understanding of where large bodies of works are lacking or where there is an overabundance of studies.

Another defining feature of the systematic literature review is the use of a data extraction sheet to gather the same information from each study as well as to compare within and across the categories of the data extraction sheet. Again, this is to ensure consistency in the information included. In addition, the quality of each study is assessed by methods defined by the reviewer. The included studies are then tabulated and categorized by quality and characteristics. This process allows for analysis within categories and synthesis across categories. From there,

findings are summarized and relevant future research areas are identified. Ultimately, the systematic literature review presents a clear review process to the audience for transparency and replicability, which in turn ensures a higher quality comprehensive review.

Trust and the Science of Team Science: Selection of Literature

The literature search included peer-reviewed papers published from January 1986 to December 2016. This allowed the presentation of data after the introduction of the computer to the work place to account for then-novel methods of collaboration. This time frame also prevents the inclusion of significantly outdated research in trust and team sciences. Searches were performed using the following databases: ERIC, Google Scholar, Wiley Online Library, SpringerLink, ScienceDirect, JSTOR, Taylor and Francis Online, IEEE Xplore, and ProQuest. Within these searches the following keywords were used: *trust*, *collaboration*, *collaborative research*, *communication*, *team science*, and *team trust*. Additional articles were retrieved from the references of the articles found and approved from the initial searches.

Inclusion Criteria and Data Extraction Methods

Several inclusion criteria were developed to identify acceptable papers for the review. The inclusion criteria are shown in Table 1.

Table 1: Inclusion criteria for the systematic literature review

Inclusion Criteria	
i	Papers published in peer-reviewed journals
ii	Papers that focus on trust and/or collaboration as factors that affect team work
iii	Papers that define trust and collaboration as a model, concept, framework or measure of study
iv	Papers with clearly defined methods (rather than commentaries or best practices)
v	Non-undergraduate student participants

Conversely, papers that met two or more of the following exclusion criteria shown in Table 2 were discarded before analysis. Studies of undergraduate students were also excluded. These studies were excluded due to short-lived, temporary nature of these teams. Furthermore this study is focused on research settings which rarely occur in undergraduate classrooms. Dissertations, books, commentaries, guides, case studies, and literature reviews were excluded. These works were excluded in order to have consistent criteria for analysis which would have been more difficult and complicated to achieve if too wide of a variety study types were included.

Table 2: Exclusion criteria for the systematic literature review

Exclusion Criteria	
a	Papers that do not detail the number of participants and/or teams
b	Papers that do not discuss participant details
c	Papers that do not discuss team sizes
d	Papers that do not outline variables observed/accounted for
e	Papers that do not outline their methods for data collection
f	Papers that do not outline methods of data analysis

Articles were not excluded on the basis of quality nor the country of focus. Detailed information about each study was recorded in a data extraction sheet. The following variables were included in the data extraction sheet: author, publication date, measures, number of participants, team size(s), methods of data collection (survey, interview, etc.), methods of analysis (descriptive statistics, regression, structural equation modeling, etc.), and conclusions with respect to trust. Conclusions related to the relationship of trust and team success were sorted into “trust descendant conclusions” and “trust antecedent conclusions.” Descendants of trust are defined as variables or aspects of teamwork and success directly affected by trust. Antecedents of trust are those variables or aspects of teamwork and success that directly affect trust within a team.

Study Selection

As shown in Figure 1, the initial search generated 140 studies. The 140 studies initially included were reviewed first by their title and abstract according to the inclusion criteria. Of these, 28 were not published in peer reviewed journals, 15 did not address trust as a factor that affects teamwork, 15 did not define trust and/or collaboration as a model, concept, framework, or measure of study and 5 studies had only undergraduate students as participants. The remaining 77 papers were reviewed. Of the 77, 5 did not address trust as a factor that affects teamwork, 7 did not define trust and/or collaboration as a model, concept, framework, or measure of study, 26 had unclearly defined methods, and 15 studies had only undergraduate students as participants. A total of 24 studies remained. A search of the references from these papers yielded 37 additional papers. The same procedure for inclusion was performed for these additional papers. After the two step review process, 7 of the 37 were included. In total, 31 papers met the inclusion criteria for this study and were reviewed.

