When Teams are More Effective than Workgroups: A Quasi-Experimental Investigation of the Moderating Effects of Organizational Context on Process Effectiveness

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Abstract

This longitudinal quasi-experimental study showed that implementing teams had positive effects on five of six process criteria of effectiveness. The effectiveness of teams, however, depends upon organizational context. In conditions where the organizational reward, educational, and information systems were good, teams produced negligible effects on effectiveness criteria.

Press Paragraph

Semi-autonomous teams have become a popular method for structuring work, but the impact of teams on improving employee effectiveness is uncertain. This study examined the impact of implementing semi-autonomous teams in a manufacturing company. Results showed that teams did indeed improve employee effectiveness, but only in situations where the organization's reward, training, and information systems were poor. These results imply that organizations will not realize benefits from implementing teams when their organizational systems are good. Additionally, the results imply that teams somehow compensate for poor organizational systems.

Team-based approaches to organizing work have become very popular in the last two decades in the U.S. (Goodman, Ravlin, & Schminke, 1987; Guzzo & Shea, 1992; Hollenbeck, Ilgen, Sego et al., 1995; Tannenbaum, Beard, & Salas, 1992). Among other reasons, new manufacturing and information technologies encourage organizational designers to use work teams because of the need for functional and process interdependencies among workers (Majchrzak, 1988). It is hoped that structuring work around teams will harness the potential synergies that can result when people work interdependently as compared to when people work independently (e.g., Gladstein, 1984; Hackman, 1987; Katzell & Guzzo, 1983).

Given the substantial expense and risks organizations incur in moving to a team-based design, it is surprising how little empirical research has been conducted that investigates the transition from an individual-based design to teams and then actually demonstrates the value of work teams in field settings. The work that has been done has shown mixed results on the effectiveness of moving to a team-based design; some have shown positive results (Banker, Field, Schroeder, & Sinha, 1996; Campion, Medsker, & Higgs, 1993; Campion, Papper, & Medsker, 1996), whereas others have shown mixed (Cordery, Mueller, & Smith, 1991; Wall, Kemp, Jackson, & Clegg, 1986) or negative results (Katz, Kochan, & Keefe, 1987).

We propose that this discrepancy in the literature is due, at least in part, to two factors. First, the dependent variables in studies on team-based design interventions have varied widely. Team-based designs will have a greater effect on the more proximal process-oriented variables than on more distal performance variables. Second, the organizational context in which team-based designs are embedded may play a large role in determining the extent to which they will be better than more individual-based designs. Certain contextual conditions may reduce the benefits of moving to a team-based design, whereas others may cause a move to a team-based design to have large positive benefits. Without a delineation of the conditions under which team-based designs will be successful, organizations may unnecessarily take on the risk and expense of implementing teams, when staying with traditional workgroups may be just as effective.

We add to the literature on team-based design implementation in two ways. First, we provide quasi-experimental evidence on whether team-based designs increase the process effectiveness of workers over individually-based designs. Second, we seek to establish the conditions under which team-based designs may have the greatest benefit over individually-based designs. To accomplish these purposes, we employed a longitudinal quasi-experimental research design to evaluate the effectiveness of a transition from traditional workgroups to semi-autonomous teams in a work redesign in a manufacturing environment. In traditional work groups, employees perform production activities, but have no management responsibility or control over planning, organizing, directing, staffing, or monitoring (Banker et al., 1996). In semi-autonomous teams, workers both manage and execute major production activities (Banker et al., 1996).

Prior Research on Work Teams

Many anecdotal accounts and descriptive case studies attest to the positive effects of team-based work design (as noted by Guzzo & Shea, 1992). The results of empirical research, however, vary depending upon what the team-based design was proposed to affect. The few studies that have been done have found positive effects on attitudinal variables like satisfaction (Cordery et al., 1991; Wall et al., 1986), organizational commitment (Cohen, Chang, & Ledford, 1997; Cordery et al., 1991), and quality of work life (Cohen & Ledford, 1994). The relationship of team-based designs with performance measures is decidedly more mixed, with positive findings on productivity and quality (Banker et al., 1996), and ratings of performance (Cohen &

Ledford, 1994), whereas others have found no relationship (Hollenbeck, Ilgen, Tuttle, & Sego, 1995; Wall et al., 1986), or negative relationships with performance (Katz et al., 1987). Additionally, the use of autonomous teams has also been found to be related to higher absenteeism and turnover (Cordery et al., 1991).

The diversity of dependent variables in these studies makes it difficult to say with any certainty whether moving to team-based designs benefits organizations. The effectiveness of team-based designs on improving the more distal variable of performance seems particularly perplexing. This may be because there are too many intervening or moderating variables between the redesign and performance, including organizational context, group design, and material resources provided to the team (Hackman, 1987). Therefore, the effectiveness of team-based designs can perhaps best be determined by looking at the more proximal process criteria of effectiveness, rather than at distal performance criteria. In contrast to the final outcome of performance, processes describe the interactions between employees in a work group that are presumed to either promote or inhibit performance. Despite the fact that teams-based designs have been put forward as a way to affect the very processes that lead to synergistic gains, the effect of implementing a team-based design on process criteria has been virtually ignored by researchers.

