Evaluation of Team Quality

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Abstract: Competitive pressure and increasing market size have forced organizations to rely more on teams. This study has three objectives: to structure a list of attributes affecting the overall quality of a team; to use a survey tool to determine the significant ones among those attributes; and to compare between manufacturing and healthcare sectors. The data gathered were from employees working in teams in USA and China. A one-way analysis of variance and stepwise regression analysis was performed on the responses to determine team quality attributes. The ANOVA results for attributes versus teams revealed team efficacy, team trust, personality and skills & knowledge as significant. The stepwise regression analysis for team quality versus other attributes (for all the teams combined) showed that job satisfaction and team trust were significantly affecting the overall team quality. Analyses showed differences between China and USA.

Keywords: Team Quality Attributes, Teams, Manufacturing, China and USA

1. Introduction

Globalization and competitive pressures have forced organizations to rely more on teams. The use of teams has been implemented intensely in response to these challenges. A team can be defined as a group of three or more people with a full set of complementary skills, who collaborate on a common task and operate with a high degree of interdependence towards a common goal (Hackman 1987, Guzzo & Shea 1992). Teams have become an essential aspect of the workplace structure in order to get work done. They prevail at all layers of organizations and accomplish a wide range of tasks (Katzenbach & Smith, 2003). Teams have become the line of attack when organizations are confronted with complex and demanding tasks. Teamwork can help accomplish a given task at a faster pace primarily due to two reasons. Firstly, many individual contributions add up and thereby reducing the overall workload and secondly, problem solving becomes easy when each individual presents a unique idea to arrive at the best solution. Teams are vastly used when failures can lead to severe results, when the job intricacy exceeds the capability of an individual, when the task environment is imprecise, uncertain, and stressful and when numerous and prompt decisions are needed.

Published literature on usefulness of teams is in plenty. For example, 82 percent of companies with 100 or more employees reported that they use teams. Sixty eight percent of Fortune 1000 companies reported that they used teams (Mohrman et al., 1995). In examining data on 56,000 U.S. production workers, Cappelli & Rogovsky (1995) found that one of the most common skills required by new work practices is the ability to work as a team. So, it is apparent that the success or the failure of an organization depends largely on the overall quality of the teams within that organization. For all sectors in the industries, teamwork has an enormous impact on the overall success. Therefore, the concept "team quality" is important and is very specific to the sector for which it is applied, and is complicated especially because of the multifaceted nature of the working of teams (Denison et al., 1996). Hoegl et al. (2001) addressed the concept of teamwork quality in service

sectors as a complete collaboration of teams. The framework chosen was very much pertinent to McGrath's (1964) input-process-output model. This is also known as the "team effectiveness framework" and is one of the most extensively used frameworks by researchers for studying team effectiveness or performance. The inputs are comprised of factors such as the individual's skills, personality and character. The processes include attributes such as team's trust, cohesion and interdependency. The outcomes can be, but are not limited to, the team's performance, effectiveness, success or team's overall quality.

Studies have shown that input parameters influence the output or the performance of a team (Benders et. al., 1999; Hoegl et al., 2001).   Therefore, it can be inferred that, the quality of a team can be significantly improved through the proper selection of input parameters and by constantly improving the process parameters. Also, there is considerable amount of sector specificity (Rezgui, 2007). Teams are used in aerospace, the military, health care, financial sectors, nuclear power plants, engineering problem-solving projects, manufacturing, and countless other domains; as the complexity of the workplace continues to grow, organizations increasingly depend on teams (Eduardo et al., 2001). Given the existence of the extensive literature on team work, even today the factors that comprehensively measure the concept "Quality of Teams" have not been studied to the full extent. The only initiative taken towards developing the metrics to measure the quality of teams was by Hoegl et al. (2001) for the software industry. The six metrics which were developed were communication, coordination, balance of member contributions, mutual support, effort, and cohesion.