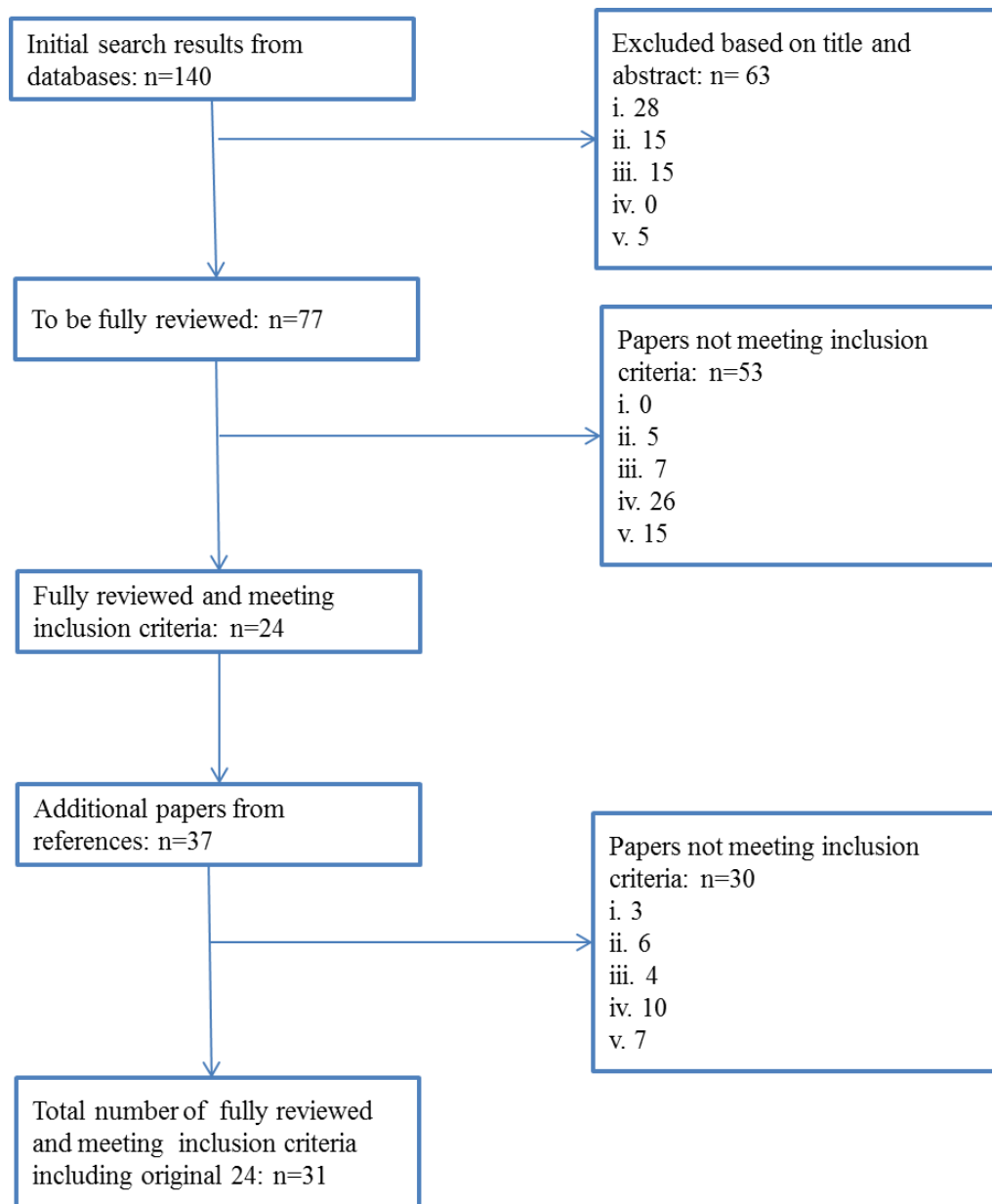


Figure 1: The exclusion process for the papers found and the number of papers remaining at each stage of the exclusion process. See Table 1 for explanation of criteria i – v.

