Team Creativity

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Abstract

This paper proposes a concept of overall team creativity based on the number of roles members of a team cover at the creative level of consciousness. The results of a decade of experience while developing a questionnaire-based approach to this at Stanford are presented. They show a tripling of the fraction of student teams winning prizes in an independently judged nationwide design contest. Data from the most recent three years suggests that a team's prize-winning ability increases with the number of roles covered at a creative level.

Introduction

Over the last decade Stanford's Engineering Design student teams have tripled the rate of their receipt of awards from the Lincoln Arc Welding Foundation in a program open to all US engineering colleges. This has been accomplished by forming the teams using psychological information involving innocuous student preferences. This method uses Jungian personality theory (Jung 1921), a notion of team roles (Wilde 1999), and a Jungian version of Belbin's theory of management teams (1981). Recently, Levesque (2001) and Wilde and Labno (2002) have related these roles—more precisely the corresponding cognitive modes of Jung—to different forms of creativity. Basically then, the improved performance seems to have resulted from increasing the variety of creative roles on the teams—perception roles during the first five years (Phase I) and then also judgment roles in the most recent three years (Phase II). Phase II data support a concept of overall team creativity based on the number of roles a team covers at the creative level of consciousness.

After presenting twenty-two years of prize data supporting the effectiveness of the team formation methods used, the article gives recent data supporting the hypothesis that greater role diversity leads on the average to better team performance as measured by prizes won. Ways to further progress are suggested.

Jungian typology role map

Following are two square graphs, together known as a role map, which visually describe the four-dimensional space of Jungian typology. Abscissas are the Sensory-iNtuition axis S-N in the Perception Domain (plane) and the Thinking-Feeling axis T-F in the Judgment Domain. Ordinates are the Introverted Perception–Extraverted Perception axis Pi-Pe in the Perception Domain and the Introverted Judgment–Extraverted Judgment axis Ji-Je in the Judgment Domain.

The original coordinates may be written either as algebraic numbers ranging from -50% to +50%, or with letters instead of signs and with % signs omitted. Zero values of psychological functions S-N and T-F may use either letter, as in the examples following.

Examples:

1) Member A: (40, -20, 20, 0): N40, Pe20, F20, Jo 0

2) Member B: (-10, 10, 0, 5): S 10, Pi10, F 0, Jo 5

3) Member C: (0,—5, -10, -30): N 0, Pe 5, T10, Je30

For each domain, a simplified non-numerical indicator for each characteristic is defined as the function letter together with the subscript taken from the attitude.

Examples:

1) Member A: (40, -20, 20, 0): Ne, Fo

2) Member B: (-10, 10, 0, 5): Si, Jo

3) Member C: (0,—5, -10, -30): Po, Te

Visual determination of characteristics

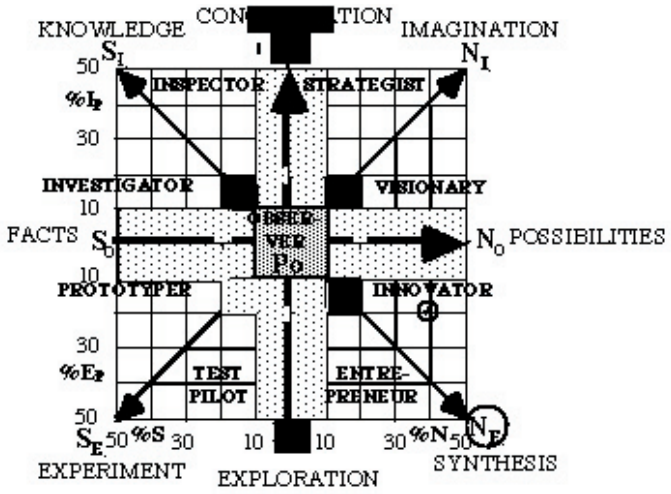
A quick visual way to determine the characteristic indicators is to use the role map below, an example involving Member A. On it the set of all possible coordinate pairs (points) in each domain is presented as a square.

In each domain, the horizontal axes are bounded on the right and left by the psychological function extremes of +50%. Similarly, the vertical axes are bounded by the attitude extremes of +50%. The corners of the domain squares correspond to extremes of the eight creative modes.

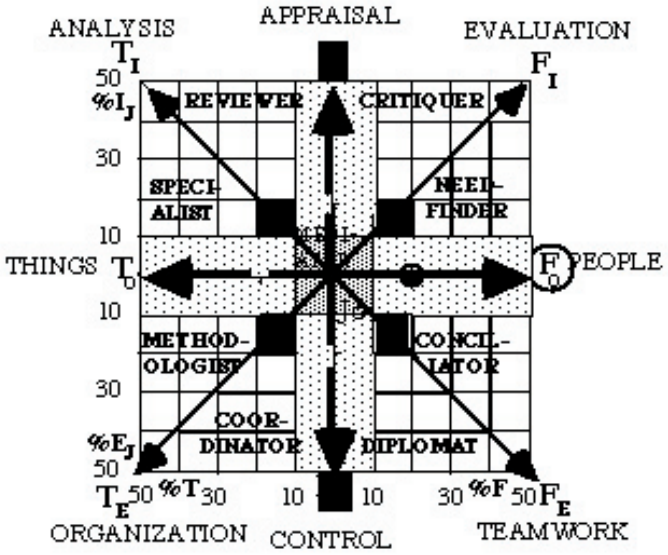
Plotting the coordinates locates a point in each domain which identifies a region of the domain. If the point is outside the smallest square at the origin, its characteristic indicator is given at the corresponding corner—Ne in the perception domain for Member A in the example. If one of the coordinates is single-digit it will lie within a dotted region sided by the center square. In this case, which is true for Member A's judgment domain, the mode indicator is read on the side (or top or bottom)—Fo in the example. Doing this makes a good exercise to prepare for forming a team. Points in the center square indicate double ambiguity, as occurs for members B and C.

