Title: A Critical Review of "Comparison of Manufacturing Performance of Three Team Structures in Semiconductor Plants"

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Abstract: A paper titled "Comparison of Manufacturing Performance of Three Team Structures in Semiconductor Plants" is critically reviewed in this individual report.

A Critical Review of "Comparison of Manufacturing Performance of Three Team Structures in Semiconductor Plants"

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SUMMARY

The paper focused on team building theories and their practiced in the field. Three types of teams of cognitive model were described and discussed in the research paper. These teams include Continuous Improvement Team (CIT's), Quality Circle (QC's), and Self Direct Work Team (SDWT's). Three preconditions of cognitive models of participation were defined in the aspects of autonomy, training, and participation in decision making. According to these preconditions, one Hypothesis was made : Team program emphasizing increased levels of autonomy, extended training and modified tasks will lead to better performance. Performance was defined as productivity (wafer processed per operator-hour) and Scrap Percentage (wafer scrapped per wafer processed). Eight fabs participated in this research and provide their performance data as verification of this research. The results were presented in two categories, one is quantitative and the other is qualitative. Study result in a deviation from the hypothesis, and the discussion about this deviation was addressed.

1. Methodology

The author studied cognitive team building theories and focused on those teams existed in semiconductor manufacturing industry. Three team styles were identified in according with their different levels of agreement with the preconditions of cognitive teams, autonomy, training and decision making. The author classified all the working teams by her observations and verified the results with managers of the working environment. A statistical model was established to serve as facts finding purpose. The model employed a hypothesis with its analysis of variation (ANOVA) design. Types of team structures were the independent variable. Validity check on the independent variables were done by using self-report measures and analyzed with ANOVA. The results are summarized and given in Table I. The preconditions of cognitive teams such as autonomy, training, modified task content and workforce characteristics and their breakdown details were used as dependent variables. Co-relations among these dependent variables were also studied and given in the paper. Team performances were measured in labor productivity and rate of wafer scrapped. Other non-measurable characteristics such as creativity, time for problem solving were discussed in qualitative surveys. Data were collected from the fab records, interview and self-report measurement.

Table I. Degrees of compliance to the preconditions of the tree cognitive teams.

Preconditions	Autonomy		Training		Modify Tasks	
	Administration	Technology	Technical	Team	Time in Meeting	Time in Problem Solving
CIT's	LOW	LOW	LOW	LOW	LOW	LOW
QC's	MEDIUM	MEDIUM	HIGH	MEDIUM	HIGH	HIGH
SDWT's	HIGH	HIGH	HIGH	HIGH	MEDIUM	HIGH

2. Contributions of Paper

The major contribution of this paper is to propose a measuring model of performance in both qualitative and quantitative aspects for various team structures. The results of this research provide a field experience to those who are interested in the areas of team building and performance evaluation. By relating team and/or individual training program to team performance, this paper also identified an area for those who focus on operational improvement-teams and in the semiconductor manufacturing industry. The aspect of teamwork is always accompanied by the complexity, which involves both task context and human factors. The paper focused its attention

on autonomy, training and task content, as these variables reflect the level of decision-making power, skill attainment, and skill use permitted within each team program. All these variables are considered essential components of team building and have been identified as critical factors to successful teamwork[1]. Furthermore, evaluation of different approaches of team building and sustain of high performance team have become an important area of modern management. The results of this survey and discussion raised in this paper will serve as a basis for further researches.

3. Literature Survey on Related Researches

3A. What have other researchers found that are related to this research?

A wide range of researches is related to this topic. But the concentration should be given to team structures and performance measurement in the semiconductor manufacturing area.

