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Do Teams Need Cog-Synergy Mental Models for Strategic Direction

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ABSTRACT

Teams' interaction with a focus on mental models is an active area of research. Yet, teams' mental models with spatial, social and strategic cognition remained an area to be expanded and empirically validated. This paper empirically validates the cog-synergy mental model through an experimental research design after development of a construct. The data collected through observers and team mates are analyzed through SEM. The results empirically validate the relationship of the cog-synergy mental model with high performance teams. The results develop an understanding of the teams' interactions and are useful for researchers, trainers, top management teams and practitioners. The paper contributes in team mental model literature and helps in understanding the interactive cognitive processes.

Keywords: Cog-synergy mental model; spatial, social and strategic cognition; high performance teams; team mental models

1. INTRODUCTION

Cog-synergy mental model is based on spatial, social and strategic cognition of team members and teams. First, at spatial level of cognition, it includes mental approach and experience of knowing the physical features. These features need to be perceived, recognized, conceived and reasoned to form a cognition. The spatial feature associated to the situation, colleagues, memory, task from shared and differentiated cognition are parts of spatial cognition. It combines in itself the characteristics of the earlier mental models from spatial perspective i.e. description of the team members, place where tasks are to be carried out and an understanding of the situation. Second, at social level of cognition, there exists a need to understand the mental approach and experience of knowing. The mental approach is based on perceiving, recognizing, conceiving and reasoning of the social interactions in a given situation and among teams. It includes past social interactions of team members, social interactions during task performance with an understanding of the team members from shared and differentiated cognition (Wilms et al., 2019). It combines in itself the characteristics of the earlier mental models not only from knowing perspective but also extending its scope: who prefers what and who is biased to what. These preferences and biases help in developing team dynamics necessary for performance from social point of view. Third, at strategic level of cognition, it refers to mental approach and experience of knowing. This mental approach and knowledge coming through experience

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from strategic direction is of vital importance. Strategic direction in a given situation and task is learnt through the process of perceiving, recognizing, conceiving and reasoning. It takes into account the past strategic targets in similar situations and develops a strategic plan to achieve the targets and cope with the situation in a novel way by taking into account the emerging situations. Creating this understanding of the task/target with an understanding of the team members from shared and differentiated cognition refer to strategic cognition (Kozlowski, S. W., & Bell, B. S. 2019). The strategic cognition helps team members develop an understanding of the targets in terms of team resources and the challenges it faces. This strategic cognition helps teams to achieve targets, deadlines, outcomes from expectancy theory perspective etc. is a recent phenomenon.

The increasing complexity in team performance creates a concern among researchers to see this phenomenon across disciplines. A review into the antecedents of cog-synergy mental model processes is important. This insight is useful to understand the synergistic view of teams. It also requires assessing diversity in the individuals' viewpoint. The literature supports that successful teams are characterized by the members' discussion even on minor things. This creates togetherness in thinking and discussion. This surfacing of ideas often result in an agreement. The idea may be shared or a new one. The result is that members of these teams are highly interdependent. They trust to share their creative and innovative ideas (Ricketts, D., & Lockton, D. 2019). This creates an environment of trust and each member can ask critical questions. This leads to creation of a process of shared responsibility amongst them. One of the objectives of these mental models is to understand individual cognitive processes in order to achieve higher performance to meet the current global challenges (Aggarwal et al., 2019). This paper views conversion of individual cognition into team cognition as a solution to this problem.

Teams when faced with a specific target needs to understand the spatial cognition i.e. representation of individuals in the team with an understanding of geographical features of the area where the task is to be performed, the description of team members, environment, task, internal and external structure of place, etc. An understanding of the individuals and teams to this effect from differentiated and shared cognition helps in development of spatial cognition shared mental model. Individuals as part of team simultaneously needs to exhibit a learning behavior towards spatial cognition for a performance episode. This helps in achieving one level of performance. Similarly social cognition is individuals and team members' representation of their liking and disliking towards team members, task processes, situation, situation analysis and tasks (Dindar et al., 2019). The surfacing of these likings and disliking, and making attempts to create homogeneity or accommodating diversity is another challenge in creating social mental models (Jackson, C. L. 2020). These social mental models as a part of cog-synergy mental model help in achieving another level of performance.