Results of Systematic Literature Review

Study Characteristics

The characteristics of the 31 papers included in this research can be found in Appendix A. Studies were categorized into those that took place in one of 4 settings: business, research00, academic (student), and other (any settings not in aforementioned categories).

Table 3: Reviewed papers' characteristics

Characteristic	Business (k=20)	Research (k=4)	Academic (Student) (k=5)	Other (k=2)
Pub. Date				
1992-1996	2	0	0	0
1997-2001	1	0	1	1
2002-2006	5	1	2	0
2007-2011	7	2	0	0
2012-2016	5	1	2	1
Team Size(s)				
2-5	7	0	4	0
6-10	7	1	1	0
11-15	6	0	0	1
16-20	4	0	0	0
21-25	3	0	0	0
25-30	2	0	0	0
31+	2	0	0	1
Outcomes				
Comparison of types of trust	10	1	2	1
antecedents of trust	13	1	2	1
descendants of trust	18	3	3	2

The purpose of this grouping was to emphasize the lack of studies in collaborative research settings. With the exception of a few studies, the primary method of data collection was a single self-administered survey. There was a wide variety in duration of time that the teams existed. For example, teams in educational contexts had a shorter “lifetime” whereas teams in industry contexts tended to have longer “lifetimes.” Team lifetime information was only available for a small portion of the studies included. In general, the number of relevant studies drastically increased in the early 2000s but has remained relatively steady since then (albeit not in engineering contexts). Of the studies included in this systematic literature review, the majority took place in business settings as opposed to the desired research setting.

Study Quality

Quality Assessment

As no papers were excluded on the basis of quality, quality assessment was performed after selection of papers for review. Each aspect was rated on a scale of 1 to 3 with 3 being the highest quality and 1 being the lowest quality. The aspects of quality assessment used in this study can be found in Table 4. It is important to note that although all variables were rated on a scale of 1 to 3, trust as a direct measure is only a value of 1 or 3, in order to more effectively weight trust in this review: If trust is not a direct measure then the study is less relevant to this review as the goals of this review pertain to the role of trust in collaborative research settings. The specifics of how each rating was determined for each variable can be found in Table 4.

Table 4: Quality Assessment Measures

Measure	Score = 3	Score = 2	Score = 1
Theoretical basis for experimental method	Methods are based on explicit theory	Methods may be based on implied theory	Methods are based on no theory
Sample size	100 people, 20 teams or more	50 people, 10 teams to 99 people, 19 teams	Less than 50 people, 10 teams
Team longevity	6 months or more	3 months to 5 months	Less than 3 months
Piloting of methods prior to implementation	Piloting of methods	Methods based on other research designs	No piloting nor methods based on other research designs
Sample heterogeneity	Substantial heterogeneity	Some heterogeneity	Minimal heterogeneity; almost entirely homogeneous
Generalizability	Applicable across many disciplines, cultures, and settings	Applicable across some disciplines, cultures or settings	Applicable only to a specific discipline, culture or settings
Trust as a direct measure	Trust was a measured variables	-	Trust was not a measured variable
Appropriateness of measures	All measures are appropriate and/or have been previously defined and measured	Most measures are appropriate or have been previously defined and measured	Measures are inappropriate and/or have not been previously defined and measured

Measure	Score = 3	Score = 2	Score = 1
Reliability and validity of measures	Reliability and validity of all measures are calculated	Reliability and validity are calculated for some measures	Reliability and validity are not calculated
Discussion of limitations	Limitations of the study are thoroughly addressed	Limitations of the study are briefly mentioned	Limitations of the study are not discussed

From the methods of assessment laid out in Table 4 the total quality rating for each category was calculated and split into 3 ranges as show in Table 5:

