

# Virtual Team Performance Factors: A Systematic Literature Review

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*Abstract* – What constitutes a successful virtual team or not is of great importance considering their widespread use in business. Despite this, the failure rate of virtual teams remains relatively high compared to non-virtual teams. This study conducted a literature review that analysed 135 articles from peer-reviewed English journals. The results were coded into groups of factors and the impact of these groups on performance and their status in literature were determined.

It was found that beneficial interpersonal characteristics such as empathy or behavioural flexibility were the most commonly identified positive factors in virtual team performance, followed by trust, and the appropriateness of functionality and richness of communication technology used by the team. The most significant failure factors in virtual teams were found to be the effects of geographic and temporal dispersion, the effects of cultural diversity, and negative leadership qualities such as bias.

*Keywords* – Virtual team, team performance, success factor, failure factor, literature review

## I. INTRODUCTION

Despite the many observed and theorized benefits of virtual teams and despite their high and increasing usage across organisations [1], the success of virtual teams remains low and often elusive. Despite commonality with traditional teams in some areas, virtual teams have inherent differences that impact how they perform due to technological, temporal, geographic, cultural and other boundaries.

This results in challenges that include trust, cultural differences, technology, training, intra-team relationships, time zones, diversity, and leadership [2], [3]. Some examples include the perceived distance of a colleague or leader being greater than the actual distance [4], cultural differences between team members causing communication or social connection challenges [5], or the technology the team uses to communicate and coordinate tasks by [6].

While many researchers have identified factors that contribute to virtual team performance such as leadership [7] or the relationships between team members [8], there remains a need to evaluate the literature as a wider whole to identify which factors occur most frequently and in which combinations. This would reduce the limitations in individual research and to determine if there are significant interactions between factors from nominally disparate areas of research.

This research aimed to determine what the most important factors that influence the performance of virtual project teams are, using a literature survey.

There is not a single answer to the question: the reduction of failure factors does not imply success and the loss of success factor influence does not mean failure is inevitable. As such this research attempted to answer the question in 4 different ways:

- 1) *Success*: A positive influence on performance.
- 2) *Failure*: A negative influence on performance.
- 3) *Indirect influence*: Which factors are related to the greatest number of other factors.
- 4) *Paired factors*: Which factors are most commonly matched with each other.

## II. LITERATURE REVIEW

Virtual teams have a high failure rate, as high as 71% [9]. Many challenges face virtual teams that are either not present in traditional face-to-face teams or have much greater impact in virtual or semi-virtual settings.

Several authors have investigated virtual team performance such as investigating team performance in a general sense [10], satisfaction [11], selected aspects of performance like decision quality [12], or antecedents of performance such as leadership and trust [13]. However, there still remains a need to expand the coverage of research in this area [14] and to distribute this research to management and project practitioners.

A search for virtual team literature yielded studies reporting the state of the field over a period of 13 years. From this, an understanding of the definition and performance of a virtual team was found.

### A: Virtual Team Definition

The basic term ‘virtual team’ does not have a single, unified definition within the literature, nor even a single common term [15], [16]. Ref. [15] performed a literature review of the definitions of virtual teams and found the combinations of dimensions as shown in Table 1. The combined dimensions of ICT use and spatial dispersion were used through this research.

TABLE 1  
DIMENSIONAL COOCCURRENCE OF VIRTUAL DEFINITIONS [15]

Common Dimensions	Common Articles Count
ICT Use, Spatial Dispersion	102
ICT use only	51
ICT Use, Spatial Dispersion, Temporal Dispersion, Organisational Dispersion	34
ICT Use, Spatial Dispersion, Temporal Dispersion	27
ICT Use, Spatial Dispersion, Organisational Dispersion	15
Spatial Dispersion, Temporal Dispersion, Organisational Dispersion	7
Spatial Dispersion, Temporal Dispersion	6
Spatial Dispersion, Organisational Dispersion	2

### B: Virtual Team Performance

There is a wide diversity of measures of performance within the literature, as discussed in [17] for traditional teams. Some of the terms used include performance, growth, satisfaction, effectiveness, and self-efficacy.

Ref. [18] and [19] categorised the outcomes of virtual teams into three classes when they performed a meta-analysis of virtualness of team functioning:

- *performance*, a team’s task such as efficiency, duration, and quality;
- *affective reactions*, the team’s emotional and mental states such as commitment and satisfaction;
- *behaviours*, the team’s interactions and actions such as turnover and conflict.

