Measuring the Performance of Cross-Functional Multidisciplinary Teams using an Epistemic Game: Impact of Team Cohesion and Personality

Abstract

Job performance of multidisciplinary cross-functional teams are characterised by the ability of individual team members' disposition in completing the task within a given resource constraint. Prior research has established the linkages between a teams personality and job performance and the task type being a moderating factor. Majority of the studies conducted in this area have looked at job performance as a rating coded by an instructor(s) and only a few have looked at objective measures arising out of an experimental setup. In this study we have used a proprietary business simulation game designed by one of the authors and measured job performance and team cohesion using epistemic network analysis. Team cohesion plays a significant role in determining the performance of cross functional teams and the personality traits of the team influences team cohesion.

Index Terms—Cross-functional Teams, Job Performance, Epistemic Games, Team Cohesion, Personality.

I. PERSONALITY AND JOB PERFORMANCE

The relationship between personality and job performance has been of interest to researchers for a long time and has been extensively studied and reported. Job performance is a multidimensional construct measuring the ability of an employee(s) to perform a given task, the initiative and resourcefulness they show in solving a problem. It also indicates the manner in which the task is completed with the help of available resources, time & energy[1].

Job performance can be affected by a multitude of factors such as the characteristics of the job, nature of task, organisational factors and the disposition of people involved in performing the task[2]. Dispositional factors denote the personality characteristics of people involved in performing the task such as their needs, attitudes, motives, perceived benefit & preferences that impact the way they react to a situation.[3]

Job Performance is influenced by the interaction between an employee's attitude, need for achievement, self regard, locus of control and temperament[1].

Traditional industrial psychologists have argued that personality measures do not have predictive validity over job performance, since they can be easily faked[4]. However recent research in this area shows that the personality dimensions are related to job performance and unlike measures of cognitive ability they do not have any adverse impact.

The recent research focus in the area of personality and its impact on job performance have largely been looking at the characteristics of individual team members personality and impact of team effectiveness[5], shared mental models of a team and its impact on effectiveness[6] and the third area has been on how effectively to measure team level constructs[7]

Due to the interdependence nature of working teams where one team members decision impacts the work of an another team member's and the interpersonal nature of working among individuals, suggest that personality traits should relate to job performance[8].

There are many types of teams under study and they relate to the tasks that are being performed, for example; sports teams, hobby teams, groups formed in colleges to complete an assignment and cross-functional multidisciplinary teams. Cross functional multidisciplinary teams are those seen by others as a social entity and are interdependent because of the task that they perform as members of a group, and the outcome of one individuals' tasks impacts the others. The teams performs a complex set of tasks which require a specific output by a specific deadline. Since the task is complex, it requires coordination among the team members performing the task and each of tasks are integrated and governed by a space and time constraint.

This study focuses on the performance of cross functional teams and the impact of team cohesion and personality traits of individual team members. Previous studies have looked at personality traits and its impact on team performance. Team performance in prior studies have been generally represented by subjective rating by instructors and supervisors and this has been often criticised because of the subjective nature of evaluation[9]. In this study we use an experimental setup using a multiplayer role playing business simulation game where objective measures are used to measure performance of teams. We also posit that for cross functional teams, team cohesion plays a significant contributing factor towards predicting job performance. Team cohesion is characterised by the way the team members interact, the way they manage their interdependency and alignment of their tasks towards the end objective.

II LITERATURE REVIEW

A well accepted framework to measure the personality of an individual is the Five-Factor Model of Personality also known as the Big Five[10]. Research has established that the factors remain relatively stable over time and situations. Extraversion is associated with behaviours like being sociable, gregarious, assertive and active. Agreeableness relates to being courteous, flexible, trusting, good natured, tolerant and soft hearted. Conscientiousness refers to being careful, thorough, responsible, organised, achievement oriented, persevering and planful. Emotional stability relates to behaviours such as calm, posed and secure. Neuroticism is associated with being anxious, depressed, angry, embarrassed and insecure. The behaviours

associated with openness is being imaginative, curious, cultures, intelligent and artistically sensitive [11].

Teams Personality Score
Team composition research provides us information on how to measure and arrive at a teams personality score. Individual trait scores are aggregated in order to represent the team composition in terms of personality (Mean, Variance, SD, Maximum and Minimum).

Critics have often argued that individual personality scores do not fully generalise to the team level aggregated score. They argued that individuals may behave differently while working in teams and also they may rate their behaviour different from that of their team[12].

However it has been found that the team referent measure did not significantly add to the prediction of overall team performance above the individual measure. Hence looking at the trait elevation by arriving at the sum of the trait score of individual within teams or average trait score is a good measure of computing the teams personality score. The other measure to look at would be to measure the trait variability which is computing the variance and standard deviation of a certain trait.