Table 5: Overall Study Quality by Category

Quality	Business (k=20)	Research (k=4)	Academic (Student) (k=5)	Other (k=2)
14-18	1	0	1	1
19-23	13	3	2	1
24-27	6	1	2	0

The average study quality overall was 22 out of 30, ranging from 14 to 27. Research setting studies scored marginally higher than business setting studies, both of which were slightly above the overall average, while academic and other setting studies scored below average. It is important to note that the marginal difference cannot be treated as statistically significant due to the significantly smaller sample size of all other settings compared to the number of business setting studies. The average score of each setting type for each quality assessment measure can be found in Table 6.

Table 6: Average study quality measures as compared against setting

Measure	Business	Research	Academic	Other
theoretical basis for experimental method used	2.65	2.5	2.6	2
sample size	2.95	3	2.2	2.5
team longevity	3	3	2.2	2.5
piloting of methods prior to implementation	1.95	2	2.2	2.5
sample heterogeneity	1.95	1.5	1.4	1
generalizability	1.85	1.75	1.6	1
trust as a direct measure	2.9	3	2.6	2
appropriateness of measures	2.6	3	2.6	2
reliability and validity of measures	2.6	2.75	2.2	1.5
discussion of limitations	2.2	2.5	2.2	2

In most quality assessment measures, research conducted in research and business setting studies scored comparatively. Business setting studies were slightly less likely to directly measure trust and were less likely to have experimental methods that had been piloted before research was conducted. Generally, research settings had poor heterogeneity which may be attributed to smaller sample sizes. Studies in academic settings with students tended to have the greatest heterogeneity, which can be attributed to a diverse student body. As a result of greater heterogeneity with larger sample sizes and reliable measures, business setting studies had greater generalizability than research studies. However, it is important to note that all settings scored an average of below 2 on the criteria of sample heterogeneity and generalizability. No statistical conclusions can be drawn because of the small sample sizes of articles used in this systematic literature review.

Emergent Themes and Findings Related to Trust in Collaborative Settings

Within the business setting category, the studies varied widely in all characteristics. This is most notable in the variety of team sizes not only between studies but within individual studies. Studies in this setting tended to focus on descendants of trust in their outcomes though the majority of these studies looked at both the antecedents and descendants of trust. Only about half of these studies compared the antecedents and descendants of different types of trust. The different types of trust compared were not necessarily consistent, though the most common type of trust comparisons was affective trust versus cognitive trust, and trust in the team versus trust in a leader. For the research settings the majority of the studies were of small teams. Within any given research setting study there was a smaller range of team sizes. As with studies in business settings, these studies tended to focus on descendants of trust.

Far fewer studies were found that took place in collaborative research settings. None of the studies in the collaborative research setting explicitly focused on collaboration between graduates students and their faculty advisors. While the quality of the papers found for research settings was not poor, the sample size within studies was small and the quality was not ideal. The majority of these studies focused on descendants of trust rather than antecedents of trust and defining trust within a collaborative research setting. Only one of the studies in the research setting²⁶ mentioned antecedents of trust and only one factor (transformational leadership) was explored as an antecedent of trust. Emerging from the body of literature reviewed, the most common descendants and antecedents of trust are shown in Table 7.

Table 7: Common descendants and antecedents of trust in the literature

<p>Common antecedents of trust</p>	<ul style="list-style-type: none"> • Transformational leadership • Team diversity • Leader opinion of workers • Leader consideration of member input • Team familiarity, longevity and experience
<p>Common descendants of trust</p>	<ul style="list-style-type: none"> • Creativity • Job satisfaction • Knowledge sharing • Team efficacy and performance • Team cooperation and cohesion

Of the descendants, team efficacy and performance, and knowledge sharing were the most commonly identified and measured. These studies noted that trust was most critical to team performance as a whole, however, many of the descendants of trust were interrelated (the level of analysis of descendant “interrelatedness” varied by study). In several studies trust was essential to mitigating conflict and enhancing communication and cohesion which in turn increased the overall team performance^{27,28}. Studies that observed the relationship between trust and knowledge sharing generally surveyed teams within industry. These teams required trust among teams and companies in sharing pertinent project information.