Hackman's (1987) highly influential model of team effectiveness proposed that the overall process effectiveness of work groups in organizations is a function of three factors, each of which involves both a potential process loss and a potential synergistic gain. First, the level of effort expended by group members determines the extent to which the group experiences process losses due to social loafing, and reflects the degree to which group members are committed to and feel accountable for the team and its work (a potential synergistic gain). Second, the extent to which the group members apply their unique knowledge and skills to the group's task determines the amount of process loss from underutilization of group member expertise, as well as the gain achieved through collective learning. Third, the appropriateness of the group's task performance strategy determines the process loss due to slippage in strategy implementation, as well as the gain achieved through creating innovative strategic plans for the group's tasks. Hackman (1987) provides little detail on what the process loss from slippage in strategy implementation means; the notion is that something goes awry in the team's plan, and adjustments must be made. Therefore, we conceptualize this variable in terms of the process of problem solving, whereby the group collectively develops and evaluates options and implements solutions.

Because these criteria are framed in terms of process losses and synergistic gains, one might expect that redesigning work around teams may result in lower levels of the process loss factors, and higher levels of the synergistic gain factors. Process criteria, however, assess the interaction practices between employees, not their individual output. Therefore, there is no reason to expect that employees who are restructured into teams will exhibit greater loss in their interactions with their coworkers than those who remain in traditional workgroups. On the contrary, the redesign from traditional workgroups into semi-autonomous work teams should lead to improvements on all three of Hackman's (1987) factors for assessing work group effectiveness, including improvement on both the process losses and synergistic gains for each factor.

> *Hypothesis 1: Individuals whose work has been redesigned into semi-autonomous teams will show greater improvement on a) effort expended on group tasks, and b) perceived accountability for group tasks than those who remain in traditional workgroups.*

Hypothesis 2: Individuals whose work has been redesigned into semi-autonomous teams will show greater improvement on a) skill usage for group tasks, and b) collective learning than those who remain in traditional workgroups.

Hypothesis 3: Individuals whose work has been redesigned into semi-autonomous teams will show greater improvement on a) problem solving, and b) innovation than those who remain in traditional workgroups.

Organizational Context

Context refers to "the surroundings associated with phenomena which help to illuminate that phenomena, typically factors associated with units of analysis above those expressly under investigation" (Cappelli & Sherer, 1991, p. 56). In this investigation, we were concerned primarily with organizational context—the characteristics of the organizational environment in which the individual is embedded that affect his or her behavior. Hackman (1987) outlined three key systems of organizational context that impact team effectiveness.

First, the organization's *reward system* can either reinforce or undermine the motivational benefits of work tasks. One of the fundamental characteristics of good reward systems is providing positive consequences for excellent performance; that is, good performance is recognized and rewards are at least partially contingent upon performance. In Hackman's (1987) model, the reward system is proposed to affect the first factor determining group effectiveness: the amount of effort expended by group members to the group task. Although Hackman (1987) suggested that good reward systems improve team performance, we suggest that good reward systems will in fact attenuate the positive effects of team-based designs; that is, in situations where the reward system is good, moving to a team-based design will have negligible effects on the amount of effort workers expend. In situations where the reward system is poor, however, moving to a team-based design will have large positive effects on worker effort.

Hypothesis 4: Rewards will moderate the relationship between team interventions and a) the amount of effort expended on group tasks, and b) perceived accountability for group *tasks, such that teams will only produce positive effects on effort and accountability in conditions with poor reward systems.*

The second contextual factor identified by Hackman (1987) expected to impact group process effectiveness is an organization's *education system*. The education system determines the extent to which groups have the knowledge and skill necessary to carry out their tasks. According to Hackman (1987), the degree of training available to a work group is expected to impact the second of his three criteria for process effectiveness: the sufficiency of knowledge and skill applied to the group task. Similar to the moderating effects of an organization's reward system, we expect that in situations where the education system is good, implementing a team-based design will not significantly affect the application of knowledge and skill, but in situations where the education system is bad, implementing a team-based design will have large positive effects.

Hypothesis 5: Training will moderate the relationship between team interventions and a) the application of skill to group tasks, and b) collective learning, such that teams will only produce positive effects on skill usage and collective learning in conditions with low training.

The third contextual factor offered by Hackman (1987) is an organization's *information system.* If information about other areas in the organization is not readily available to work groups, they may implement strategies that work at cross-purposes with other groups in the organization. Conversely, if groups have a great deal of information about other areas in the organization, not only can they coordinate the work of their group with the work of others, they may also be able to generate more alternative strategies to problems they face. Again, this contextual variable is expected to moderate the effects of implementing a team-based design; in situations where information is readily available, implementing a team-based design will not significantly impact a work group's task strategies, but in situations where information is not readily available, implementing a team-based design will have large benefits.

> *Hypothesis 6: Information on other areas in the organization will moderate the relationship between team interventions and a) problem solving, and b) innovation, such that teams will only produce positive effects on problem solving and innovation in conditions with low information.*

Method

Sample and Intervention

The study used a quasi-experimental research strategy in a large Midwestern printing company. Prior to the redesign, work was organized around traditional work groups. Workers were responsible for their own jobs, and work was formally directed and coordinated by a single supervisor (such as a lead press operator). As a result of the intervention, some of the work was organized around semi-autonomous teams. As noted above, in semi-autonomous teams, workers both manage and execute major production activities. Data were collected one year apart, with the intervention occurring in between, thus providing both pre- and posttest assessments of all variables in the study.