Some important inconsistencies regarding variations in team members' understanding at strategic level have yet to be resolved. The literature review discusses variation in team outcomes (Debrulle, J., Maes, J., & Gardiner, E. 2020) from various perspectives without giving its straight forward linkage to team members' understanding at strategic level. The strategic decision whether to go for extension of the current organization or to start a new organization are of critical importance. The analogy can be drawn from the decision whether to continue with the current product and whether to go for new product is also strategic one. This paper does not emphasize on who knows what, rather emphasizes on interactions to surface the ideas and create awareness among members. This awareness from strategic cognition perspective is not limited to creating homogeneity but also associated to accommodating diversity. The paper views it important that what direction a particular strategic member wants to follow and other members also consider that direction important while making decisions.

Cog-synergy mental model takes into consideration spatial, social and strategic cognition with a syntegrative approach i.e. the interaction among human beings, their understanding of the geographic conditions and their ultimate targets. This paper therefore, takes into consideration the team interactions as centerpiece of team processes. These processes and interaction with a collaborative approach help in achieving the higher degree of performance in teams. The idea is to surface the understanding of team members' interaction in order to create cog-synergy. The holistic approach to these interactions with its relation to niche, general description, social interaction and strategic directions need to be explored and validated.

Cog-synergy refers to an accurate shared understanding of team member's mental models. Constant interactions among team members can help in evolving this understanding. The measurement of this understanding requires degree to which they interact and develop synergy. At spatial level, they need to know general information such as family background, the areas to which they belong and the area where work is to take place and environments factual knowledge. At social level, they need to understand the liking and disliking of their team members. At strategic level, they need to have shared understanding of the degree as to how other team members make decision. Cog-Synergy is compositional in nature as it depends on the composition of team members. How accurately they understand each other and share information. The nature of the relationship between the component-level construct (a team member's shared understanding of others mental model) and the team-level construct could conceivably take several forms (Harrison & Klein, 2007). The current paper is a step to create awareness among researchers, strategists, managers, top management

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teams that conceptualized cog-synergy mental model (Khan & Lodhi, 2011) is a step leading to improvement in teams interaction, functions, operations and performance.

Significance of Cog-synergy in Teams

The Covid-19 has transformed the work structures worldwide with more emphasis on technological basis. The shift from shared office to work from home is being witnessed. The work is more centered to individuals or teams with increased global competition. This paradigm shift has led to the use of excessive technology and innovation. Thus the pressures are created to influence the emergence of teams as basic building units of organizations. The change in organization structures is taking place through expansion, mergers and acquisitions (Lessambo, F. I. (2020). The joint ventures place more importance to cross-cultural and mixed culture teams. Physical and virtual coordination is taking place with the help of advanced computer and communication technologies. These ongoing transformations in the basic work design have been viewed with interest by researchers and demand more focus on the functioning of teams.

2. OBJECTIVES OF THE PAPER

The main research aim of this paper is to provide a holistic and integrated view of teams (Bolzani, et al., 2019). Teams in organizations for performance have effective role and for effective performance, key issues related to team are in need of research attention. The paper extends and expands the scope of spatial, social and strategic cognitions. These cognitions are seen from layer perspective and the first layer individually culminates into one level of performance, second layer on another level of performance and final layer as the best possible performance. This can be a leading argument with further extension through mediator and moderator. This may help and bring value to the topic with further exploration necessary for theory development.

The less attention to spatial, social and strategic layers of cognitions needs to be explored and validated. For validation, the research design is experimental. Volunteer students of MBA formed teams. Based on the existing widely used mental models, the cog-synergy model extends and expands the scope thereof. The paper is an attempt to investigate the relationships between CS mental model and high performance. It researches the level of CS in teams and draw conclusions necessary to proceed further in the domain. Guided by the attention on social networking theories and based on a scenario that include Covid-19 as a determining factor for the shift in work structures, the conceptual model is particularly useful. Now researchers have increasingly unlimited access to information through technology with limited abilities to attend to and process these information (Borgatti et al. 2009, Gallagher 2009, Jackson, 2009, Ocasio, 1997, Khan et al. 2011).