In contemporary manufacturing, teams have been an indispensable part of initiatives such as Total Quality Management programs (Flynn et al., 1995), Just -in-Time production where teams are used to fight waste, reduce set-up times and help reduce inventory from the system (McLachlin, 1997) and in supply chain integration. Recently a study by Bikfalvi (2011) on a sample of 1,298 manufacturing companies from Germany showed that almost two-thirds of those companies used teamwork in production and at least fifty percent of the teams had 4-9 employees each. In the recent years, manufacturing firms have approached a more structured way of deciphering the talent and skills of their employees; thereby creating teams comprising of employees of varied skill set, which was not the case few decades back when there was no well thought-out procedure to form teams.

The success of an organization in accomplishing its goals depends on various factors such as its mission, values, strategy, technology, employees and management style. Critical amongst them is the employee factor and the role it plays at team level and organizational level. In fact, the success of any organization thrives upon how well the team's goals and strategy mesh with the organization's goals and strategy (Kaplan et al., 2000). Due to the ever-increasing interdisciplinary fields and requirement for shorter product life cycles, teams have become a crucial part of many manufacturing industries; even more critical is the role of leadership. Over the past few years, significant amount of research has been conducted in order to understand the functionality of teams and there is an extensive body of literature available which indicates the importance and role of teams in organizations. However there is no empirical evidence in the entire body of literature, which effectively addresses the concept "Team Quality".   Hence our research objectives were to identify a comprehensive list of attributes affecting the overall quality of teams, to develop a model to determine team quality, and to compare team performance in two cultures.

2. Methods

In order to investigate the attributes that were most likely to affect a Team's Quality, a comprehensive literature review was conducted on literature studies published from 1997 to 2012. This study identified 17 attributes that have multiple occurrences in various research articles, which are summarized in Table1.

Table 1. Attributes Cited in Literature

Attributes	Tao et al (2009)	Wei-ku (2010)	Marks (2002)	Bailey (1999)	Shen et al (2007)	Barrick et al (1998)	Scott et al (2009)	Little et al (1997)	Edmondson et al (2009)	Lynn et al (2006)	Friedrich et al(2009)	Lepine et al (2011)	Stajkovic et al (2009)	Liu et al (2009)	Salas et al (2008)	De Hoogh et al (2008)	Zoogah et al (2011)	Stephen et al (2001)	Total
Job Satisfaction	X			X															2

Attributes \ Name of the Author	Tao et al (2009)	Wei-ku (2010)	Marks (2002)	Bailey (1999)	Shen et al (2007)	Barrick et al (1998)	Scott et al (2009)	Little et al (1997)	Edmondson et al (2009)	Lynn et al (2006)	Friedrich et al(2009)	Lepine et al (2011)	Stajkovic et al (2009)	Liu et al (2009)	Salas et al (2008)	De Hoogh et al (2008)	Zoogah et al (2011)	Stephen et al (2001)	Total
Team Leadership		X			X		X		X		X					X		X	7
Communication			X	X		X		X	X		X								6
Cohesion				X		X					X	X			X			X	6
Training & Support				X										X	X				3
Team Diversity															X		X		2
Conflict Management					X	X	X		X	X					X		X		7
Individual Roles										X	X	X							3
Team Efficacy		X					X	X					X						4
Performance Feedback			X			X	X							X		X			5
Gender & Ethnic Differences	X																X		2
Team Trust			X		X						X								3
Personality						X		X		X		X							4
Skills & Knowledge										X				X	X				3
Team Competence			X																1
Team Potency													X						1
Cross Functionality												X							1

Of these 14 attributes were considered in this study. The definitions of the 14 attributes are as follows (Table 2):

Table 2. Attributes and Definitions Considered for the Study

Attributes	Definition
Jobs Satisfaction	An overall emotional feeling employees have about their job as a whole
Team Leadership	One who provides guidance, instruction and direction to the team for the purpose of achieving a key result or group of aligned results
Communication	Any act by which one employee gives to or receives from another employee information about that person's needs, perceptions, knowledge, or affective states
Cohesion	The tendency for a team to be in unity while working towards a goal or to satisfy the emotional needs of its members
Training & Support	Aids, devices, equipment, and services provided to teams for their efficient operation

