THE IMPACT OF PROCESS STANDARDIZATION AND TASK UNCERTAINTY ON CREATIVITY IN GSS ENVIRONMENTS

Cesar Perez-Alvarez, William Paterson University
perezc@wpunj.edu
Mahmoud Watad, Fairleigh Dickinson University
watad@fdu.edu

ABSTRACT

This paper discusses the links between task complexity, group process structure and creativity in GSS environment. The type of standardization of the group process mediates the strength of the impact that groupware has on group creativity. Group creativity was found to increase when the group process is less restrictive. Greater levels of task uncertainty were found to lead to more creative solutions.

INTRODUCTION

Creativity has been considered a key factor to boost organizational effectiveness in post-industrial environments. As such environments pose new challenges; organizations are required to find novel ways to deal with more complexity and increased turbulence. In order to respond quickly to the constant and unexpected changes, organizations rely increasingly on teamwork. Group Support Systems (GSS) have been used to improve the generation of creative solutions by teams (Santanen, E.L., R.O. Briggs, G.J. de Vreede, 2000), consequently improving the effectiveness of the decision-making processes.

Creativity researchers have mainly focused on the qualities of the creative person or group, the creative product, or the contextual variables that affect creativity. Prior research has focused largely on creativity in the following dimensions: a) the idea generation phase of problem solving (Hender, J.M., T.L. Rodgers, D.L. Dean, & J.F. Nunamaker Jr., 2001; Massetti, B. 1996; Sosik, J.J., B.J. Avolio, B.J. & S.S. Kahai, S,S., 1998), b) the impact of technical aspects (Fjermestad, J., & S.R. Hiltz, 1999), and c) the cognitive, social and procedural structures behind creativity (Bostrom, R.P. & M. Nagasundaram, 1998). Very few studies have explored the process behind creativity. This research will look at creativity in GSS environments, from a process standpoint, and focusing on the output of the whole problem solving process. Understanding which types of processes yield increased levels of creativity is the main goal.

Group processes can be more or less restrictive, depending on the extent to which there is a pre-defined sequence of tasks they should go through when solving problems. Some researchers claim that "laissez-faire" group processes result in higher levels of group creativity, are more favorable to innovation, or provide freedom to try new ways of performing tasks. This research

explores two group Process Structures in terms of their level of restrictiveness, and their impact on group creativity in electronic-mediated meetings. The two structures are: Standardization of Processes (SP) and Standardization of Outputs (SO). Additionally the research explores task complexity or uncertainty as an intervening variable affecting the relationship between structure and creativity.

PROCESS STRUCTURE, TASK COMPLEXITY AND CREATIVITY

Innovation and creativity mean to break away from highly formalized behaviors (Mintzberg, H., 1979). The literature on group innovation and creativity mentions five sets of antecedents to creative processes, namely (i) leadership, (ii) group cohesiveness, (iii) group longevity, (iv) group composition, and (v) group structure (King, N., & N. Anderson, 1990). High levels of innovation are facilitated by leadership styles that promote democratic collaboration. While low cohesiveness is necessary in the earlier stages of innovative processes, higher levels are required in subsequent phases (Nyström, H., 1979). In terms of group composition, minority influence theories argue that minority sources lead to more divergent thinking, which in turn establishes the ground for creative solutions (Nemeth, C.J., 1986). Finally, the level of restrictiveness of a group's structure and the group's degree of innovativeness are related (Meadows, I.S., 1980). This study focuses on the last set antecedent, that is, group structure and its impact on creativity.

A few authors assert that some level of structure is conducive to creative solutions, and that too much structure or the wrong structure may render the group process non-creative. "Laissez-faire" group structures are said to result in higher levels of group creativity (Glover, J.A., 1979). Low levels of restrictiveness are claimed to be favorable to innovation (Holbek, J., 1988). Finally, the provision of freedom to try new ways of performing tasks is claimed to be a necessary condition for creativity (Isaken, S.G., 1988). Nonetheless, the level of group structure did not have an impact on group's creativity in one case (Ocker, R., S.R. Hiltz, M. Turoff, & J. Fjermestad, 1995).