As noted previously, the most common antecedent of trust that was identified and measured was transformational leadership. Transformational leadership is a leadership style defined by a leader who considers the input of her or his team members to identify where change is needed and how to achieve this change while inspiring the team to commit to the needed change²⁹. By this definition, transformational leadership correlates with leader consideration of member input. The studies that looked at transformational leadership all concluded that transformational leadership positively affected trust within the team^{26,30-32}. Outside of transformational leadership team familiarity, longevity and experience also were significant antecedents of trust, all correlating positively with trust.

Limitations

Limitations of this research study include the high number of non-research setting studies found. For this systematic literature review, the search terms used resulted in a variety of general “best practices” articles and commentaries from popular business magazines, such as the Harvard Business Review. This is an indicator of how few peer-reviewed articles have studied trust in

collaborative research contexts. More targeted and limited search terms may have more easily illuminated niche papers that would have better addressed the questions of trust in research settings. Similarly, the inclusion and exclusion criteria of this paper were intentionally broad allowing for the inclusion of a wider body of work. To focus solely on trust in research settings, more narrow and explicit inclusion and exclusion criteria may be needed. In addition, this review did not exclude papers based on quality. While this does not negate the findings of this review, it would be beneficial to perform another review that excludes any papers of poor quality to ensure substantial contributions from each included study.

Discussion

We first discuss the findings from this systematic literature review in terms of opportunities for future work as well as the opportunity to link our findings from this study with other bodies of literature in engineering education research.

The emergent findings of the antecedents and descendants of trust in collaborative settings are not inherently groundbreaking: anecdotal evidence, commentaries, and accounts of best practices often mention these criteria. However, by grouping these parameters with the concept of trust at the core, we illuminate a new relationship between the criteria. Rather than assuming a direct relationship between transformational leadership (as an example) with team productivity or creativity, we can see that trust has a mediating effect.

In terms of current engineering education literature, many of the comment antecedents of trust are commonly studied in engineering education. For example, teaming literature in engineering education^{22,33} also suggests that strong leadership and relationships between team member is essential to a successful and productive team. In addition, many studies in engineering education and engineering suggest team-members' skills and diversity (of lived experiences and of thought) enhances overall team creativity and the ability to generate more user-focused and innovative solutions to engineering problems^{19,23,24,34,35}. Lastly, "knowledge sharing" is a skill that is emphasized in design courses and project-based learning classes through emphasis on engineering communication (written, oral) with team members and team sponsors¹⁸.

We posit that one of the results of this systematic literature review is to re-frame this discussion of engineering competencies as "line items" to teach students throughout their time in an undergraduate or graduate degree program. Instead, if in collaborative coursework or research settings, an emphasis can be placed by a research advisor or a course instructor on facilitating team trust via the antecedents, then potentially the "line items" such as knowledge sharing and creativity will happen more naturally as a result. Ultimately, this is taking a more learner-centric and relationship-building point of view, housed in theories of social constructivism^{36,37} and cognitive dissonance theory.³⁸ If students work to establish a strong network of trust among

teammates and with team leaders (whether they be professors or student leaders), then the collaboration becomes a social and mutually beneficial relationship fostered through strong communication. If a student (graduate or undergraduate) feels safe to express opinions and that they are accepted even if they come from a different background or point of view than the rest of the team, the student then will more easily share innovative ideas that can productively move a team forward.

From this paper it is clear that there is much work that can and should be done in exploring trust and collaboration among teams. There is a lack of studies not only in research settings but in exploring teams of graduate students and their advisors, which likely vary from traditional business teams. Graduate student teams within engineering may also work on several projects at a time led by multiple faculty members, a unique dynamic that has not been studied. Future research areas also include: How is trust defined within the context of research teams and how does this differ from other contexts of teamwork? How does trust develop within a team over time? Is trust development different in mature versus new research groups/teams? How does the development of trust in traditional research teams differ from global and from interdisciplinary team? What behaviors and milestones are critical for new team members to develop mutual trust with other team members?