Ref. [20] added the perceptions of effectiveness and performance to team outcomes and showed the impact of affective reactions such as self-efficacy and team self-efficacy on perceived performance outcomes. Ref. [21] cast the performance of R&D teams in terms of creative output such as new ideas generated. Ref. [22] in contrast measured R&D performance in a more traditional project team manner with work quantity, quality, budget and schedule as metrics. Ref. [8] noted from their review of literature than with a virtual project team the performance outcomes can be subdivided into individual, team and project levels.

## III. METHODOLOGY

A systematic literature review format was selected due to its synthesis of multiple disciplines [23], as required of an investigation into as broad and diverse and broad a topic as team performance. Additionally, the systematic review removes individual study limitations [23]. The overall research process model can be seen in Fig. 1.

### A: Search Procedure

The research question was devolved into four components:

1) *Most important factors*: the factors that emerge from the research comprise the population of this component.

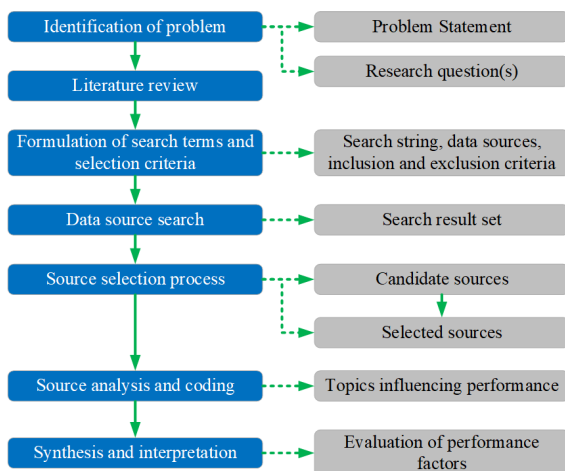


Fig. 1. Research model

2) *Influence*: the demonstration of a causal link between factors and topics in research and the performance of virtual teams.

3) *Performance*: the aspect of virtual teams’ functioning this study focused on. Derived from [18] and [19], this study included the categories of functional performance, affective reactions and behaviours. It was not practicable to search the literature specifically for outcomes, thus virtual team performance was assessed in the inclusion / exclusion process.

4) *Virtual Teams*: the central concept of the research, virtual teams are a searchable term. The terms and synonyms used in the search string are derived from [8], [11], [15], [19], [24]–[26] as:

*((Virtual\* OR cross-nation\* OR dispersed OR distributed OR remote OR “virtual project” OR global) AND team\*) OR virtuality OR virtualness*

The search utilised the following sources due to the focus on team and project management within the engineering and technology disciplines:

- EBSCO Business Source Complete Collection
- IEEE Xplore
- ScienceDirect

### B: Selection Procedure

The inclusion and exclusion criteria are detailed in Tables 2 and 3. The results from the initial search (see Fig. 2 & Fig. 3) were scanned by title and abstract for relevance to the research question. Articles and proceedings that were relevant were passed into the candidate data.

After the candidate data set was populated, all literature was reviewed, and the inclusion and exclusion criteria were applied to populate the selected data set.

TABLE 2  
LITERATURE INCLUSION CRITERIA

Number	Inclusion criterion	Criterion description
11	Primary source	Literature details data gathered and interpreted by the authors and not based on other research conclusions.
12	Relevant topic	Literature directly references virtual project teams and provides an analysis of a success, failure or performance factor as described in the search procedure.
13	Literature hypothesis / proposition quality	Literature poses a testable hypothesis or demonstrable proposition and evaluates this via collected data.
14	Methodology quality	Literature includes research methodology and utilises this methodology.
15	Data quality	Data sample must have meaning and relevance. Literature must show and meet reliability measures for quantitative methods to ensure valid sample sizes and compositions. Literature must show data sources are numerous enough, qualified enough and representative enough to avoid bias in qualitative literature.
16	Outcome quality	Literature demonstrates direct link between evidence from gathered data and analysis outcomes.
17	Review quality	Literature is published in a peer-reviewed journal.

TABLE 3  
LITERATURE EXCLUSION CRITERIA

Number	Exclusion criterion	Criterion description
E1	Secondary source	Article is a secondary source.; secondary sources can skew this analysis by presenting a single data set and result multiple times.
E2.1	Irrelevant topic	Literature does not reference virtual teams (or a synonym), or utilises the term in a manner not consistent with its usage in project team contexts, such as social groups, academic or cultural organizations.
E2.2		Literature does not propose nor demonstrate conditions that lead to project team performance impacts or the lack thereof.
E3.1	Inadmissible quality	Literature does not pose a testable hypothesis or research question.
E3.2		Literature posits an untestable opinion or conjecture.
E3.3		Literature does not adequately or completely document its methodology such that it cannot be determined where the data were retrieved from and / or how it was analysed.
E3.4		Literature is not published in a peer-reviewed journal.
E4.1	Unavailability	Literature was not available in research data sources at the time of data collection.
E4.2		Literature is not available as a full-text article in the selected data sources.
E9	Language	Literature is not in English.
E10	Duplication	Literature is a duplicate of other literature in the study.