The cog-synergy term has in it the roots of cognition and its synergy among the team members (Khan et al. 2011). Cog-Synergy and the mental model on which the team-level cog-synergy construct depends bear similarities to other constructs in the literature, including transactive memory systems (TMSs) and perspective taking. The differences between cog-synergy and these other constructs would create confusion in theory construction and in the comparison and interpretation of empirical findings. Cog-synergy and the TMS construct are similar since they are composed of team members' understandings. A TMS refers to the shared understanding of team members with their abilities to encode, store and retrieve knowledge. The source of this knowledge from team members is different but complementary (Hollingshead, 2001; Wegner, 1986). In contrast to a TMS, the knowledge associated with cog-synergy is more associated to the surfacing the knowledge of the team members at each level. The team members having knowledge at spatial, social and strategic level have more understanding and can deliver better in complex world. Cog-synergy focuses on the synergistic cognition of the members at all the three levels. It also accommodates an understanding of the differentiated knowledge from performance perspective. An understanding of the situation (spatial knowledge) is as critical in decision making as that of social and strategic. Therefore, team members at strategic level, with the spatial or social level understanding of the task may prove better in a performance episode.

The literature on team cognition does not entail proper discussion at all the three levels discussed above, rather social categorization perspective has been more emphasized. The social categorization perspective on work team diversity suggests an inconsistent relationship i.e. sometimes negative and at other times positive between diversity in inter-team, inter-team and team performance (Williams & O'Reilly, 1998). Whereas diversity has been positively related to performance (Lewis and Huber, 2010 and Khan and Lodhi, 2010) the cog-synergy might explain the inconsistencies just noted.

It seems that the cog-synergy might explain the inconsistency in the literature associated to the observed impact of diversity on team performance. Cog-synergy explains these phenomena at spatial, social and strategic level and advocates accommodation of the teams knowledge at all three level as positively related to performance. It advocates that members with diversity in intra team or inter-team may surface their ideas and develop cog-synergy. This cog-synergy may result in ensuring persuasive arguments with

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high cog-synergy would be able to use their insights into others' mental models at the level at which team is operating to make more persuasive arguments settling down in collaborative approach. This cog-synergy coupled with collaborative approach may expand the scope of this mental model and result in effective team's decision making.

Team mental models are based on team members' internal representations of external reality. This representation helps in developing interaction with the people around them. These are the results of team members' unique and shared experiences and perceptions of the work. These experiences and perception lead to develop understanding of the work and environment and develop better behavior. It is important to understand not only intra-team interactions but also those of stakeholders' perceptions. This paper explores the application of these mental models in the team operations, and functions. It also addresses the major theoretical and practical challenges related to the development of construct and thus, provides a cognitive dimension to cog-synergy model.

Cog-synergy applies to teams engaged in tasks at various levels, i.e. spatial, social and strategic. This paper explores that surfacing the understanding of the team cognition can lead to value creation. This holistic approach of cog-synergy applies to cross functional teams, task force teams, product development teams, top management teams, project teams, etc. These teams may benefit by applying spatial, social and strategic cognition model for improved performance (Khan et al., 2011). Cog-synergy schema applies to teams engaged in tasks. This schema develops intra-team and inter-team interactions for value creation.

3. DEVELOPING HYPOTHESES

A systematic way to develop and test the hypotheses is mandatory for determining the relationships. In this paper, seven hypotheses are developed in view of the conceptualization. All of them deal with the structural relationship of Cog-Synergy measures and team performance. These hypotheses have been tested through experimental design using structural equation modelling in order to establish causal relationship between explanatory and response variables.

Table 1: List of Hypotheses

Hypothesis	Description
H_1	The spatial cognition in team mental model has effect on performance.
H_2	The social cognition in team mental model has significant impact on the team performance.
H_3	The strategic cognition in team mental model has impact on the team performance.
H_4	The spatial and social cognition in team mental model has significant impact on the team performance.
H_5	The spatial and strategic cognition in team mental model has significant impact on the team performance.
H_6	The social and strategic cognition in team mental model has the effect on performance.
H_7	The spatial, social and strategic cognition has significant impact on the team performance.

4. MEASUREMENT OF COG-SYNERGY

To help researchers wishing to use and test the cog-synergy, this paper offers two approaches for measuring the understanding that each member has about each other member's mental model. The first approach is to measure a focal member's perceptions about the extent to which he or she understands the mental model of each other member. The second approach is to measure the behavioral manifestations of each focal member's understanding.