Name A	
Pref Fcns	N 40, F 20
Date	5/18/01
Jung Attitudes	Pe-20, J 0

Team ABC



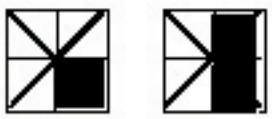
Perception Roles



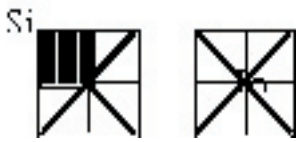
Judgment Roles

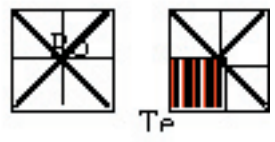
Team roles

The axes and the diagonals of the role map together partition each of the square domains into eight octants to be known as "(radial team) roles." At the center of each domain is a ninth (central team) role. Each of the eighteen team roles defined in this way represents an activity a team member might undertake depending on circumstances. Short descriptions of these expected role activities on an engineering design team are given by Wilde (1999). The creative characteristic indicators just defined suggest which of these roles a given person might prefer. Taken together, the characteristic indicators for a group of team members will eventually outline a preliminary assignment of team duties among its members. The patterns used here have no intrinsic meaning. The patterns are determined entirely in the perception domain, since the same pattern must be used in both domains by any given person. Such a convention helps students avoid matching up with similar people, at least in the perception domain. When the three members form a team, the individual role assignments can be combined to give the team role map following the individual maps.

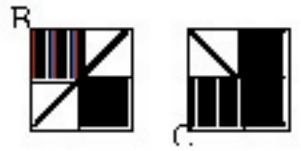


Member A: Ne, Fo





Member B: Si, Jo



Member C: Po, Te

Team ABC Role Map

Since no roles overlap in the example (good practice for forming a maximally creative team) the maximum number of roles for these three members, eight in this case, has been covered, and each person knows what is expected of him or her and the others. This is as good as could be expected for the particular three people involved here. Distributing creative talents in this way has in fact been the method used successfully at Stanford since 1998.

Performance of three ways of composing student teams

Following are statistics covering the awarding of Lincoln Prizes to the last twenty-two years of Stanford ME210/310 student design teams. Annually, only twelve prizes are given in the US. The data have been partitioned into three groups to reflect experimentation with using preference questionnaires to guide team formation. Phase 0 covers the thirteen years (1978-1990 and 1996) when students formed their teams without any such preference information.

Time, years	13
Total no.of teams	150
Avg. no.of teams	11.5
% Silver,Gold & Best awards	9
% all awards	27

No preference

Phase I includes the six years (1991-1995 and 1997) when preference information guided team formation by distributing perception modes.

Time, years	6
Total no, of teams	75
Avg. no. of teams	12.5
% Silver, Gold & Best	23
% all awards	57

Perception roles only

Phase II is the three most recent years (1998-2000) in which a Web site no longer in use was used to inform students what creative roles can be inferred from the preference information. The students formed teams seeking diversity of all roles, judgment as well as perception. Actual teams conform only approximately to this suggested model, with deviations arising from the inevitable influx and efflux of students from the course.

Percentages were used instead of absolute numbers, because recently the teams have become larger and fewer. Improvement progressed as more sophisticated team formation methods were used. Phase I perception mode distribution more than doubled the fraction of teams receiving awards, and almost tripled the fraction getting the top three awards. In Phase II, during which judgment modes were also distributed, the performance for all prizes is almost triple that for no preference information, almost quadruple for the top prizes.

Time, years	3
Total no, of teams	26
Avg. no. of teams	8.7
% Silver, Gold & Best awards	35
% all awards	73

All roles covered

Role Diversity and Prizes, Classes of 1998-2000

The top three lines of the table following show that in Phase II over the last three years, ME310 teams having more roles covered creatively tended to win better Lincoln awards. On the average, every extra radial role above eight (out of sixteen possible) raised the expected prize level to the next category. The top three prizes (best, gold & two silver) have been put into the same top category. The other prize category includes three bronze and five merit awards. The bottom category includes all non-winning teams except those from 2000/1, for which data are not available.

Prize Category	Number of teams	Mean no. of roles
Silver, gold & best	9	10.3
Merit & bronze	10	9.4
Non-winners*	5	8.4
All students*	19	9.2

* 2000/1 class data not available

Role Coverage and Award Level

Note that this correlation does not permit precise prediction of which teams will win based only on the number of modes covered creatively. Each category had a range of about + 3, so that one Silver team had only seven roles covered and one team with eleven did not capture a prize. Such uncertainty is indeed appropriate in a classroom situation, for it would be unfair to permit a team to operate knowing it had no chance of winning. The data do, however, verify that team performance tends to improve as more roles are covered at a creative level of consciousness. This data is behind the concept of team creativity advanced here.

Future improvement—Phase III

Phases I and II concern only roles covered at the creative level of consciousness, which leaves many roles unassigned—half of them in the example. Certainly a team should perform better if it has a good strategy for assigning these other roles. Indeed, it was suggested earlier that members with doubly ambiguous characteristics could handle those roles not preferred at the creative level by the rest of the team. One would expect these roles to be covered indifferently rather than creatively by this assignment, but this should be better than letting others take on roles they dislike, or letting the roles be handled at random. A scheme known as Phase III for dealing with this problem is currently under trial at Stanford and will be reported on after experience with it has been gained.

Concluding summary

Evidence is presented that greater team role diversity does tend to produce teams better at winning design prizes. One of several opportunities for further improvement of team organization is indicated.

Acknowledgment

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