### C: Analysis Procedure

Coding was performed on the selected data set. For each article included in the selected data set, the process as shown in Fig. 2 was applied. For each article included in the selected data set, the hypotheses or propositions in the article that relate to virtual team performance were recorded, along with their direction of effect on performance (or lack thereof for unsupported hypotheses) as a factor.

Closely related factors were then logically grouped together for further analysis (such as different types of trust-enabling characteristics to be grouped into ‘Trust’).

## IV. RESULTS

The model of results of the search procedure are shown in Fig. 3. The selected articles ranged in published date from 1998 to 2019. After analysis of the articles and coding of the topics in them, a total of 91 coded factors were found, with a total of 354 individual positions taken on these factors. These 91 factors were grouped where the factors are highly similar, such as different forms of trust, different types of satisfaction, or different aspects or models of communication technology.

The groups arranged according to the highest positive factor count can be found in Table 4, the groups arranged by the highest negative factor count can be found in Table 5, where counts are determined in the coding process as shown in Fig. 2.

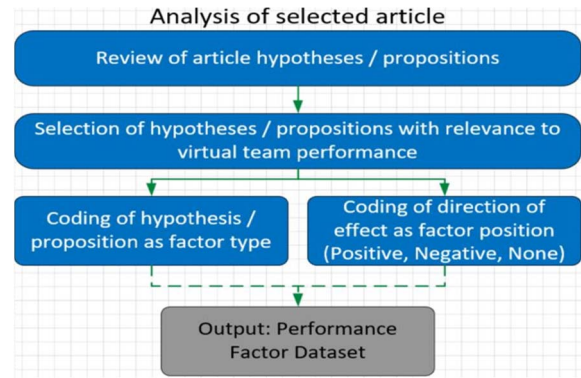


Fig. 2. Article analysis model

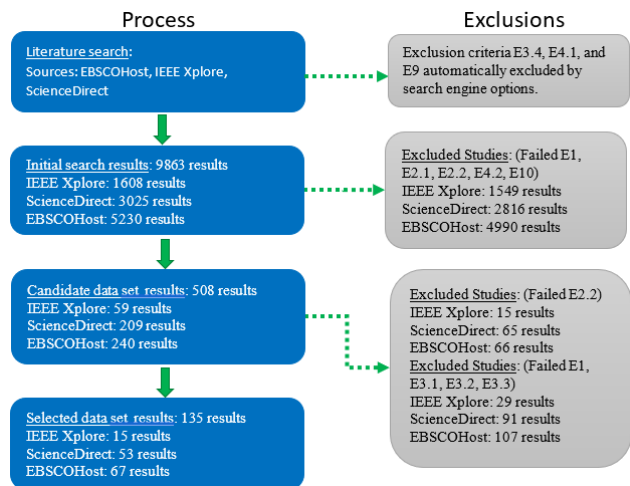


Fig. 3. Search process results

TABLE 4  
RANKED POSITIVE FACTORS

Factor group	Positive factor count
Interpersonal Characteristics	30
Trust	28
Communication Technology	27
Intra-team Relationships	16
Leadership Activities	15
Collaboration	14
Team Characteristics	13
Communication Characteristics	11
Knowledge Transfer	11
Synchronicity	7
Leadership Structure	7
Communication Structure / Guidelines	6
Empowerment/Autonomy	6
Satisfaction	5
Leader Qualities	5
Commitment	4
Task Structure / Guidelines	4
Dispersion	3
Intercultural	3
Leadership Training	2
Cultural Characteristics	1
Cultural Diversity	1

TABLE 5  
RANKED NEGATIVE FACTORS

Factor group	Negative factor count
Dispersion	10
Cultural Diversity	8
Leader Qualities	6

Team Characteristics	4
Intra-team Relationships	3
Cultural Characteristics	3
Commitment	2
Leadership Structure	2
Interpersonal Characteristics	1
Communication Characteristics	1
Communication Technology	1
Synchronicity	1

Inter-factor commonality determined how many articles each factor shared with every other factor (as a sum of common articles). This showed an agreement with the single-factor results, the same factor groups appeared in the upper rankings (both positive and negative) of inter-factor comparisons as in single-factor comparison. This can be seen in the inter-factor commonality analysis in Table 6 where the top 5 factors also appear in the top 4 of either positive or negative single factor results. Similarly, the co-modelled pairs shown in Table 7, the top 5 pairs all have both elements in the top 3 of either positive or negative single-factor results.