Experimental Design

Based on the benefits associated to experimental design, this study uses it for establishment of causal relationship between explanatory and response variables. In an experiment, the researcher intervenes on objects or subjects in order to observe the predicted response. This requires a great deal of care and sophistication. The validity of an experiment is challenged on the basis of its construction and execution. It is important that the researcher determines the same conditions -- the same subject, similar context, similar length of time, and so on. These need to establish the change associated to explanatory treatment. We know that experimental design is criticized on its contrivance. It might fail in real life settings, where new variables emerge.

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Team Formation, Training as a Treatment and Team Assignation

Team formation demands creation of homogeneity in all the teams (experiment teams, control team). This homogeneity needs to be ensured by equivalent. One way of doing it is random assignation. This random ensures equal chance to each member for selection and we may call such teams probabilistically equivalent. However there is equal chance that teams such formatted may be unequal. Another method is to match the team members on the basis of their characteristics and deliberately spread them in such a way as to ensure equivalent. This study followed the second approach. We needed a control group to see the difference between the treatments and seven treatments are given to the teams. Therefore eight teams on the basis of equivalent are formed (Table 1).

After formation of eight teams on the basis of confounding characteristics, the next question is how to assign teams for specific treatment or for non-treatment. Such assignation at researchers' will may lead to bias. In order to control such contaminating effects of researcher bias, this paper followed the process of randomization. Randomization, here provides equivalent probability for each team to be selected.

The teams were given intervention through "training". Traditionally, treatment is given to the whole team and the team performance is assessed. Cog-synergy mental model is based on team processes and team dynamics. This paper follows a different approach and the treatment is given to only one member. The rest of the team members will get that information during intra-team interactions and thus develop synergy. Amongst seven treatment teams comprising of 21 members, training to four members is given in spatial cognition and similar pattern is observed for remaining experiment (Table 2). However, the control team is not given any training.

Table 2: Team Formation, Training and Team Assignation

Team No.	No. of Team Members	Spatial Training	Social Training	Strategic Training	Teams Name
Team 1	3	-	-	-	Control Team (C1)
Team 2	3	1	-	-	Treatment Team (T1)
Team 3	3	-	1	-	Treatment Team (T2)
Team 4	3	-	-	1	Treatment Team (T3)
Team 5	3	1	1	-	Treatment Team (T4)
Team 6	3	-	1	1	Treatment Team (T5)
Team 7	3	1	-	1	Treatment Team (T6)
Team 8	3	1	1	1	Treatment Team (T7)

Training Component

Training in specific domain of team is provided to one of the respective team members. The general training is meant for all the members in the teams (Table 3).

Table 3: Contents of Training and Members Receiving Training

Sr. No.	Contents of Training	No. of Teams Receiving Training	No. of Members Receiving Training
1.	**General** Orientation of experiment, Introduction of team members, Understanding of team members regarding their interaction, Dress code i.e. formal, and Neat and clean i.e. properly shaved, washed etc.	8	24
2.	**Spatial** The designed object should be totally placed on a blue square, the smooth surface of the blocks should be facing one side, the seating plan of the teams, the numbers indicated on the back of pieces, information regarding environment where the experiment will take place.	4	4
3.	**Social**	4	4

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	Minimum two pieces of same shape are to be used, minimum two pieces of same color are to be used, pieces of all shapes are to be used, only two pieces or less of same shape can be used together, only two pieces or less of same color can be used together.		
4.	**Strategic** Specific object to be designed is given, utilization of minimum pieces, pieces with maximum marks are to be used, utilization of minimum time, the designed object should give a better appearance.	4	4

Experiment Material, Task and Process

The material required for this experiment included block pieces, tables, chairs, proper light in the room, time watch, the board and the picture of the target object to be designed. 60 pieces of various shapes of blocks are provided to each team participating in the experiment. These blocks are instrumental to design various objects. The requirement of the experiment is to design a specified object. The specified object is given only to the members receiving training in strategic component.

The teams started working on the specified object simultaneously. A facilitator worked as observer and assessor. The developed proforma was given beforehand to observer/facilitator. The observer/facilitator recorded his/her observations on the proforma. The event was repeated thrice. This was part of the design to see their learning curve through interaction and by surfacing their mental models. This helps in standardization and generalization of results.