Attributes	Definition
Team Diversity	The degree of heterogeneity among team members on specified demographic dimensions
Conflict Management	To enhance learning and group outcomes by limiting the negative aspects of conflict and by increasing the positive aspects of conflict
Individual Roles	The characteristic and expected behavior of an individual based on his/her job position function
Team Efficacy	Team's shared belief that it can successfully perform a specific task
Performance Feedback	A system through which organizations assess the performance of employees
Gender & Ethnic Differences	To show differentiation between employees of different genders or ethnic backgrounds
Team Trust	The firm belief an employee has in the reliability, truth, ability or strength of another employee
Personality	Personality is the particular combination of emotional, attitudinal and behavioral response patterns of an individual
Skills & Knowledge	Knowledge is information we already have and skill is the ability to use knowledge to actually accomplish something

Subsequently, a survey questionnaire was developed. In its final form it had 43 questions. Besides the 14 attributes, there were four questions corresponding to overall team quality. The responses for each question were designed based on the 5-point Likert scale, with appropriate anchor points. Table 3 shows the attributes and the corresponding question numbers in the survey. Reliability of the questionnaire was tested through determining Cronbach's alpha (.70)

Table 3. Attributes used in the Study and their Corresponding Questions

Attributes	Corresponding Question Numbers
Jobs Satisfaction	Q1, 2, 3
Team Leadership	Q4, 5, 6
Communication	Q7,8,9
Cohesion	Q10, 11
Training & Support	Q12, 13, 14
Team Diversity	Q 15, 16, 17
Conflict Management	Q18,19,20
Individual Roles	Q21,22,23
Team Efficacy	Q24,25,26
Performance feedback	Q27, 28
Team Quality	*Q29, 30, 31, 32*
Gender & Ethnic Differences	Q33, 34. 35, 36
Team Trust	Q37, 38
Personality	Q39, 40, 41
Skills & Knowledge	Q 42, 43

A total of 22 manufacturing teams comprising 50 employees responded to the survey questionnaire. The number of female respondents was 18 (36%) compared to 32 (64%) male participants. There were 4 manufacturing teams comprising of

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8 employees from the United States (USA) and there were 18 manufacturing teams comprising of 42 employees from China. Table 3 summarizes the data sets. Due to operational difficulty, data was gathered using an unequal sample size. Hence general linear modelling (GLM) procedure was used in the analyses

Table 4. Participants in this Study

	USA	China
Employees	8	42
Teams	4	18

For procedure, an online survey was created at the website, "Survey Monkey". This ensured confidentiality of responses. The link to the survey was sent to all the interested employees from China and United States after obtaining approvals from the director's or other appropriate personnel's of the participating manufacturing companies. Also, since most of the employees from China were not fluent in English language; the entire survey questionnaire was translated into Chinese language with the help of a local translator, in order to obtain accurate responses from the employees.

3. Results

3.1 Overview

There were two types of analyses. For the GLM the different questions and attributes were used as dependent variable while for regression the questions on team quality was used as dependent variables

3.2 GLM Procedure

3.2.1 Attributes versus Teams

Table 5 shows those attributes that were found significant for teams. The results indicate that four out of the fourteen attributes were significant. The attributes which are not significantly affected by any of the independent variables are: *Job Satisfaction, Team Leadership, Communication, Cohesion, Training & Support, Team Diversity, Conflict Management, Individual Roles, Performance Feedback and Gender & Ethnic Differences*.