TABLE 6  
INTER-FACTOR COMMONALITY BY COMMON ARTICLE COUNT

Factor	Common article count
Interpersonal Characteristics	58
Communication Technology	54
Trust	53
Cultural Diversity	46
Intra-team Relationships	44
Communication Characteristics	42
Dispersion	38
Leadership Structure	32
Leader Qualities	26
Knowledge Transfer	25
Team Characteristics	24
Leadership Activities	23
Collaboration	22
Empowerment/Autonomy	22
Communication Structure / Guidelines	18
Satisfaction	14
Leadership Training	14
Commitment	10
Intercultural	10
Cultural Characteristics	8
Task Structure / Guidelines	7

TABLE 7  
HIGHLY FREQUENTLY CO-MODELLED FACTORS (>4)

Co-factor 1	Co-factor 2	Co-modelled articles
Communication Technology	Cultural Diversity	8
Cultural Diversity	Dispersion	8
Communication Technology	Dispersion	7
Interpersonal Characteristics	Trust	7
Interpersonal Characteristics	Leader Qualities	6
Communication Characteristics	Trust	5
Communication Characteristics	Communication Tech	5
Communication Technology	Intra-team Relationships	5
Interpersonal Characteristics	Intra-team Relationships	5
Collaboration	Trust	4
Communication Technology	Knowledge Transfer	4
Communication Technology	Leadership Activities	4
Communication Technology	Synchronicity	4
Communication Technology	Trust	4
Cultural Diversity	Leadership Structure	4
Cultural Diversity	Intra-team Relationships	4
Dispersion	Intra-team Relationships	4

Empowerment/Autonomy	Leadership Structure	4
Interpersonal Characteristics	Team Characteristics	4
Knowledge Transfer	Trust	4
Leadership Structure	Trust	4
Intra-team Relationships	Trust	4

## V. DISCUSSION

The four perspectives of performance factors are:

### Direct success factors:

- 1) The interpersonal characteristics of team members such as empathy, behavioural and intercultural flexibility, and social relaxation.
- 2) Trust in team members based on foundations of benevolence, integrity, ability and similar characteristics.
- 3) The appropriateness and richness of communication technology, in the context of the specific task and team characteristics.

### Direct failure factors:

- 1) Dispersion (geographic and temporal) of the team and its configuration in these regards.
- 2) The effects of cultural diversity, including languages spoken, cultural norms and other points of cultural difference.
- 3) Negative leadership qualities such as bias or procedural unfairness.

### Indirectly influencing factors:

- 1) The interpersonal characteristics of team members such as empathy, behavioural and intercultural flexibility, social relaxation (coded as per Fig. 2 and Section III C).
- 2) The appropriateness and richness of communication technology, in the context of the task and team specifics.
- 3) Trust in team members based on foundations of benevolence, integrity, ability and similar characteristics (coded as per Fig. 2 and Section III C).

### Highly paired factors:

- 1) Communication technology and cultural diversity were in tied first place: technology can mitigate or exacerbate the effects of cultural differences.
- 2) Cultural diversity and dispersion also tied for first: differences in culture become more apparent as a function of geographic distance.
- 3) Communication technology and dispersion: the necessity of communication technology addressing the communication challenges of geographic or temporal dispersion.

Also ranking highly in results for positive impact were intra-team relationships between team members (such as team identity), leadership activities (such as planning, clarifying role and providing feedback to the team), the characteristics of communication between team members (such as frequency and predictability), and the quality of the knowledge transfer process.

## VI. CONCLUSION

Four of the top five positive factors are primarily directly focused on people, their mental and emotional states, and the bonds between them. Thus, a very high

emphasis on establishing and reinforcing positive bonds between team members and a strong climate of well-being and positive behavior would be beneficial. These also tend to be antecedents to the outcomes of interpersonal characteristic factors, the trust factor, the intra-team relationships factor and some aspects of the leadership activities factor.

A second focus point would be active communication design: the deliberate planning of communication technologies and characteristics to fit to the team and task.

Finally, to reduce the impact of highly negative factors a focus should be placed on mitigating the effects of diversity (language, communication and cultural) through informal exposures and formal training.

Of note is the relatively low impact of formal management tasks and tools, such as team structural design and task guidelines.

This study is limited by the data sources which may have missed research from different fields and the use of English results only. Further meta-analysis of statistical relationships may have affected the strength of determined relationships between factors and performance.

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