Data Collection

For the quantitative data collected, this paper followed dyad approach. The data are collected through independent observers and team mates. Participant observers' may influence the experiment and there exists recommendations that non-participant observer can help in minimizing the biasness. Following the benefits associated to non-participant observer, independent observer are selected for data collection. These observers were recruited from amongst M.Phil. PhD students and faculty members. The experiment for the study was conducted twice and the participants of each experiment were separately recruited. This was deliberately done in order to ensure that the members in an experiment do not know the training component i.e. intervention of the experiment. This helps in neutralizing any impact on the performance. The coordinators were recruited to facilitate the participants and observers. An event was repeated thrice in each experiment. The observer recorded the observations during the event and completed after the event. The team mates recorded and completed their observations only after the experiment. This was deliberately done so that team mates do not know the performance parameters otherwise in event two and event three they might have known the performance parameters and accordingly adjusted their working, which would have resulted differently. Eight teams with three members in each team participated in the first experiment and this practice was repeated in the second experiment conducted on the following day.

There are two ways to measure manifest variables: i.e. directly measured or through latent variables. This paper used the second approach and measures the manifest variables through latent variables. The object is to collect data for empirically validating the relationships between manifest and latent variables. The observations on the latent variables are recorded by the observer and team mate. The observer and team mate accordingly, gave observations on these fifteen latent variables thrice. One observation was treated on the basis of three events. The total observations are (items X observations 15 X 16= 240). Eight teams (7 experiment and 1 control) representing spatial, social and strategic layer were developed and the number of observations from each team was 30. Thus total observations are (30 X 8 = 240). Finally, the post-hoc analysis using Least Significant Difference (LSD) test helped in exploring the possibilities of pair-wise comparisons of means.

Cog-synergy Team's Comparison with other Teams (Observers' Rating)

The team with spatial, social, strategic i.e. Cog Synergy treatment showed significant better performance (5.087, 0.000) than the rest of the teams (observers rating). Each member of this team was given treatment on spatial, social, strategic cognition, whereas in the rest of the teams only treatment was given on one of these three dimensions. These team members have to share their treatment among themselves and thus they have information on all the items. This helped them to make a significant difference than the rest of the teams (Table 4). This proves that the final hypothesis reflects better performance.

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Table 4: Control Team's Comparison with other Teams (Observers' Rating)

No.	Other Team	Mean Difference	Standard Error	Significance
1	Spatial	2.0667	.99656	.000
2	Social	3.5000	.99843	.000
3	Strategic	3.0667	.99757	.000
4	Spatial, Social	4.7333	.99757	.000
5	Spatial, Strategic	4.8000	.99757	.005
6	Social, Strategic	4.3000	.99757	.022
7	Spatial, Soc. Strategic	5.087	.98756	.000
8	Control	0.00	.00	-

Path Analysis for Cog-Synergy Mental Model (Observer's Rating)

Path analysis for Cog-synergy mental model is done using Statistica-7. Before conducting path analysis GFI reveals whether path analysis should be conducted or not. Joreskog GFI (0.730 criterion ≥.90, AGFI 0.704 ≥.80, Steiger-Lind RMSEA Index 0.74 ≥.08, Chi-Square 2716.070, Degrees of Freedom 1029.000 p-level 0.000) which is quite encouraging to conduct path analysis. Accordingly, path analysis is conducted, which helps in estimating the strength of each path.

Table 5: Model Estimates for Cog-synergy Mental Model (Observers)

	Parameter Estimates	Standard Error	T-Statistics	Prob. Level
(So)-96->(P)	0.304	0.106	2.868	0.000
(Str)-97->(P)	0.315	0.091	3.462	0.000
(Sp)-99->(So) ->(P)	0.589	0.042	14.024	0.000
(So)-100->(Str) ->(P)	0.658	0.135	4.874	0.000
(SP)-101->(Str) ->(P)	0.592	0.082	7.219	0.000
(Sp)-102->(So)-103->(Str) ->(P)	0.726	0.078	9.307	0.000