Groups' process structures are dependent on coordination needs. Coordination modes that yield effective performance are a function of groups' structural characteristics and the complexity of the group's task (Dailey, R.C., 1980). The nature of the group interactions becomes mostly determined by the level of task complexity (Hackman, J.R., 1968). Group size and cohesiveness mediate this causal relationship (Dailey, R.C., 1980).

Tasks are usually classified in terms of both level of goal agreement and beliefs about causation (Thompson, J.D., & A. Tuden, 1959). Complexity is defined as a function of the amount of relevant information that has to be processed to attain a solution. Decision-makers deal with both a broad span of goals, and a considerable number of pieces of information associated with each course of action. In one case, group members deal with information that enables the definition of the desired outcomes (i.e., goal agreement). In the other case, they deal with information that allows them to elucidate the associative links between actions and consequences. The lack of knowledge concerning these links has been referred to as task uncertainty.

When group members face an undetermined number of pieces of information associated with each course of action, standardization helps groups to reduce the task-related uncertainty (Mintzberg, 1979). In certain tasks, the options and their consequences can be fully determined in advance (Mintzberg, 1979). The contents of the task can be specified and programmed, by means

of rules and procedures to secure acceptable outcomes (i.e., Standardization of Processes, SP) (Mintzberg, 1979). On the contrary, in uncertain tasks, options and consequences are not fully known, and the group is forced to turn to standardization of outputs (SO). While maintaining control, SO allows task-doers sufficient autonomy to manage their sub-tasks (Mintzberg, 1979).

If conflicting preferences about outcomes and internal conflicts over goals and values exist, a social process is needed to handle the level of goal disagreement. Group members engage in less structured interactions to generate a shared interpretation of the task at hand. This social process corresponds to a process of informal communication, that is, mutual adjustment (Mintzberg, 1979).

RESEARCH FRAMEWORK

Based on the discussion in the previous section the research framework presents two basic hypotheses. The first relate to the structure of the process and the second relate to task complexity or uncertainty.

SO provides structures that are less restrictive than those available under SP. Restrictive processes may exert pressure on the group to spend less time in the generation of alternative courses of action (11). On the contrary, less restrictive structures allow members to share ideas directly and increase the occurrence of novel associations, and hence of creative solutions (Van de Ven, A.H., & A.L. Delbecq, 1971). SO is hypothesized to (i) favor more divergent thinking, (ii) reduce conformity pressures, (iii) make possible for groups to spend more time in the generation phase, and (iv) increase the level of group creativity.

Hypothesis 1:	Group processes based on SO will render the group more creative than those based on SP.

In highly uncertain tasks, group members spend a great deal of time gathering and sharing relevant information. As they engage in more information-exchanging activities, they consider more relevant pieces, and hence a broader set of alternative courses of action. When the pieces of new information are abundant, there is more need to share them directly. Direct sharing is related to the development of novel associations and, ultimately, to creativity (Van de Ven, A.H., & A.L. Delbecq, 1971).

Hypothesis 2:	Groups working on high-uncertainty tasks will generate more creative solutions than those groups working on low-uncertainty tasks.

RESEARCH DESIGN

The study used a 2x2 simple factorial design, fully counterbalanced for both variables: Uncertainty (i.e, the amount of informational exchange) and Standardization (i.e., amount of restrictiveness).

Two versions (i.e., low and high uncertainty) were developed for the selected task, a marketing case from HBP. Two experts rated the cases in terms of equivocality, uncertainty, and

level of goal agreement (Cronbach's Alpha for the combined set of scores was 0.702). According to them, the levels of both equivocality and goal disagreement were low.

Two process structures were used, namely SP and SO. Under SP, groups were asked to follow a sequenced approach in their dealing with the task. The sequence imposed a tight process, with little room for improvisation. Under SO, groups were given more flexibility. They were asked to include three parts in the formal final report: issues, assumptions, and recommendations.

The GSS used provided an asynchronous electronic environment in which groups solved the case. Thirty two groups (two four-person groups, and thirty three-person groups) that participated in the experiment were randomly assigned to one of the four conditions. There were not statistical differences between conditions for all the contextual factors. Facilitation of the group process was precluded by the design of the experiment.

Ninety eight undergraduate students, mostly in their junior and senior years, participated in the study. Extra credit was given for participation. The average age was 26 years, with an average of 4.4 years of experience. They reported to have moderate levels of experience in business environments, and low levels of experience working with groups.