In graduate level engineering settings, this type of research could be helpful in three practical respects. First, today's graduate students are tomorrow's experts working to lead global and interdisciplinary teams in industry and in academia. By illuminating mechanisms by which collaborative competencies such as trust are developed and the impact they have on collaboration success over time, there is a potential for graduate students to be able to be more immediately productive in their future careers. Second, determining the role of trust in research group collaborations could "jump start" the onboarding process with which many first-year graduate students struggle as they seek to navigate the often unclear expectations for working in an established research group. Third, research in this area could be useful in developing tools and strategies for junior professors starting new research groups who need graduate students to become productive as fast as possible in an academic setting. If the role of trust is as critical to collaborative research as this systematic literature review indicates, then establishing strong trust between research advisors and graduate students and among the students themselves is critical to the success of tenure-track research faculty. In all three of these respects, trust in general could lead to more efficient and effective communication and thus improved productivity.

Conclusion

This paper presented a systematic literature review of studies focused on trust in collaborative settings. Of the 31 papers reviewed only 4 of these took place in research settings. These results highlight the lack of studies investigating the role of trust and how it is developed in

collaborative research teams; however, the synthesized results of this study did indicate common antecedents and descendants of trust. The discussion of the findings from this study posit that engineering educators might re-frame the discussion of engineering competencies (creativity, diversity, etc.) in terms of how best to establish trust in collaborative settings. In addition, several future research areas are proposed as a result of this review, many of which have enormous implications for graduate level engineering education and in faculty development.

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Appendix

Appendix A: Summary of Findings and Quality Assessments

Author	Pub. Date	Measures	Number of Participants	Team Size(s)	Methods of Data Collection	Methods of Analysis	Conclusions w/ Respect to Trust	Quality Scores
Arnold et al.	2001	team efficacy, transformational leadership, trust, commitment, and iron cage perceptions	177 people, 42 teams	2-7, ave 4	self-administered survey	Descriptive statistics Hierarchical regression analysis	Antecedents of trust: Transformational leadership	25
Bierly et al.	2009	cooperation, trust, virtuality, relationship conflict, process conflict, training, familiarity, goal clarity	116 people, 116 teams	3-20+	self-administered survey	Descriptive statistics Regression analysis	Antecedents of trust: Goal clarity (for face to face teams) familiarity Minimized initial conflict (virtual teams) Descendants of trust: Cooperation (for face to face teams)	23
Brattstrom et al.	2012	systematic processes and structures, goodwill trust, competence trust, creativity	99 people, 99 teams	N/A	self-administered survey	Descriptive statistics Regression analysis	Descendants of trust: Creativity	22
Braun et al.	2013	transformational leadership, trust in supervisor, trust in team, job satisfaction, team performance	360 people, 39 teams	N/A	self-administered survey	Descriptive statistics Hierarchical regression analysis	Antecedents of trust: Transformational leadership Descendants of trust: Job satisfaction	23

Author	Pub. Date	Measures	Number of Participants	Team Size(s)	Methods of Data Collection	Methods of Analysis	Conclusions w/ Respect to Trust	Quality Scores
Bruneel et al.	2010	orientation related barriers, transaction related barriers	503 people, 503 teams	N/A	self-administered survey	Descriptive statistics Fractional logic regression analysis	Descendants of trust: Lower barriers to knowledge sharing	19
Chou	2013	transformational leadership style, team cognitive trust, collective efficacy, team performance	92 people, 46 teams	3-35, ave 9	self-administered survey	Descriptive statistics Structural equation modeling	Antecedents of trust: Transformational leadership Descendants of trust: Team efficacy Cognitive trust is necessary but not sufficient Trust in team members is more important than in leadership	27
Chowhury	2005	affect based trust, cognition based trust	164 people, 31 teams	N/A	self-administered survey	Descriptive statistics Regression analysis	Descendants of trust: Complex knowledge sharing Cognition-based trust is more important for knowledge sharing	23