Dependent Variable (P) = Team Performance

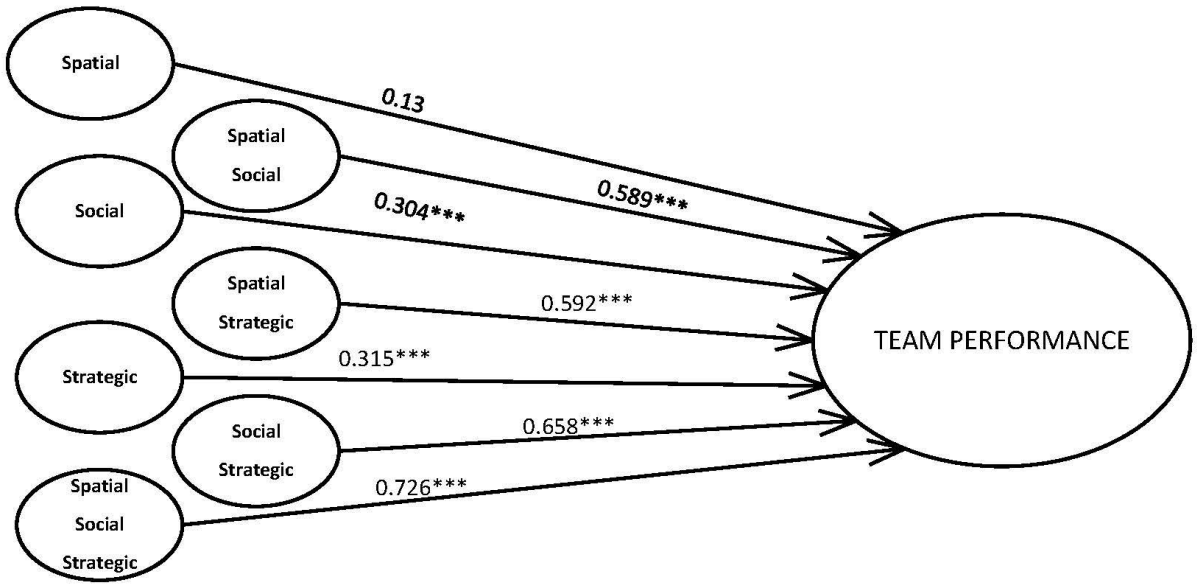

Fig. 1: Cog-Synergy's Mental Model's Impact on Team Performance (Observer)

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Data analysis on the basis of observers' observation indicates the effect of spatial, social and strategic cognition on level one of team performance. Spatial cognition being insignificant is not shown in the table. Social cognition (0.304, 0.000) and strategic cognition (0.315, 0.000) are the first layers of the model and they show significant impact on performance. Spatial-social cognition (0.589, 0.000); social-strategic cognition (0.658, 0.000) and spatial-strategic cognition (0.592, 0.000) are the second layer of the model and show better performance than the first layer of cognition. Finally, spatial-social-strategic cognition i.e. cog-synergy (0.726, 0.000) impact on team performance is significantly better than the first two layers (Fig. 1).

Cog-synergy Team's Comparison with other Teams (Team Mates' Rating)

The team that was given spatial, social, strategic i.e. cog-synergy treatment showed significant performance (6.123, 0.000) than all the rest of the teams (team mates' rating). Each member of this team was given treatment on spatial, social, strategic cognition, whereas in the rest of the teams only treatment was given to the member on one of these three dimensions. These team members have to share their treatment among themselves and thus they have information on all the items. This helped them to make a significant difference than the rest of the teams (Table 6). This indicates that cog synergy mental model team shows better performance than other teams.

Table 6: COG-synergy Team's Comparison with other Teams (Team Mates' Rating)

No.	Other Team	Mean Difference	Standard Error	Significance
1	Spatial	2.83	.99678	.000
2	Social	3.328	.99867	.000
3	Strategic	3.145	.99757	.000
4	Spatial, Social	4.769	.99757	.000
5	Spatial, Strategic	4.832	.99757	.005
6	Social, Strategic	4.876	.99757	.022
7	Spatial, Soc. Strategic	6.123	.98756	.000
8	Control	0.00	.00	-

Dependent Variable (P) = Performance

Path Analysis for Team Mental Model with Team Member

Path analysis being an extension of the regression model is considered useful form of multiple regressions. In order to establish causality, path analysis is viewed as a special case of structural equation modeling (SEM). CFA and Path Analysis is done using Statistica-7. Before conducting path analysis Goodness of Fit Index (GFI) Joreskog GFI (0.804 criterion ≥.90, AGFI 0.773 ≥.80, Steiger-Lind RMSEA Index 0.07 ≥.08, Chi-Square 1220.716, Degrees of Freedom 429.000 p-level 0.000) which is quite encouraging to conduct path analysis. Accordingly, path analysis is conducted, which helps in estimating the strength of each path.