Task Type
Prior research has found that impact of personality trait on the type of tasks that are performed. A taxonomy of tasks classifies them as unitary and divisible. Unitary tasks have been further classified as addictive, conjunctive, disjunctive and discretionary. A brainstorming activity is considered to be an addictive task, since the performance involves the aggregation of all the suggestions made by the group. A teams performance in such tasks will depend on their ability to contribute collectively.

In conjunctive tasks, the performance is based on the lowest contributing team member. Contrary to conjunctive tasks in disjunctive tasks, the performance is based on the highest performing team member. Disjunctive tasks are not that common in work teams. An example of a discretionary task is the one performed by management teams. A management team while implementing organisational initiatives, manages their time, organise teams and evaluates their efforts[13].

The tasks that cross-functional multidisciplinary teams performs are largely discretionary in nature. They work towards implementing organisational objectives while managing various resources within a specified constraints. Prior studies have looked at the impact of personality traits such as conscientiousness on addictive, conjunctive and disjunctive tasks. However there is very little studies which have looked at the impact of personality traits on discretionary tasks in cross functional teams

Criterion Measure: Team Performance
Common to majority of team performance ratings is that they have been made by a supervisor or instructor. The supervisor can be known or unknown to the team and rate their performance on various objective measure relevant to the task at hand. To remove the subjectivity in ratings, multiple assessors would be involved. Very few studies in the area of job performance use experimental studies where objective measures are defined[14]. In our study we have used an epistemic game where cross functional teams are formed to perform tasks which are discretionary in nature to meet a certain objective.

Team Cohesion
Apart from the personality of the individuals, the type of tasks that they perform, we posit that the team cohesion in terms of how well all the team members are aligned towards the task the ability to manage the interdependency and communication among the members of the team will impact the team performance. A team could have high performing individuals with a positive trait disposition towards the task, but if they are not aligned with other team members and if they act in silos, it would impact the overall performance of the team.

III EXPERIMENTAL DESIGN & ANALYSIS

In order to test the impact of team cohesion and personality on team performance we used a multi player role playing business simulation game. The game was designed to handle the tasks of cross functional teams and simulated a virtual business enterprise with all its complexity and nuances.

The game was conducted among post graduate students of a business school in India. Totally 124 students participated in the exercise. Students were split into teams of 6 in a random fashion to eliminate any selection bias. We administered the Big Five personality test prior to the simulation.

Students were tasked with the responsibility of running a virtual enterprise and were asked to assume roles of the head of Marketing, Operations, Finance, HR, IT and International Business. Each role had a defined role and responsibility matrix and set of decisions that they can make while playing the game.
Since it was a multi player game, each student had access to the game in their PC's or tablets. This ensured that every student's action can be tracked individually. There were totally 21 teams comprising of 6 students in each group and the last group had 4 members in a team.

Figure1: Multi Player Business Simulation Game

Decisions in the game are interconnected and the decision of one student and the outcome has a bearing on the other. The teams would have to align their strategy together and communicate with each other to compete with other teams in the game universe.

For example the player who dons the HR role decides the number of people to recruit based on the decision made by the marketing, operations and other roles. Based on the business plan of other departments, the HR role formulates the recruitment plans and seeks budget, which is approved by the finance role.

The HR role would take cognisance of the following guidelines before making their decision

Number of people to be recruited = f(number of sales people required to sell the product)+f(number of products to be produced) +f(requirement from other departments)

Time of on-boarding = Time of recruitment request submission (move number)+ No of moves taken for on-boarding for each designation as defined by the gaming engine

Recruitment Efficiency (Number of candidates who accept the offer) = f (Salary offered, channel effectiveness, brand image

of the organisation)

Managing financial resources effectively = f(estimating budget required) + f(Managing to secure adequate budget from finance) + (budget spent <=budget approved) +f(effectively spending the budget to meet objective)
Having secured adequate budget and understood the overall teams strategy to recruit people, the player would have to take decision at the appropriate time to ensure the resources are on-boarded when required and at the same time improving recruitment efficiency and optimising departmental budget.

Team performance in the game was computed by taking a weighted average score of a teams Revenue, PAT, Book Value of Share and Employee Happiness Index. All the teams started with the same set of values and their performance in the above parameters were recorded at the end of 5 years of game play which lasted for 10 hrs. The score of each of the teams were tabulated in descending order to determine the ranking of a team.

We formulated a set of use cases to measure the individual performance of each role in the game based on their contribution to the overall team performance. The use case took into consideration an individual's performance on key department parameters and parameters which had cross functional linkages.