Table 5. Significant Attributes

Attribute	p-value (significance at $\alpha = 0.05$)	R-square value
Personality	0.023	68.62%
Team Efficacy	0.003	69.45%
Team Trust	0.002	71.62%
Skills & Knowledge	0.039	59.77%

Table 6 shows the mean value of these attributes and it can be deduced that:

- Teams 4 and 10 had the highest *team efficacy* while Team 12 had the lowest.
- Teams 2, 5 and 17 had higher *team trust* among team members while Team 12 had minimum trust among them.
- Team members from the Teams 15, 18 and 22 ranked higher in showcasing positive attitude at work while members from Team 3 ranked the lowest.
- Employees from Teams 2, 4, 17 and 20 perceived their team members to be highly skilled and knowledgeable in the work they do while employees from Team 3 perceived their team members to be poorly skilled.

Table 6. Mean Value of Attributes for Different Teams

	Team Efficacy	Team Trust	Team Personality	Team Skills & Knowledge
Team 1	3.17	4.50	2.83	3.25
Team 2	3.83	4.75	3.33	5.00
Team 3	2.83	4.25	2.33	3.00
Team 4	4.67	4.25	3.83	5.00
Team 5	4.00	4.75	4.00	4.50
Team 6	3.67	4.25	3.83	4.25
Team 7	3.67	4.50	4.17	3.50
Team 8	4.00	4.33	3.56	3.67
Team 9	4.44	4.17	3.56	4.67
Team 10	4.67	4.50	3.50	4.75
Team 11	4.56	4.67	3.56	4.67
Team 12	2.22	2.50	3.56	4.50
Team 13	3.00	2.83	4.22	3.50
Team 14	3.17	3.00	3.33	3.25
Team 15	3.83	4.00	4.33	4.25
Team 16	4.17	4.25	3.67	4.50
Team 17	4.50	4.75	3.83	5.00
Team 18	4.50	4.50	4.33	4.25
Team 19	4.17	4.25	2.83	3.50
Team 20	4.50	4.00	4.00	5.00
Team 21	3.83	4.00	3.33	3.75
Team 22	4.33	4.50	4.33	4.50

3.2.2 Questions versus Teams

Table 7 below shows the effect of teams on the actual survey questions. It is seen that team effect was significant only for certain questions. These questions are consistent with attributes which were significant from the above result: *Attributes versus teams nested within groups*.

Table 7. Effect of Teams on Questions

Questions	p-value (significance at $\alpha = 0.05$)	R-square value
Q5:Team leadership	0.004	68.01%
Q9:Communication	0.007	66.71%
Q15:Team Diversity	0.046	64.55%
Q24: Team Efficacy	0.014	69.41%
Q25:Team Efficacy	0.016	63.78%
Q38:Team Trust	0.001	73.66%
Q39:Personality	0.012	67.03%
Q42: Skill and Knowledge	0.027	61.10%

3.2.3 Attributes versus Groups

Teams participating in this survey are primarily form two countries: A one-way analysis of variance was performed to test for differences among the groups participating in this research. The results indicate that three out of the fourteen attributes were statistically significant while the rest being non-significant (Table 8).

Table 8. Effect of Attributes on Groups

Attributes	p-value (significance at $\alpha = 0.05$)	R-square value
Training & Support	0.001	21.75%
Performance Feedback	0.025	10.09%
Personality	0.002	18.00%

In all the three attributes, Chinese teams scored more as shown in figures 1 through 3. Higher ratings given by teams from China show that they were more satisfied with the Training & Support provided by their respective managements than their U.S counterparts. Higher ratings given by teams from China show that they were more satisfied with the opportunities provided for overcoming weaknesses and improving skills by their respective managements, than their U.S counterparts. Higher ratings given by teams from China show that their personality traits were more influenced by outside issues (such as work atmosphere) than their US counterparts.