There were 914 employees in the total pretest sample and 1,030 employees in the total posttest sample (staffing levels increased during the intervening time period) across two locations, representing a response rate of over 90%. Missing data on some variables reduced the sample sizes somewhat for various analyses, as reported in the tables. In the pretest sample, 71% were males, and respondents had an average of 17 years with the organization (SD = 9.93). In the posttest sample, 56% had been restructured into teams, 66% were males, and respondents had an average of 14 years with the organization (SD = 11.1).

In order to assure anonymity, respondents were asked to record a personal identification number, chosen by and known only to them, on their questionnaire at the time of the pretest. They were asked to put this same number on the posttest questionnaire so data could be matched.

Successful matches of identification numbers could be made on only 27% of the posttest respondents because many individuals forgot or otherwise omitted their number. Data from this sample, henceforth called the "matched sample," were used for all analyses. Of this matched sample, 44% were in teams, 64% were males, and respondents had an average of 14 years with the organization (*SD*=11.2). These percentages correspond fairly closely to those of the total sample, as reported above.

Analyses were conducted to test whether results for the sample of individuals who had matching identification codes in the pre- and posttests would be similar to those for the total sample. Regarding demographic and work-related characteristics, chi-square analysis indicated that the matched sample did not differ significantly from the unmatched sample on gender, their tenure with the organization, or the shift they worked.

Measures

Table 1 shows the scale name, internal consistency reliability estimates, means, standard deviations, and example items for the matched sample. Scales were drawn from Campion et al. (1993; 1996). A 5-point response scale ranging from "strongly agree" (5) to "strongly disagree" (1) was used for all measures. Internal consistency reliabilities ranged from .65 to .88, with an average reliability of .78 (across all measures, pretest and posttest, following an r-to-z′ transformation). In addition, inspection of the means and standard deviations offered no indication of range restriction or ceiling effects.

The contextual variables were measured at the individual level and aggregated to the department level. Patterson, Payne, and West (1996) suggest that aggregating individual perceptions to higher levels should reflect both within-group agreement and meaningful structured collectives. Kozlowski and Salas (1997) showed that training is often targeted at subunits, rather than at individuals or the organization as a whole, and we argue that rewards and information are often similarly targeted. The key subunit in the organization under study was the department, and perceptions of rewards, training, and information varied significantly between organizational departments. Therefore, we created department-level contextual variables, and tested their cross-level effects on individual outcomes. The subjects in the study represented thirteen departments in the company; three departments were dropped because only one or two subjects represented their departments. After dropping these cases (as well as those who did not indicate their department), the final matched sample consisted of 266 employees in ten departments, with an average of 27 employees in each department (*SD*=24.8).

To create the highest level of rigor in the creation of the contextual variables, however, we used the data from the entire pre-test sample. This removed common source bias between the predictors and the dependent variables by separating them both in time (the data were collected one year apart) and in source, as the individuals under investigation provided less than one-third of the data used in the creation of the contextual variables. The ICC values were all highly statistically significant ($p<.01$), justifying aggregation of individual perceptions to the department level. The values for ICC(1), ICC(2), and r_{wg} can be found in Table 2.

At the pretest, all employees were in traditional work groups; at the posttest, many employees were in formal work teams. Thus, both pretest and posttest surveys referenced the employee's "work group" so the questions would apply to people in traditional work groups, as well as people in semi-autonomous teams. This enabled the same items to be used on both pretest and posttest questionnaires and avoided potential instrumentation effects (Cook & Campbell, 1979). Items indicating whether an employee was in a team were at the end of the posttest survey to avoid priming effects of these items. Employees completed the same survey at the pretest and posttest. Because we were interested in the effects of moving from traditional workgroups to semi-autonomous teams on the interactions of individuals, the data were analyzed at the individual level.

Results and Discussion

Table 3 shows the intercorrelations among the study variables at pretest and posttest. The dependent variables display moderate relationships with each other, presumably due in part to response/response bias. These are not so large, however, as to suggest that these measures are redundant with one another, and therefore, parallel regression of the dependent variables is an appropriate analytic strategy (Wall et al., 1986). Thus, we tested each of the six dependent variables in separate hierarchical regression equations. The score on the dependent variable at pre-test was always entered in the first step, to control for between-subject variance at the time of the pre-test and to avoid the problems associated with difference scores (Edwards & Parry, 1993). In the second step, a dummy code for whether the employee had been restructured into a formal work team was entered. This allowed us to test the main effects of the team-based design intervention on each of the dependent variables. In the third step, the department-level contextual variable was entered, testing for main effects of context on the dependent variables. Finally, in the fourth step, the interaction term for the team dummy code and department-level context was entered, testing the moderating effects of context on the relationship between the team intervention and each of the dependent variables. We note that this type of analysis reflects a "cross-level moderator model", where "the relationship between two lower-level constructs is changed or moderated by a characteristic of the higher-level entity in which they are both embedded" (Kozlowski & Klein, 2000, p. 43).