The game engine automatically captures the evidences of players actions and records them in an adjacency matrix. The presence of an evidence was marked as 1 and the absence as 0. The assessment in epistemic games are made possible by designing the game using evidence centred design framework

(ECD). This method of gathering evidences in the game is quite similar to the way an individuals are assessed for performance in an organisation

The adjacency matrix matrix captures an individual's roles performance and skills exhibited while playing the game.The elements of ECD is further transferred into a network map using Epistemic Network Analysis. Each player's evidences are captured at various intervals of time and translated into a network map which provides a learner's performance at various intervals of the game[15]. The degree centrality of the network was computed.

$$\text{Centrality of the node C (N)} = \sqrt{\sum_{j=0}^{j=n} A(i, j)2}$$

ENA analysis imparts a wide panorama of the individual's behavioural aspects and thinking process[16]. Following the ENA framework of analysis, the game adopts SKIVE (skills, knowledge, identity, values and epistemology) to assess the cognitive processes of the individual [17].

The competitive edge that ENA holds over other modelling approaches is that ENA explains the structure of connections among the cognitive elements of an individual and helps to draw a meaningful interpretation out of it. Wheras, existing network analysis approaches are designed to analyze large networks with thousands and millions of nodes and use summary statistics such as structural cohesion, clustering coefficients, or density to draw meaningful interpretations. As a result, these analysis do not shed light on the significant differences in the structure of the networks. The ENA analysis on the other hand addresses these limitations because it is optimized for the analysis of networks that are too large to be analyzed using multivariate parametric techniques and highlights the important differences among the structures of two networks ([18]

Team Cohesion and Team Performance
The teams cohesion was computed by aggregating the degree centrality measure of every individual's network at various time slices. A quarter in the game was considered as a time slice where an individual's performance was measured. A high degree centrality team score indicated that every individual in the team performed well and their decisions were coordinated. The game design ensured that an individual role will be able to perform well only if the others in the team also perform.

Hypothesis 1 H1: Increase in team cohesion has a positive impact on team performance

Liner Regression - Team Performance - Team Cohesion

Job Perfor-mance	Coef	Std.Err	t	p>ItI	95% Conf Internval	
Team Cohe-sion	-0.007	-0.001	-6.26	0.000	-0.009	-0.004
Constant	41.75	3.38	12.34	0.000	35.05	48.45

Team Performance =-0.007184 (Team Cohesion) + 41.75

(n = 124, R Squared = 0.2434)

In-order to measure the impact of team cohesion on team performance we ran a linear regression. Team cohesion was found to have a positive impact on the team performance at 5% level of significance. With one unit increase in team cohesion, the overall rank of the team decreases by 0.007 units. It should be noted that a lower team rank indicates better performance.

Personality and Team Cohesion

We ran a linear regression on the teams personality score which was computed based on the aggregated values of all the individuals traits in a group to that of the team cohesion.

Hypothesis 2 H1: Teams personality score has an influence on the teams cohesion.

Linear regression between the big 5 personality scores of an individual and the degree centrality of the network showed that Extroversion, Openness were significant at 5% confidence levels. While Openness had a negative coefficient , Extroversion had a positive coefficient

Liner Regression - Team Personality - Team Cohesion

Team Co-hesion	Coef	Std.Err	t	p>ItI	95% Conf Internval	
Agreeable-ness	-3.71	15.16	-0.25	0.80	-34.10	26.67
Conscien-tiousness	11.23	11.95	0.94	0.35	-12.71	35.19
Extraver-sion	20.12	10.72	1.88	0.06	-1.35	41.62
Neuroticism	30.06	11.88	2.53	0.14	6.25	53.87

Liner Regression - Team Personality - Team Cohesion

Team Co-hesion	Coef	Std.Err	t	p>ItI	95% Conf Internval	
Openness	-23.37	12.59	-1.86	0.06	-48.60	1.86

(n = 82, R Squared = 0.28)

Extroverts tend to search for social relationships with co-workers, leading to increased relationships with teams and in the game, students with higher extroversion scores were in a position to adapt to the task that was provided to them and were able to perform better.

Neuroticism, though was not significant, interestingly has a positive relationship with the teams performance. This could be attributed to the teams collective insecurity and their urge to excel leading to higher team cohesion.

Openness has been generally connected to creativity in workplace environments. The higher the openness score the more creative the person and less would be his interest in working on tasks which are routine. The game does offer new avenues to explore and experiment. However over a period of time, the tasks get repetitive and hence a creative student might loose interest leading to lower team cohesion.

IX DISCUSSION AND LIMITATIONS

Team cohesion plays a significant role in determining the performance of a cross-functional multidisciplinary teams whose role is to perform discretionary tasks. Prior research have found positive impact of personality on various task types and job performance. In this study we have studied the impact of team cohesion on job performance and the impact of a teams personality on team cohesion.We have found that team cohesion has an impact on job performance and a teams personality traits such as Extroversion, Openness and Neuroticism have an impact of teams cohesion.

This study contributes to the body of knowledge by looking at factors that contribute to the performance of cross-functional multidisciplinary teams.

The analysis was performed on a smaller sample size. In our future research we would like to expand and experiment with larger sample size and endeavour to explore whether team cohesion moderates the impact of personality on job performance.

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