Teamwork can exist in every levels of an organization, from executive management teams to operational level. The task complexity also varies from one industry to another. For this case, the author emphasis operational teams with three different structures, CIT's, QC's, and SDWT's in the semiconductor industry. Each team has its background and field experiences. Therefore, each team structure has its unique application to a certain environment or company culture. For example, quality circle is a participative management tool used successfully by Japanese to improve the efficiency of process and quality of products. Companies that implemented quality circles with successful results also realize that quality circles was only a piece of the more encompassing total quality management program. Investigation revealed that although many company say that they still use quality circle, most probably do not in us their original application.[6] In addition, the application of Japanese management concept of quality circles to Western situations does not only required the solid support of senior management but also the positive reception of the method by organizational subcultures and the existence of supportive and appropriate supervisory management system.[7] A comparison of Japanese and German approaches to teamwork also supported this culture variation.[12] In contrast, self-directed work team is a group of workers with no supervisor and who perform a set of management functions.[8] If team programs were created more to please external agents, as stated in qualitative results of the paper, team performance is difficult to be measured and distinguished merely by their structures.

3B. What are the findings of this paper support, extend or refute the findings of other researchers?

The hypothesis of this paper, higher autonomy, training and decision making resulting higher team performance, is not very supported by its own quantitative results. In the qualitative analysis portion revealed that deviation of team purpose, lack of managerial support and disorganized, un-directed team activities are major courses of such results. By looking at this, human side of team programs can not be neglected. Longenecker et al. [9] conducted a study of 60 US successful manufacturing plants to identify human resource practices that improve productivity. Results indicate that successful firms view their employees as partners and emphasize teamwork, autonomy, accountability and involvement. Another survey by Sheridan in Varian Associates Inc. [10] also indicated that emphasizing teamwork, giving employees more autonomy and using a focus factory approach to build quality products resulted in a increase of market share from 30% to 44% in a 3 years period. In reviewing factors that affect team performance, Morley and Heratgy [11] took work characteristics, job satisfaction, corporate culture, organizational belief system and quality initiatives into consideration. Findings show that a team/group approach has a favorable impact on work variety, autonomy and work satisfaction.

For training factor, team programs that call for an intensive training of workers that the main direction of business could deviate from its course[13]. This conclusion consists with this paper's result.

3C. How does this paper differ from other researchers' work?

This paper created a two-dimensional analysis of team performance. One is team structure, and the other is the preconditions of cognitive models of participation. Different than other researches, this paper focus on a semiconductor industry, in which is a very technology oriented working environment that training is continuously needed. Also focus on teams consisted only operational level workers that resulted in higher autonomy with lower performance is another unique point of this paper. In general, this paper tried to include more complicated factors into the analysis of teamwork efficiency that reflect the needs of today's high speed and high competitive environment.

4. Strength and Weakness (in terms of Concept, Methodology and Results)

Measurements are always important to management. The author provides a conceptual model for team performance measurement. The model tries to figure out the relation between those three preconditions and team performance. Furthermore, cross-reference of qualitative and quantitative results illustrated a very good methodology for performance measurement. Once the relationship between team structure and it performance can be found out, it must have great contribution to improve efficiencies of team works. Due to today's fierce competition in all kind of business, it is essential and very important to team building design for a specific of working environment.

However, the model could be even more complete if some other factors were taken into consideration. First of all, technological levels, such as line width or clean room class at different fabs should taken as one other independent variable in that conceptual model as these factors directly effect both productivity and scarp rate. Besides, the level of current company performance should also be taken into consideration when teams are been forming. Ernst & Young and the American Quality foundation, called the *International Quality Study* (IQS)[2], suggested that different approaches should be adopted based on the company's current performance, which can be determined by ROA (return on assets: after tax income divided by total assets) and VAE (value added per employee: sales less the cost of materials, supplies, and work done by outside contractors). When a firm's overall organizational performance has been determined, then the tasks and types of teamwork they can effectively learn how to employ are set by the firm's overall organizational competence. [3] Base on this suggestion, the measurement of team outputs should focus on improvements of productivity and quality instead of merely productivity and quality. In other words, the difference made by the team is the performance of the team. Thus the model could be expanded a little bit.

5. What are the conclusions of the paper? (Are they well stated? How are they supported by the research reported in the paper? Do they need strengthening? If so, how?)