Table 7: Model Estimates for Team Mental Model with Team Members

	Parameter Estimates	Standard Error	T-Statistics	Prob. Level
(Social)-63->(P)	0.378	0.091	4.154	0.000
(Strategic)-64->(P)	0.405	0.073	5.547	0.000
(Sp)-65->(Soc)->(P)	0.487	0.042	11.595	0.000
(Sp)-66->(Str) ->(P)	0.467	0.110	4.245	0.000
(Soc)-67->(Str) ->(P)	0.502	0.169	2.970	0.013
(Sp)-68->(Soc)-69->(Str)->(P)	0.713	0.076	9.381	0.000

The team mental model on the basis of team mates' observation shows the effect of spatial, social and strategic cognition on team performance as level one team performance. Spatial cognition being insignificant is shown at 0.13 in the figure and table. Social cognition (0.378, 0.000); strategic cognition (0.405, 0.000) have significant impact on team performance. The second layer variables spatial-social cognition (0.487, 0.000); social-strategic cognition (0.502, 0.000) and spatial-strategic cognition (0.467, 0.000) show better performance than the first layer cognitions. Finally spatial-social-strategic cognition (0.713, 0.000) impact on team performance is significantly higher than the first two layers (Figure 2).

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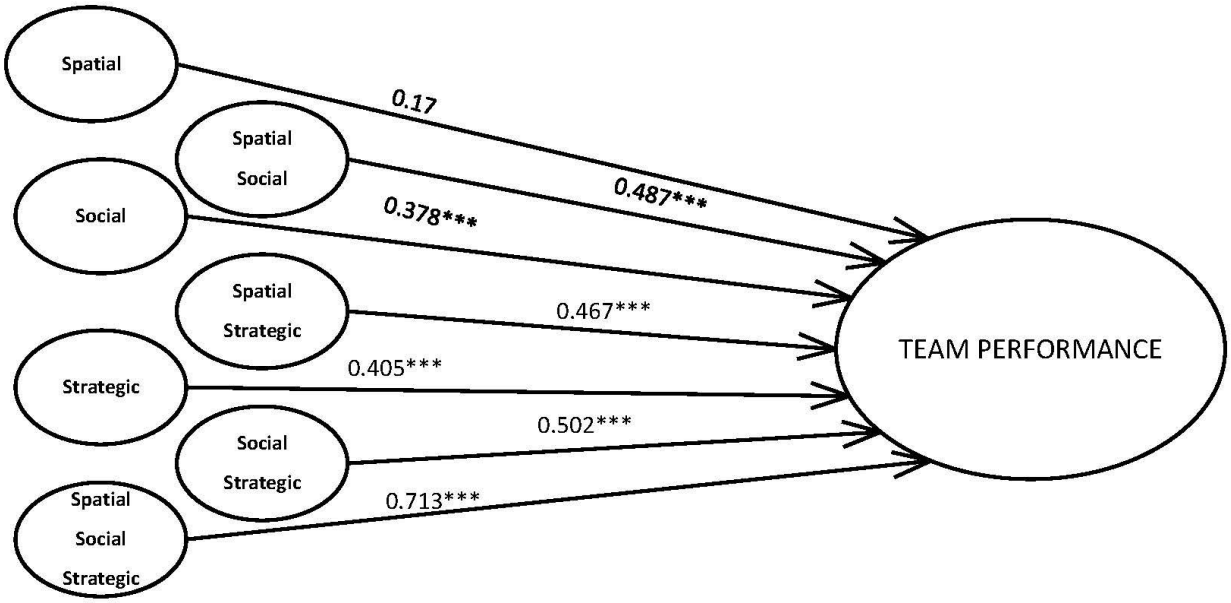

Fig. 2: Cog-synergy Mental Model for Team Performance (Team Mate)