Author	Pub. Date	Measures	Number of Participants	Team Size(s)	Methods of Data Collection	Methods of Analysis	Conclusions w/ Respect to Trust	Quality Scores
Collins and Chou	2013	interpersonal trust, insitutional trust, member satisfaction w/ outcomes, member satisfaction w/ process, team effectiveness	29 people,	3 - 4	mixed methods (self-administered survey, qualitative, and case studies)	Descriptive statistics Theme extraction	Descendants of trust: Virtual team success Team effectiveness Interpersonal trust- more for traditional teams Institutional trust- more for virtual teams	21
Costa et al.	2001	trust, perceived task performance, team satisfaction, relationship commitment, stress	395 people, 112 teams	3-6, ave 4	self-administered survey	Analysis of variance Structural equation modeling	Antecedents of trust: Perceived trustworthiness Descendants of trust: Team performance Team satisfaction Commitment Reduced stress	25
Dayan and Di Benedet-	2010	functional diversity, demographic diversity, proximity of team members, team longevity, procedural justice, interactional justice, cognitive based trust, affect based trust, team learning, speed - market, NPS, task complexity routine, task complexity knowledge, team size	93 people, 93 teams	N/A	self-administered survey	Descriptive statistics Structural equation modeling	Antecedents of trust: Moderate demographic diversity Team longevity Descendants of trust: Team learning Product success	24

Author	Pub. Date	Measures	Number of Participants	Team Size(s)	Methods of Data Collection	Methods of Analysis	Conclusions w/ Respect to Trust	Quality Scores
De Jong and Elfiring	2007	intrateam trust, team effort, team monitoring, team effectiveness, team efficiency	638 people, 73 teams	N/A	self-administered survey	Principal component analysis Hierarchical regression analysis	Descendants of trust: Team performance Individual effort Trust indirectly affects team effort via motivation	18
Dirks	2000	trust in leader, team performance, trust in teammates, team talent, coach record, experience, player tenure, team performance	355 people, 30 teams	12 ave	self-administered survey and archival data	Descriptive statistics Regression analysis	Descendants of trust: Team performance Trust in teammates isn't as important as trust in leader	21
Erdem and Ozen	2003	cognitive trust, affective trust	279 people, 50 teams	5 - 46	self-administered survey	Descriptive statistics	Descendants of trust: Team performance	19
Hansen et al.	2002	cognitive trust, affective trust, performance and satisfaction, group cohesion	779 people, 2 teams	N/A	self-administered survey	Descriptive statistics Hierarchical regression analysis	Descendants of trust: Group cohesion	21
Jo et al.	2015	perception of leader's consideration, perception of leader's initiating structure, trust in leader, trust in organization, member creativity	350 people	N/A	self-administered survey	Descriptive statistics Structural equation modeling	Antecedents of trust: Leader consideration of member input Descendants of trust: creativity	22

Author	Pub. Date	Measures	Number of Participants	Team Size(s)	Methods of Data Collection	Methods of Analysis	Conclusions w/ Respect to Trust	Quality Scores
Kiffin-Petersen and Cordery	2003	preference for teamwork, propensity - trust, individualism, trust in co-workers, trust in management, job control, opportunity for skill utilization	218 people, 40 teams	N/A	self-administered survey	Descriptive statistics Hierarchical regression analysis	Descendants of trust: Opinions on structure of team	22
Korsgaard et al.	1995	perceived procedural fairness, attachment - group, trust in leader, decision quality	209 people, 20 teams	N/A	survey	Descriptive statistics Analysis of variance	Antecedents of trust: Leader consideration of member input	23
Krishnan et al.	2006	trust, interdependence, interpartner competition, environmental instability, environmental unpredictability	126 people, 126 teams	N/A	interview	Descriptive statistics Regression analysis	Descendants of trust: Team performance Reduced effects from behavioral uncertainty	24
Lau and Liden	2008	coworker trust, leader trust, trust in leader, group performance	146 people, 32 teams	4-8, 5 ave	self-administered survey	Descriptive statistics Hierarchical regression analysis	Antecedents of trust: Leader opinion of individual Descendants of trust: Poorer performance if leader and coworker trust has strong relationship	21
Lee et al.	2010	knowledge builder role, team knowledge sharing, trust in leader and trust in team, team performance	214 people, 34 teams	3-19, ave 8	self-administered survey	Descriptive statistics Regression analysis	Antecedents of trust: Team expertise Descendants of trust: Knowledge sharing	26