Why high autonomy teams have low performance? The conclusion of this paper is mostly reviewing the reasons for obtaining such research results. The author gave several examples to explain these findings. The reasons for failed SDWT, the highest autonomy teams are given as 1)not appropriate for low-level workers[, 2)poor design of team involvement, 3)half-heart implementation, and 4)choice of outcome metric of productivity as a measure of effectiveness. The author should strengthen these reasons by citing other research findings of giving solid examples. Beyerlein et al.[14] studied 50 teams in 10 organizations to find the hurdles to effective teamwork.

These findings could serve as this purpose. The author acknowledged that some measures of qualitative metrics, such as die yield problems to individual functions was not measured due to its complexity. However, as stated in the strength and weakness session of this report, it could affect team performance greatly.

6. Are the references adequate?

Browen of UC Berkeley has conducted a research to address the relation between team training and its performance.[4] Due to the high technical demanding and hazardous working environment in a semiconductor fab, constant training is necessary. Browen used training time as a measure of Knowledge, Skill and Ability (KSA). An equation for team performance measurement was developed to reflect this relation that provides a more systematic approach for team performance measurement.

$P=C_1-C_2X^{-2}$,

where

P is the Performance of the work group,
C_1, is a constant representing the system upper limit to performance,
C_2 is a constant representing the costs incurred as a result of imperfect KSA, and X is the level of KSA of the work group.

The training contents for work teams at semiconductor fabs should be specifically designed to enhance the teams' performance. Appleyard, of also UC Berkeley proposed the correlation between performance measurements and total fab SPC[5]. This hypothesis was supported by statistical results.

7. Research ideas for future work

Teamwork is an inevitable trend in modern working environment. The importance can not be over emphasized especially in a high speed changing age. It is the area of engineering management researches that provide guidelines or examples for building efficient teams in accordance with the task and environment context. Future work may look into expanding time span of measurements that conclude a more accurate team performance. Benchmarking of group performances before and after teamwork is necessary for this purpose. Besides, corporate culture is a critical factor that affects team performance. The managerial attitude toward an operational team determines the successfulness of the team program. Taking all these factors into consideration, the future work is proposed as Figure 1.

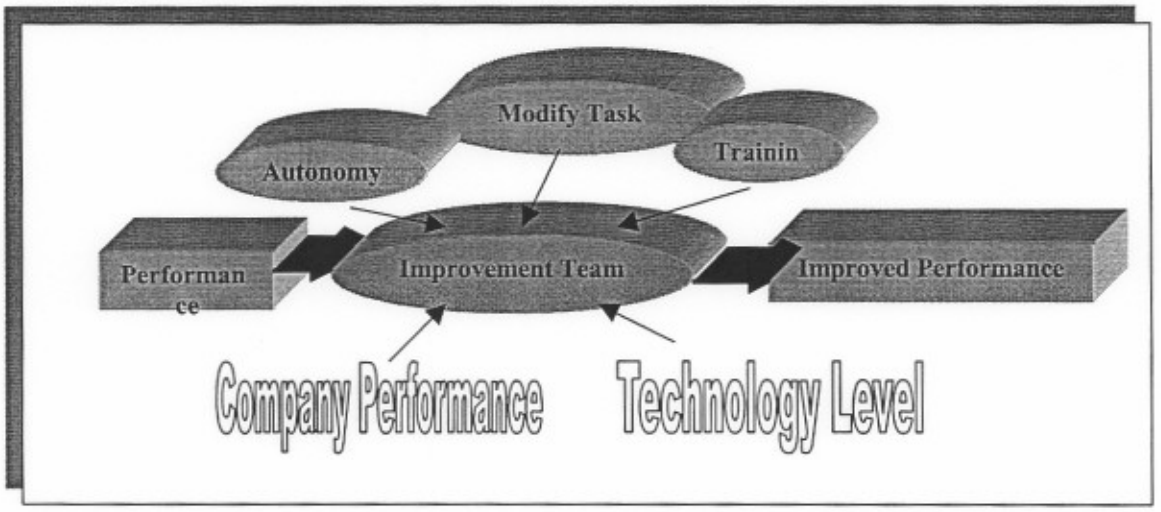

Figure 1. Conceptual Model for Building High Performance Teams

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