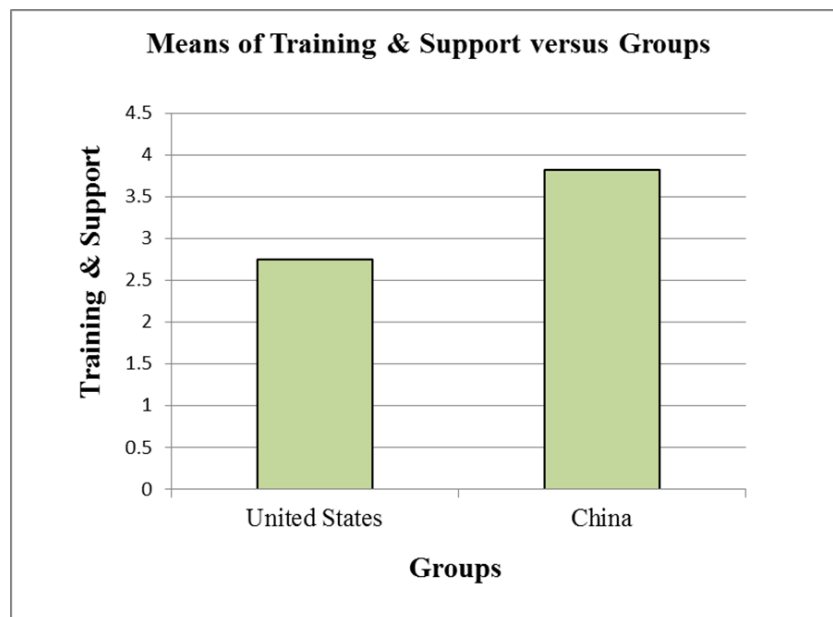Figure 1. Plot of Effect of Group on Training and Support

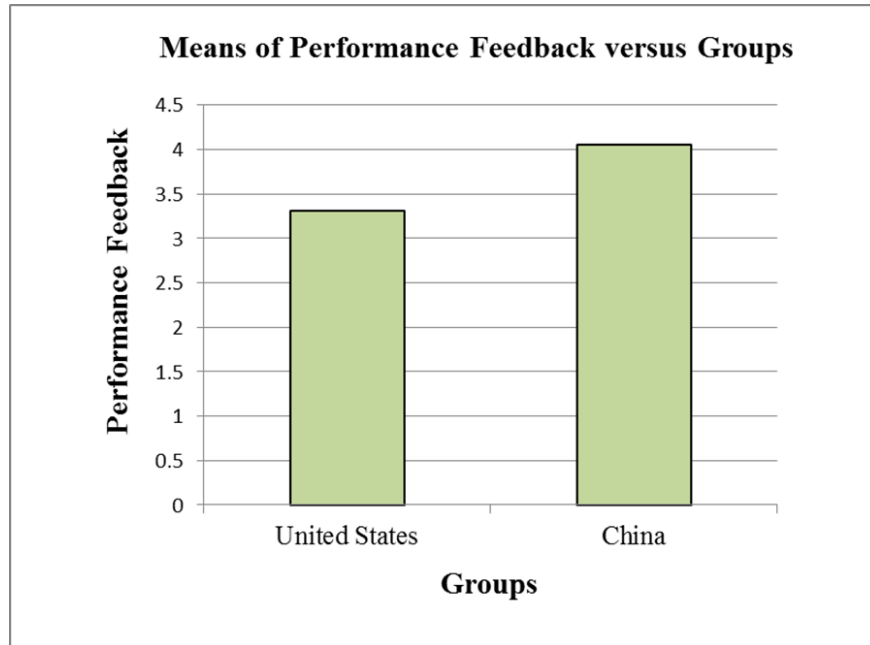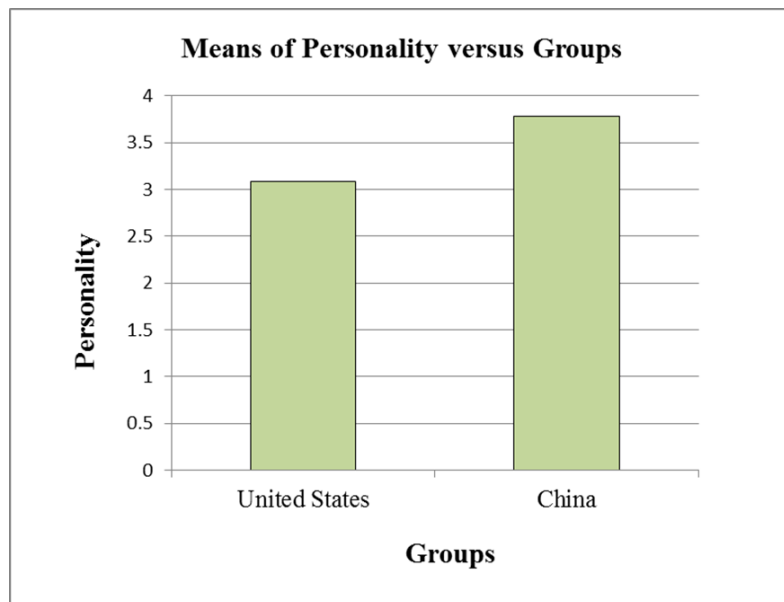Figure 2. Effect of group on Performance Feedback