Author	Pub. Date	Measures	Number of Participants	Team Size(s)	Methods of Data Collection	Methods of Analysis	Conclusions w/ Respect to Trust	Quality Scores
Lu	2015	psychological similarity, shared social activities, team trust, team cohesion, job satisfaction, team performance	388 people,	14 ave	self-administered survey	Descriptive statistics Structural equation modeling	Antecedents of trust: Team socialization Psychological similarity Descendants of trust: Team performance Job satisfaction	21
Lusher et al.	2014	experience, individual performance, overall team performance, density, highest degree	107 people, 3 teams	36 ave	survey	Descriptive statistics Analysis of variance	Antecedents of trust: Individual experience and performance Descendants of trust: Team performance	17
Masse et al.	2008	satisfaction with collaboration, impact of collaboration, trust and respect	202 people,	N/A	self-administered survey	Descriptive statistics Analysis of variance	Trust and satisfaction are correlated	22
McAllister	1995	affect and cognition based trust, behavioral response	175 people,	N/A	self-administered survey	Descriptive statistics Structural equation modeling	Antecedents of trust: Work quality Supervisor trust in individual Descendants of trust: Social needs are met	22
Peterson and Behfar	2003	task conflict, relationship conflict, group performance, trust	225 people, 67 teams	4	self-administered survey	Descriptive statistics Regression analysis	Descendants of trust: Reduced negative effects of conflict	26

Author	Pub. Date	Measures	Number of Participants	Team Size(s)	Methods of Data Collection	Methods of Analysis	Conclusions w/ Respect to Trust	Quality Scores
Pinjani and Palvia	2013	functional diversity, deep level diversity, mutual trust, shared knowledge, task interdependence, collaborative technology, GVT effectiveness	213 people, 58 teams	11	survey	Descriptive statistics Hierarchical regression analysis	Antecedents of trust: Deep level diversity Descendants of trust: Team effectiveness	27
San-ro and Sapari-	2003	communication of status and results, communication frequency, communication personalness, trust	202 people, 202 teams	N/A	self-administered survey	Descriptive statistics Hierarchical regression analysis	Descendants of trust: Relationship between communication, knowledge outcomes and tech outcomes	22
Shaubroeck et al.	2011	trust, team psychological safety and team potency, transformational leadership, team performance	999 people, 191 teams	4-7, 5 ave	self-administered survey	Descriptive statistics Regression analysis	Antecedents of trust: Transformational leadership Descendants of trust: Team potency Team psychological safety	23
Spec-r and Jones	2004	trusting stance, initial trust level	127 people	N/A	self-administered survey	Descriptive statistics Analysis of variance	Antecedents of trust: Trusting disposition prior - group formation Gender (men trust men)	19
Tsai et al.	2011	positive and negative group affective -ness, team creativity, team trust	270 people, 68 teams	6 ave	self-administered survey	Descriptive statistics Hierarchical regression analysis	Descendants of trust: Group affective -ness negatively impacts creativity Increased creativity	24

Author	Pub. Date	Measures	Number of Participants	Team Size(s)	Methods of Data Collection	Methods of Analysis	Conclusions w/ Respect to Trust	Quality Scores
Tseng and Yeh	2013	N/A	15 people, 4 teams	3-4, ave 4	open-ended and inerview	Theme extraction	Antecedents of trust: individual accountability Teammate familiarity Commitment - quality work Team cohesion	14