Tables 4, 5 and 6 display the results of the six regression equations. Hypotheses 1, 2, and 3 predicted that the team-based design intervention would have positive effects on both the potential process losses and synergistic gains of each of Hackman's (1987) criteria of process effectiveness. As can be seen from the table, the hypotheses for five of the six criteria were supported, accounting for as much as 7% of the variance after controlling for pre-test scores. These results suggest that redesigning work around semi-autonomous teams rather than around traditional workgroups, *ceteris paribus*, improves the interaction processes among employees.

Hypotheses 4a and 4b predicted that the contextual variable of reward interdependence would moderate the relationship between the team-based design intervention and effort and accountability, respectively. Both hypotheses were supported, and the nature of their interactions is plotted in Figures 1 and 2. The pattern is consistent with the hypotheses, such that the positive effects of the team-based design were negligible in departments with good reward systems, but were quite pronounced in departments with poor reward systems. Hypotheses 5a and 5b predicted that the contextual variable of training would moderate the relationship between the team-based design intervention and skill use and collective learning, respectively. Both hypotheses were supported. Again, the patterns are consistent with the hypotheses, and are graphically displayed in Figures 3 and 4. Hypotheses 6a and 6b predicted that the contextual variable of information on others' areas would moderate the relationship between the team-based design intervention and problem solving and innovation. Both hypotheses were supported; the interaction plots are displayed in Figures 5 and 6. These moderation results suggest that redesigning work around semi-autonomous teams rather than around traditional workgroups will improve interaction processes only among employees in certain contextual conditions. In departments where the reward, education, or information systems were poor, the redesign was highly effective in improving processes. In departments where these systems were good, however, the redesign had little or no effect on processes.

This research represents the first direct evidence concerning the importance of context when transitioning from traditional workgroups to semi-autonomous teams. As such, it offers insight into when it makes the most sense to move to a semi-autonomous team structure. Specifically, when there is little contextual support (e.g., good performance is not rewarded, low training, and little information) semi-autonomous teams are the most beneficial. If these contextual features are present, however, there will be little benefit in moving to teams.

The research also suggests that teams somehow compensate for poor organizational systems. When individual rewards are not contingent upon performance, teams appear to have a motivating influence on their members that increases their effort and perceptions of accountability to group tasks. Similarly, when training is not readily available to organizational members, teams appear to ensure that the existing range of skills of members is more fully utilized. This may be because semi-autonomous teams distribute production tasks among their members, and would presumably be able to place people in areas of their strengths better than a supervisor who may have less knowledge about their subordinates' unique skills. Finally, when information about other areas in the organization is limited, teams encourage innovation and problem solving. We suggest that this may be due to the sense of empowerment that results from increased autonomy; team members feel more confident in sharing information and ideas with others in the team because they believe there is a greater chance of their ideas actually being implemented. We encourage further research to delineate the actual mediating causal mechanisms underlying the positive effects of teams in differing organizational contexts.

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Table 1

Internal Consistency Reliabilities, Means, Standard Deviations, and Example Items

Variable	Pretest α	Pretest *M*	Pretest *SD*	Posttest α	Posttest *M*	Posttest *SD*	Example Item
Organizational Context							
Rewards	.71	2.46	.89	.72	2.50	.91	Most people are rewarded based upon their performance.
Training	.79	2.76	.83	.83	2.78	.92	The company provides adequate team-related training for my work group.
Information on Other Areas	.75	2.75	.82	.80	2.92	.84	My work group has adequate information about other departments.
Process Effectiveness Criteria							
Effort	.85	3.44	.97	.88	3.58	.92	People in my area work very hard.
Perceptions of Accountability	.78	3.32	.83	.87	3.42	.87	There is a high sense of accountability in my group for the decisions we make.
Skill Use	.71	2.98	.91	.70	3.20	.87	Working here makes good use of people's capabilities.
Collective Learning	.88	2.71	.97	.85	2.93	.93	There are many opportunities to learn new skills.
Problem Solving	.65	3.18	.78	.74	3.31	.81	My work group is very good at solving technical problems.
Innovation	.69	2.68	.76	.71	2.78	.78	New ideas are constantly sought and tried in my work group.

N ranges from 836 to 843 for the pre-test Organizational Context variables, from 943 to 950 for the post-test Organizational Context variables, and from 264 to 266 for the Process Effectiveness Criteria.

Table 2

Aggregation Statistics for Contextual Variables

Variable	*ICC(1)*	*ICC(2)*	r_{wg} *(avg.)*
Reward system	.04	.79	.67
Education system	.08	.88	.76
Information system	.15	.94	.77

Table 3

Intercorrelations Between Variables

	1	2	3	4	5	6	7	8	9	10
1. Work Design[a]		0.06	-0.05	-0.03	0.06	0.07	-0.08	-0.03	0.06	0.07
2. Reward Interdependence	0.23		0.35	0.31	0.13	0.25	0.30	0.33	0.24	0.40
3. Training	0.06	0.33		0.57	0.16	0.46	0.43	0.50	0.31	0.54
4. Information on Others' Areas	0.05	0.34	0.58		0.25	0.43	0.47	0.40	0.30	0.38
5. Effort	0.19	0.21	0.26	0.27		0.47	0.31	0.23	0.46	0.26
6. Accountability	0.17	0.28	0.42	0.44	0.58		0.47	0.47	0.52	0.55
7. Knowledge and Skill Usage	0.11	0.31	0.51	0.45	0.44	0.54		0.64	0.44	0.53
8. Collective Learning	0.05	0.42	0.55	0.42	0.27	0.40	0.58		0.34	0.65
9. Problem Solving	0.28	0.30	0.42	0.43	0.64	0.61	0.61	0.42		0.46
10. Innovation	0.14	0.42	0.44	0.40	0.42	0.45	0.49	0.59	0.46	

N ranges between 258 and 266. Correlations above the diagonal are at pre-test; correlations below the diagonal are at post-test. Correlations greater than .13 are significant at $p<.05$; correlations greater than .16 are significant at $p<.01$.