Creativity was rated by a panel of experts (Cronbach's Alpha = 0.743). "A product or response is creative to the extent that appropriate observers independently agree it is creative…A product or response will be judged as creative if (a) it is both a novel and appropriate, useful, correct or valuable response to the task at hand, and (b) the task is heuristic rather than algorithmic." (Amabile, 1983: 31).

The hypotheses were tested using GLM ANOVA. According to values for the Shapiro-Wilk statistic, the observations were taken from populations normally distributed. Furthermore, the values for the Hartley statistic led to the acceptance of the null hypothesis that the variances for each set are equal

RESULTS

Tables 1 and 2 present the means and standard deviations by condition, and the ANOVA results for the set of hypotheses. According to these results, type of structure and level of uncertainty have an impact on creativity.

Based on the overall results, when the level of task uncertainty is higher, groups tend to be more creative (p=0.09). Interestingly, the results for the Type of Standardization are opposite to those hypothesized. When the coordination mechanism is more restrictive, that is, it explicitly defines the steps of the decision process, groups tend to be more creative (p=0.04)

Table 1: Creativity: Means, (Standard deviations)

Condition	Low Uncertainty	High Uncertainty	Totals
SP	61.67 (11.88)	77.90 (14.15)	69.24 (15.06)
SO	42.33 (15.30)	59.11 (23.71)	51.22 (21.40)
Totals	52.00 (16.58)`	67.33 (21.74)	59.67 (20.55)

Table 2: ANOVA results			
Hypothesis	F-Value	DF	p-value
Process Structure	4.67	1,28	0.04
Uncertainty	3.06	1,28	0.09

DISCUSSION

Overall, the study provided empirical evidence to support the claim that both the type of standardization of the group process and the level of task uncertainty have an impact on group creativity.

Although the type of process standardization affects the creativity of a group, the results were opposite to those hypothesized. When the group process is less restrictive, groups are less creative ($p=0.04$). This result may be due to the so-called "multi-headed animal syndrome" (Smith, J., & M.T. Vanececk, 1989). According to it, the lack of an orderly process may render the group process ineffective. Nobody seems to take the initiative and nothing seems to happen. Although asynchronous communication allows more time for reflective thinking, there is a tendency to procrastinate and become side-tracked. For some group members, frustration from the lack of a sense that something is happening contributes to a perceived lack of progress toward a goal. Although there are several techniques available to counter this asynchronous ineffectiveness and regulate GSS groups' behavior (e.g., facilitation), the empirical design precluded using them.

A "fading motivation" may have had a role in this result. The perceived process gains that were present in the earlier stages of the groups' decision processes wore out as groups moved to the later stages, due to the lack of participation. The initial motivation probably faded away and the final solution failed to include the richer set options originally considered. Participation, which was moderate to high in the early stages, declined for SO groups as the experiment progressed.

The nature of the groups used (i.e., ad-hoc) could also have impacted this result. Teamwork takes place in a variety of settings, which condition the life of a team and the nature of its processes. By their nature, ad-hoc groups lack a broader context. Had it existed, contextual norms may have pushed groups to move forward, not to become side-tracked.

The low-significant result for uncertainty may be associated with the low structural discriminability of the uncertainty manipulation, although its operational discriminability seemed acceptable. Structural discriminability refers to the capacity of the manipulation to express the degree of differentiation that was required in the levels of this independent variable. Operational discriminability refers to the extent to which the actual use of the manipulation succeeds in distinguishing perceptions of the variable levels (Kane, J.S., & E.E. Lawler III, 1979). Although both experts and subjects perceived different levels of uncertainty (i.e., good operational discriminability), the perceptions did not correspond to the uncertainty levels intended (i.e., poor structural discriminability).

SUMMARY

In summary, when groups work under orderly decision processes, they tend to have more dynamic conversations, that is, they tend to make shorter contributions and to have more conversation rounds. The presence of such dynamism seems to entail more creative outcomes. Moreover, in tasks with higher levels of uncertainty, as group members collect and share information, their participation increases and so does the level of creativity of the group solution. The most important conclusion of this research is that If GSS groups are to be more creative, their processes need some level of structure and restrictiveness. The lack of appropriate levels of structure seems to render the group ineffective. Furthermore, when the task is more uncertain, group processes are more dynamic and groups produce more creative solutions. However, the question of what level of process restrictiveness yield the highest level of creative outcome needs yet to be answered.