Figure 3. Effect of Group on Personality

3.2.4 Questions versus Groups

As a next step to see if individual questions had different effect, a one-way ANOVA was performed for all the forty three questions.. Groups were the independent variable. Table 9 summarizes all the statistically significant questions with their corresponding P-values and R-square values. Out of the forty three questions in the survey questionnaire twelve questions were found to be statistically significant. Question 12 & 14 (shown in Table 9) correspond to the attribute *Training & Support* and questions 28 & 40 correspond to the attributes *Performance Feedback and Personality* respectively. These results were consistent with the results reported in earlier sections. However, it is interesting to note some differences. The

other questions which were significant here were questions 3, 15, 24 and 30 (shown in Table 9) and correspond to the attributes *Job Satisfaction, Team Diversity, Team Efficacy and Team Effectiveness* and questions 33, 34, 35 and 36 correspond to the attribute *Gender & Ethnic Differences*, were not significant in the earlier attribute analysis.

Table 9. Summary of One-Way ANOVA for Questions versus Groups

Question # (Attribute)	Question	P Value (Significance at $\alpha =0.05$)	R-square Value
Q3 (Job Satisfaction)	Team members are satisfies with the priorities and direction of the department or group they are working with?	0.031	9.37%
Q12 (Training & Support)	Overall how satisfied are you with the training provided in your company?	0.005	15.56%
Q14 (Training & Support)	Management and team members support your efforts to work on your weaknesses and convert them into your strengths?	<0.001	24.68%
Q15 (Team Diversity)	How long have your been working for the company?	0.007	14.13%
Q24 (Team Efficacy)	The procedures followed are effective to grade team functioning?	0.005	15.40%
Q28 (Performance Feedback)	Members find team meetings efficient and productive and look forward to this time together?	0.043	8.30%
Q30 (Team Quality)	Team members complete the given task in a timely manner?	0.006	14.79%
Q33 (Gender & Ethnic Differences)	Do management authorities behave consistently in front of team members of all ethnic backgrounds?	0.039	8.59%
Q34 (Gender & Ethnic Differences)	Do management authorities behave consistently in front of team members of different genders?	0.029	9.57%
Q35 (Gender & Ethnic Differences)	Some of the team members assume themselves to be better skilled than others because of their ethnicity?	<0.001	25.44%
Q36 (Gender & Ethnic Differences)	Do you think working with a team member of the same ethnicity as you is more beneficial?	0.004	15.85%
Q40 (Personality)	Do you feel satisfied by overcoming resistance in order to get team members do what they are supposed to do?	<0.001	25.00%

3.3 Regression Analysis

3.3.1 Regression analysis on Attributes
The model for the stepwise regression analysis with attributes is as follows:

$$Y_{Overall\ Team\ Quality} = 0.6355 + (0.5)\ Job\ Satisfaction + (0.359)\ Team\ Trust \tag{1}$$

From the results, it can be interpreted that the overall quality of a team depends on the attributes job satisfaction and team trust, i.e. presence of higher job satisfaction among the employees and presence of high mutual trust among the employees would lead to increased overall quality of a team.