[a] Represented by a dummy code (1= semi-autonomous team, 0= traditional workgroup).

Table 4

Results of Regression Equations Testing the Interaction Between the Team-based Design Intervention and the Reward System

	Effort		*Accountability*	
	β	ΔR^2	β	ΔR^2
Pretest	.45**	.23**	.42**	.16**
Team structure [a]	.29**	.03**	.25**	.02**
Reward system	.25	.00	.70**	.02**
Reward system x team design	-1.13*	.01*	-.91*	.01*

* p<.05
** p<.01
[a] Dummy coded 0 = traditional work group, 1 = Semi-autonomous team

Table 5

Results of Regression Equations Testing the Interaction Between the Team-based Design Intervention and the Education System

	Skill Usage		*Collective learning*	
	β	ΔR^2	β	ΔR^2
Pretest	.43**	.22**	.52**	.29**
Team structure [a]	.24**	.02**	.12	.00
Education system	.60**	.02**	.38*	.01*
Education system x team design	-.69*	.01*	-.81*	.01*

* p<.05
** p<.01
[a] Dummy coded 0 = traditional work group, 1 = Semi-autonomous team

Table 6

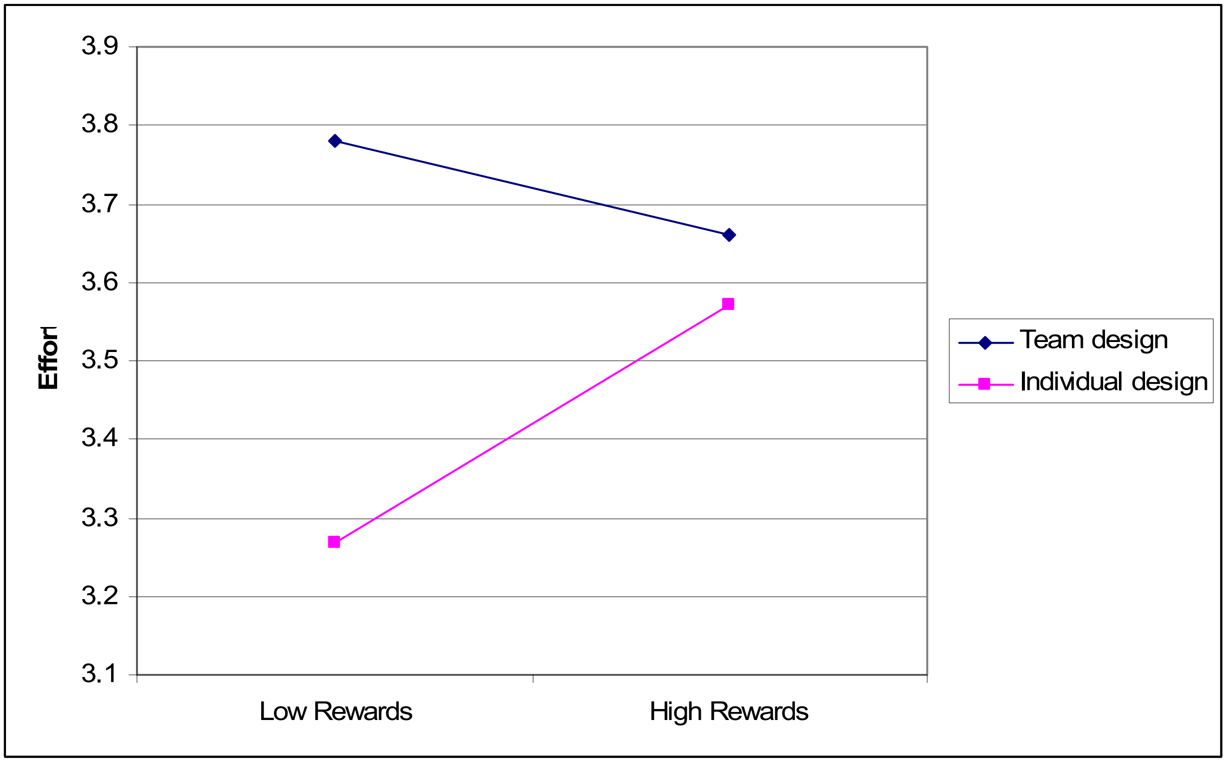
Results of Regression Equations Testing the Interaction Between the Team-based Design Intervention and the Information System

	Problem Solving		*Innovation*	
	β	ΔR^2	β	ΔR^2
Pretest	.45**	.18**	.45**	.19**
Team structure [a]	.41**	.06**	.18*	.01*
Information system	.31*	.01*	.39**	.02**
Information system x team design	-.84*	.03**	-.56*	.01*

* p<.05
** p<.01
[a] Dummy coded 0 = traditional work group, 1 = Semi-autonomous team

Figure 1

Moderating Effect of the Reward System on Effort



Low and high reflect ± 1 standard deviation from the mean.