REFERENCES

Amabile, T.M. (1983). The social psychology of creativity: A componential conceptualization. *Journal of Personality and Social Psychology, 45*(2), 359-376.

Bostrom, R.P. & M. Nagasundaram (1998). Research in creativity and GSS. Proceedings of the Thirty-First Hawaii International Conference on System Sciences, 6, 391-505.

Dailey, R.C. (1980). A path analysis of R&D team coordination and performance. *Decision Sciences, 11*(2),357-369.

Glover, J.A. (1979). Group structure and creative responding. *Small Group Behavior, 10,* 62-72.

Hackman, J.R. (1968). Effects of task characteristics on group products. *Journal of Experimental Social Psychology, 4*,162-187.

Hender, J.M., T.L.Rodgers, D.L. Dean, & J.F. Nunamaker Jr. (2001). Improving group creativity: Brainstorming versus non-brainstorming techniques in a GSS environment. Proceedings of the Thirty-fourth Hawaii International Conference on Systems Sciences

Holbek, J. (1988). The innovation design dilemma: Some notes on its relevance and solutions. In: Gronhaug, K., & G. Kaufmann (Eds.), *Innovation: A Cross Disciplinary Perspective*, (pp. 253-277). Oslo: Norwegian University Press.

Isaken, S.G. (1988). Educational implications of creativity research: An updated rationale for creative learning. In: Gronhaug, K., & G. Kaufmann, (Eds.), *Innovation: A Cross Disciplinary Perspective* (pp. 167-204). Oslo: Norwegian University Press.

Kane, J.S., & Lawler, E.E. III. (1979). Performance appraisal effectiveness: Its assessment and determinants. In: Staw, B.M. (Ed), *Research in Organizational Behavior,* Vol I. Greenwich, CT: Jai Press, Inc.

King, N. & Anderson, N. (1990). Innovation and creativity in working groups. In: West, M.A. & Farr, J.L. (Eds), *Innovation and Creativity at Work. Psychological and Organizational Strategies* (pp. 81-100). West Sussex: John Wiley & Sons.

Massetti, B. (1996). An empirical examination of the value of creativity support systems on idea generation. *MIS Quarterly, 20*(1), 83-97.

Meadows, I.S. (1980). Organic structure and innovation in small work groups. *Human Relations, 33,* 369-382.

Mintzberg, H. (1979). *The structuring of organizations*. Englewood Cliffs, NJ: Prentice-Hall Inc.

Nagasundaram, M. & R.P. Bostrom (1995). The structuring of creative processes using GSS: A framework for research. *Journal of Management Information Systems, JMIS, 11*(3), 87ss

Nemeth, C.J. (1986). Differential contributions of majority and minority influence. *Psychological Review, 94,* 23-32

Nyström, H. (1979). *Creativity and Innovation.* New York: John Wiley & Sons.

Ocker, R., S.R. Hiltz, M. Turoff, & J. Fjermestad, (1995). Computer support for asynchronous software design teams: Experimental results on creativity and quality. Proceedings of the Twenty-Eight Hawaii International Conference on System Sciences, pp. 4-13.

Santanen, E.L., R.O. Briggs, G.J. de Vreede (2000). The cognitive model of creativity: A ne causal model of creativity and a new brainstorming technique. Proceedings of the Thirty-Third Hawaii International Conference on System Sciences.

Smith, J. & M.T. Vanececk (1989). A nonsimultaneous computer conference as a component of group decision support systems. Proceedings of the Twenty-Second Hawaii International Conference on Systems Sciences, III, 370-377

Sosik, J.J., B.J. Avolio & S.S. Kahai, S,S. (1998). Inspiring group creativity: Comparing anonymous and identified electronic brainstorming. *Small Group Research, 29* (1), 3-31

Thompson, J.D. & A. Tuden, (1959). Strategies, structures, and processes of organizational decision. In: *Comparative Studies in Administration.* Pittsburgh: University of Pittsburgh Press.

Van de Ven, A.H. & A.L. Delbecq (1971). Nominal versus interacting group processes for committee decision-making effectiveness. *Academy of Management Journal, 14*(2), 203-212