5. RESULTS OF HYPOTHESES TESTING

The predicted hypotheses in the earlier part of paper can be analyzed on the basis of strength of path coefficients. These path coefficients are calculated through path values by the use of Statistica-7. The significance of the relations between latent constructs and manifest variables is shown through the standardized path coefficient (β). Chin (1998) recommends that (β) value of path coefficient should range from threshold level 0.20 to more than 0.30. These values may give meaning to the hypothesis. The β values of the impact of spatial cognition from observers and team members' ratings are insignificant and is not reported. Hence, H_1 is rejected. The β values from observers' and team mates rating respectively for impact of social cognition (H_2) (0.304, 0.378); strategic cognition (H_3) (0.315, 0.405) on teams performance. These impacts being significant and within standard range show that (H_2) and (H_3) have been accepted. Similarly the relationship between second layer of teams (H_4-H_6) can be viewed from the β values from observers' and team mates' rating respectively for the impact of spatial-social cognition (H_4) (0.589, 0.487); social-strategic cognition (H_5) (0.658, 0.502); and spatial-strategic cognition (H_6) (0.592, 0.467) on the team performance. The β values for second layer of hypotheses (H_4-H_6) are higher than the first layer of hypotheses (H_1-H_3). This helps in understanding two things: First (H_4-H_6) are accepted and the second validates the conceptual argument that teams with second layer shows better performance. Finally, the β values from observers' and team mates' rating respectively for impact of spatial-social-strategic cognition i.e. cog-synergy mental model (H_7) (0.726, 0.713) on teams performance is highly significant. The validity of this relationship shows that (H_7) is accepted and enjoys the highest performance. While, link between direct relation of spatial cognition and team performance (H_1) shows weaker β values and remains at 0.13 and 0.17 with insignificant relationship.

Contribution of the Paper

The focus of this paper on an active area of research is to theoretically expand and extend the existing mental models. This paper contributed to the research community by empirically validating cog-synergy mental model through experimental research design based on spatial, social and strategic cognition. This paper focuses on holistic approach and gives an understanding that cog-synergy requires an understanding and surfacing of the team mental models at spatial, social and strategic level. The research reveals that the team performance with better understanding of each member's cog-synergy mental model explains the better team performance.

This paper provides guidelines for accurately measuring cog-synergy mental model. The paper supports the use of experimental research design for establishing the causal relationship. The paper gives an insight into the empirical evidence of the causal relationship between spatial, social and strategic cognition and team performance. This would determine it as a source of

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reference for future studies by researchers. The use of second generation multivariate technique; statistics based structural equation modeling enables the appropriateness of application of causal analysis in complex situation. It is beneficial to understand the impact of cognition on team performance. It ascertains the predictive value of spatial, social and strategic cognition in achieving a better team performance. Since work around teams is organized into organizational structure for better performance, the managers may benefit and develop practices for converting individual characteristics into team structures.

The research views the effect of cog-synergy mental model on team performance in line with the previous studies (Rico and Maryam 2008; Khan and Lodhi 2010). This paper is an apt answer to the future paper directions of Lewis and Huber, 2010, and Khan and Lodhi (2011). The paper empirically establishes the relationship between spatial, social and strategic cognition and team performance.

Practical Implications

This paper draws guidelines to measure the cog-synergy mental model. It helps managers to seek information on the parameters associated to the model for practical use and thus enable them to ensure better performance. It is important that synergy is developed rapidly. This will further converge into developing a habit for better performance. This better performance is an answer to the challenges to the teams.

Limitations of Research

The research may be questioned on generalization of results as experimental design need further validation through ex-post facto research. Interviews can be another way of validating it. Virtual teams common today can also be seen from cog-synergy mental model. Probably spatial cognition from virtual teams may have entirely different dimensions.

Extension through further Research

The paper's contribution to existing theory can be expanded in numerous directions. A direction is to ensure the effectiveness of cog-synergy through its extensive use. Another approach is to develop global and specific construct. Mediating and moderating role of trust, culture and collaborative approach is still another area to be explored and validated. Social network analysis, neural network analysis can better explain and validate the model. Effectiveness of model on emerging virtual teams, offshore teams can be another interesting avenue for future research.

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The authors declare that there are no conflicts of interests.

Data and materials availability

All data associated with this study are present in the paper.

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