Figure 2

Moderating Effect of the Reward System on Accountability

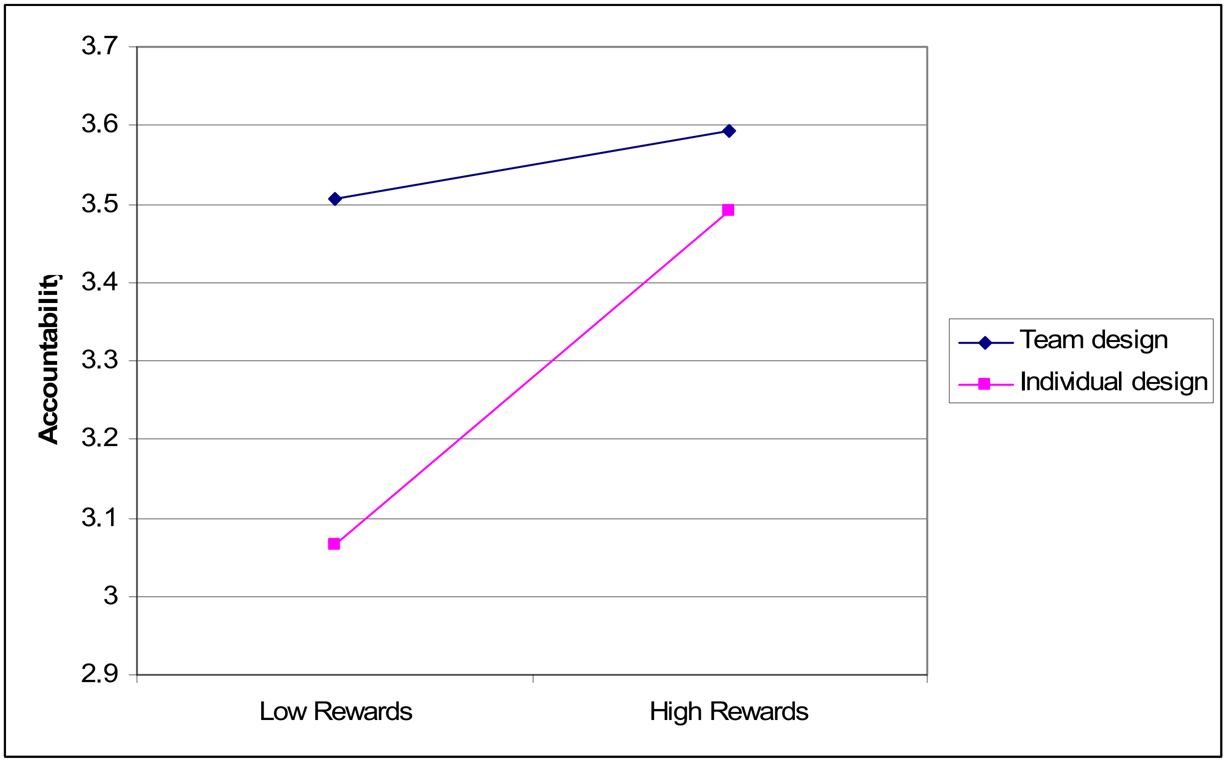
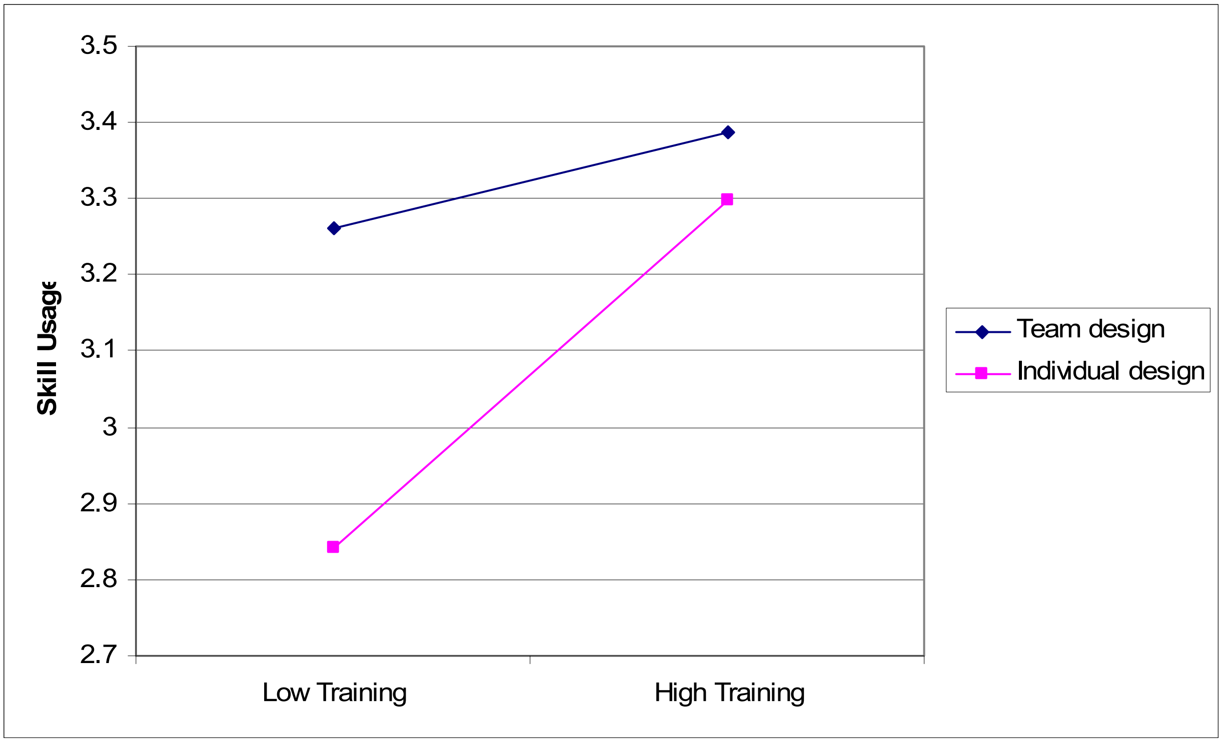