3.3.2 Regression analysis on raw questions
Out of the 43 questions from the survey questionnaire, four questions (Q29 – Q32) defined "Overall Team Quality". An average of these four questions was taken and was considered as the dependent variable. A stepwise regression analysis was performed by using each of the remaining 39 questions as predictor variables and the average of the four questions (Q29

– Q32) as response variable. The model linking overall team quality with questions in given below. It appears that only some questions were predicting the quality.

$$Y_{Overall\ Team\ Quality} = 1.944 + (0.221)\ Q25 + (0.24\ )Q1 - (0.142)Q39 + (0.170)Q14 \qquad\qquad (2)$$

Where,
Q1   - Overall how satisfied are you with the company you work for?
Q14   - Management and team members support your efforts to work on your weaknesses and convert them into your strengths
Q25   - Does your team believes and encourages in creative approach of doing things
Q39   - Do you feel really annoyed if management insists on a particular procedure?

The outcomes show that the overall quality of a team increases when there is higher job satisfaction amongst the employees, when higher team efficacy exists within the team and when the training & support provided is finest. However, the overall quality of a team decreases when there is a conflict between the employees and the management during decision making process

4. Conclusion

In summary, this study identified 14 vital attributes which could possibly affect the overall quality of a team. A generic survey was developed based on these 14 attributes and some questions which addressed team quality. The results indicate that four out of the fourteen attributes were significant. They were team efficacy, team trust, personality and skills & knowledge. The attributes which are not significantly affected by any of the independent variables are: *Job Satisfaction, Team Leadership, Communication, Cohesion, Training & Support, Team Diversity, Conflict Management, Individual Roles, Performance Feedback and Gender & Ethnic Differences*. Lack of significance may imply that these attributes are equally important for both the nations. Regression analysis for team quality versus other attributes showed that job satisfaction and team trust were significantly affecting the overall team quality.

Results also showed some interesting differences between China and USA. The attributes *Training & Support* and *Performance Feedback* were given higher ratings by the teams from China when compared to teams from The United States. This essentially means that teams from China were provided with better training and had better management support when compared to teams from The United States. Moreover, this also shows that the companies or the firms from China constantly try to motivate their employees by providing them with opportunities for feedback. This difference can primarily be attributed towards the varied working cultures of the two nations, which drives their management functionality. The results also show that the attribute Personality was given higher rating by the teams from China when compared to teams from The United States. This shows that personality traits of the employees from China are more dependent on external factors such as work atmosphere and management responses. For example, for questions such as "*Do you really feel annoyed if management insists on a particular procedure*" or "*Do you contribute more when working in an appreciative atmosphere amongst team members*" employees from China strongly agreed to them showing how sensitive their personality is towards various external factors. However, employees from The United States were comparatively less affected by such external factors, meaning that their performance at work remained more or less consistent even with the presence/absence of such factors. This is very interesting as it portraits how unique and different are the personality traits of the employees are among the two nations.
In summary this study yielded the following findings:
1. There were noticeable differences between teams from China and teams from the United States
2. Some attributes did influence team quality and effectiveness while other attributes were not significant implying that they were equally important on all fronts
3. The attributes which were consistently significant among the various analyses performed were *Job Satisfaction, Team Trust and Team Efficacy*.
The overall quality of a team can be improved by:
- Taking proper measures to ensure that the employees working within the team have optimal job satisfaction.
- Creating a harmonious and a cordial environment among the team members where each member of the team can trust the other member.
- Providing opportunities and scope for a creative approach while simultaneously encouraging the team members in their approach of doing things.

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