Figure 3

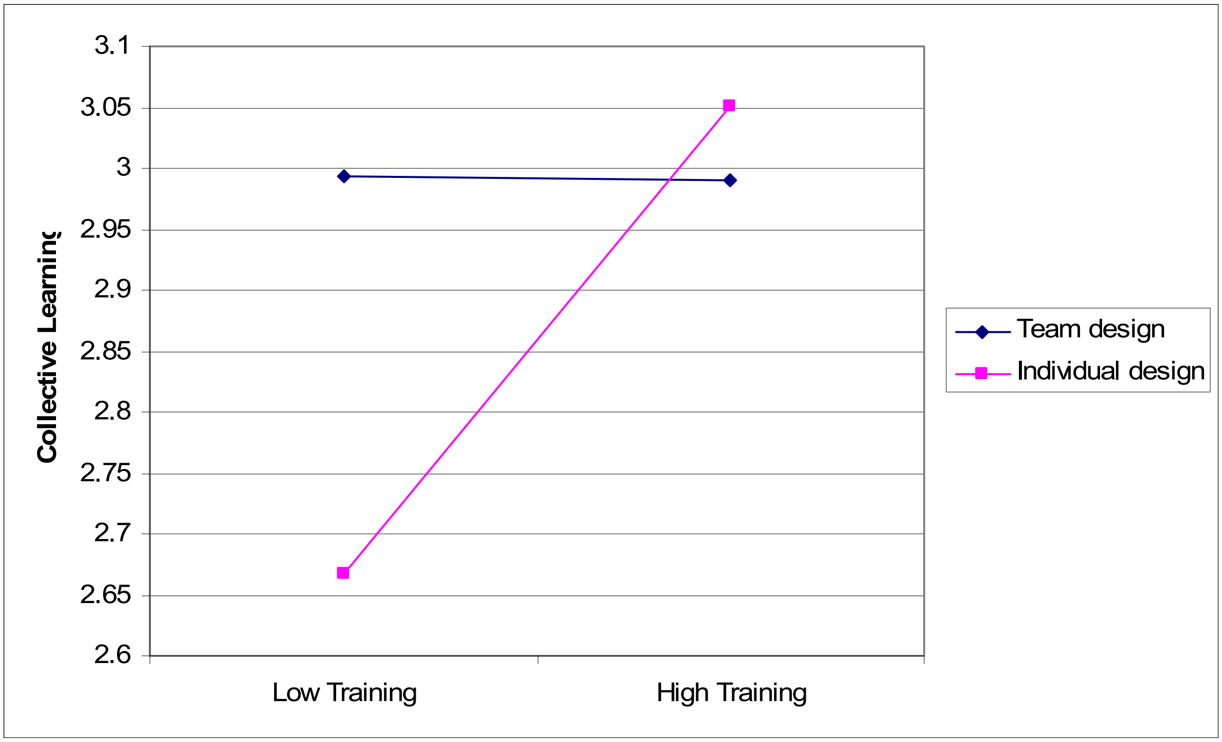
Moderating Effect of the Education System on Knowledge and Skill Usage



Low and high reflect ± 1 standard deviation from the mean.

Figure 4

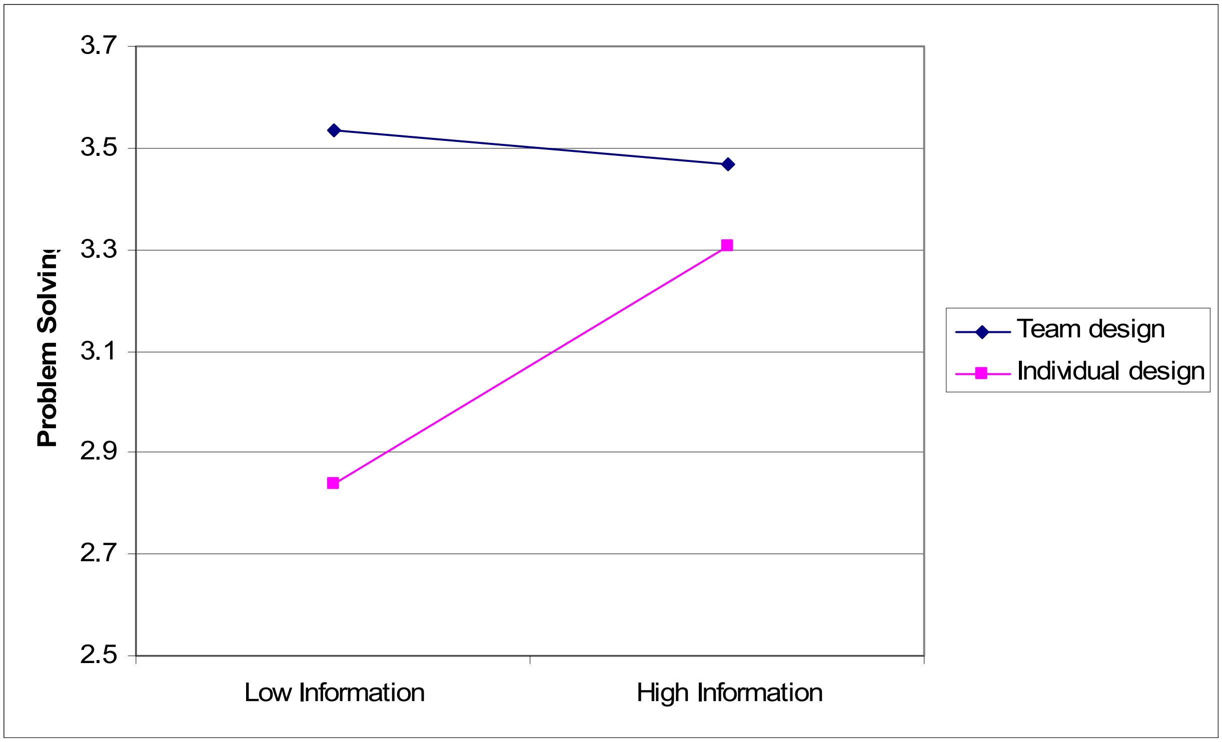
Moderating Effect of Education System on Collective Learning



Low and high reflect ± 1 standard deviation from the mean.

Figure 5

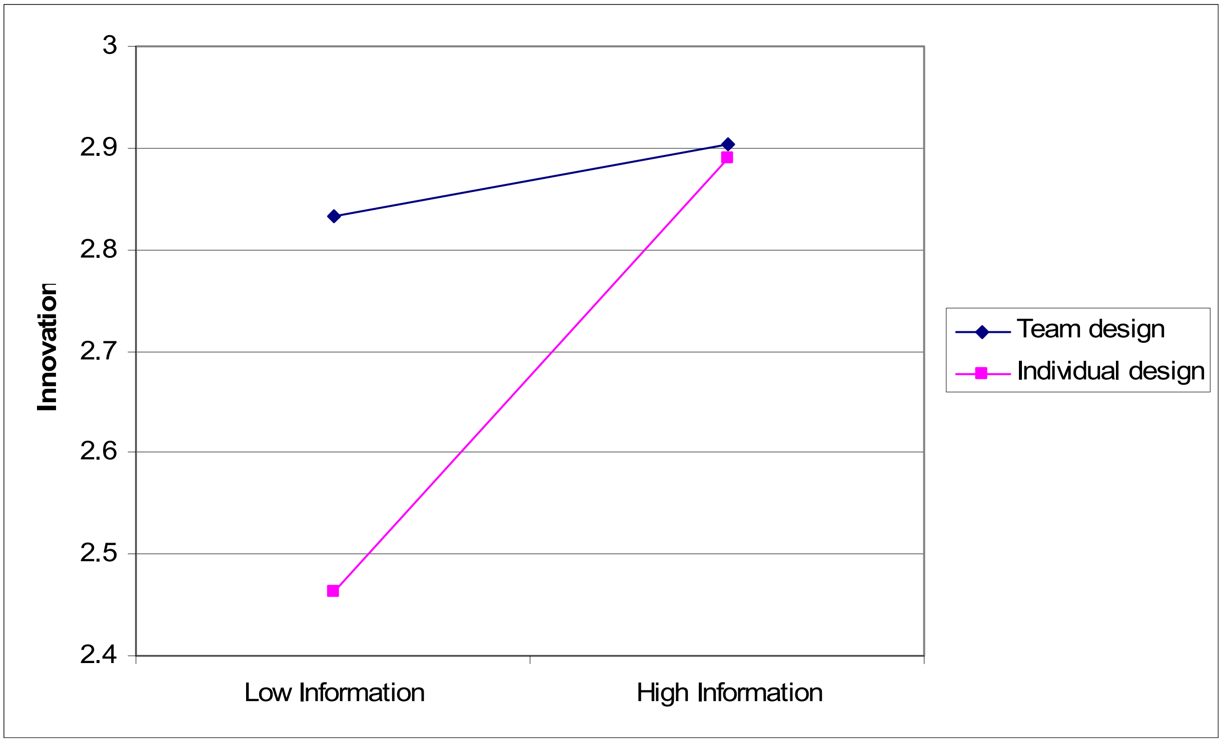
Moderating Effect of Information System on Problem Solving



Low and high reflect ± 1 standard deviation from the mean.

Figure 6

Moderating Effect of Information System on Innovation



Low and high reflect ± 1 standard deviation from the mean.