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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Critique of the IEEE Transactions on Engineering Management article: "Comparison of Manufacturing Performance of Three Team Structures in Semiconductor Plants"

This paper studied three types of improvement team programs in the Semiconductor Manufacturing Industry to determine whether greater employee participation in decisions concerning their tasks will improve their productivity. Organizational Theorists who support cognitive-models of participation claim that productivity increases as workers are allowed to participate in decisions. This is based on the premise that the addition of their intimate process knowledge to the decision making process will lead to more informed, effective decisions which also have the benefit of buy-in of the people upon whom these decisions have the greatest impact.

The three types of team programs in the study were:

- Continuous Improvement Teams (CIT) – small voluntary teams of employees that are formed to work on specific issues. The members can be from many different workgroups within the company. Once a team's issue is resolved, the team disbands.
- Quality Circles (QC) – a voluntary permanent team is formed using workgroup members from a single functional area to solve problems related to that area.
- Self-Directed Work Teams (SDWT) – the teams take the place of the old workgroups but with enlarged administrative duties and responsibilities and much greater autonomy. The teams are permanent and membership is assigned depending on the functional area in which the employee works.

The paper's author prepared and edited her surveys and familiarized herself with semiconductor manufacturing practices at a Pilot fab – which happened to use QC based teams. The data for the paper was then gathered during visits to eight semiconductor fabs owned by seven major companies using both objective and subjective methods. The visits were of 5 to 7 days duration and involved interviews with employees at every job level within the engineering, production and equipment hierarchy of the companies, attendance at team meetings, and surveys completed by two to four operators per workgroup per site. A total of 89 workgroups were surveyed among these 8 fabs, with 3 sites employing CITs, 2 sites employing QC teams and 3 sites employing SDWTs. Data on throughput, yield, equipment utilization and other process- and product-specific information over a one to three month period was provided by the fabs. Subjective data was collected during informal conversations with operators and observations during four–hour unsupervised tours of the fabs.

Direct labor productivity was measured as the number of wafers processed per operator hour. Indirect labor productivity was measured as the number of wafers processed per operator, supervisor and technician hour combined. The data was analyzed using ANalysis Of VAriance (ANOVA) statistical methods with the hypothesis that workgroups in SDWTs would be expected to perform better than workgroups whose members participate in QCs or CITs

Analysis of the results showed that CIT programs were associated with the highest levels of direct and indirect productivity, followed by QC programs then SDWTs. This is in contradiction to the performance of SDWTs in other surveys and the generally perceived performance of SDWTs in practice. The author suggested a number of possible reasons for this:

- Semiconductor manufacturing is not suited to autonomous teams – although most of the pre-conditions for successful autonomous teams were present in all fabs in the study.
- Poor performance due to managerial implementation of the team programs and a failure to integrate them with the engineering departments -- the most likely cause
- Productivity is the wrong choice for the outcome metric.

The intention of this paper was to present a comparison of manufacturing team performance that was gathered over an extended time period and from several companies. The author stated that there had been many single site surveys performed but very few large-scale studies, with most of the surveys being performed at so-called low-tech companies over very short time periods.

The data for this study was gathered during the period 1992 – 1993. The paper itself was submitted in 1996 and published in Feb 1998. Although since 1992, technology in most industries, and especially the semiconductor industry, has moved forward at a very rapid pace, the requirements for successful implementation of manufacturing teams has not significantly changed. The importance of teams for organizational success in the modern economy is being increasingly emphasized by management and in the academic press [1]. A paper published by the same author in collaboration with Susan G. Cohen reviewed a total of 54 papers on the effectiveness of teams in organizations which were written between Jan 1990 and April 1996. The review concluded that the type of team affected effectiveness with self-directed work teams having greater performance and attitudinal benefits.

There are a great number of articles about how to implement Self-Directed Work Teams, but even though they range from 1992 to today, the purpose behind implementation are virtually unchanged [2], [3], and [4]. The main reasons for implementing self-directed work teams are:

- Increased productivity, quality and customer service;
- Enhanced communication;
- Reduced operating costs;
- Improved organizational ability to change;
- Quicker adaptation to new technologies;
- Enhanced behavioral change;
- Fewer, broader job classifications; and
- Increased employee satisfaction.

The implementation stages of SDWTs have been formalized by leading organizations into five phases [2]:

- Assess feasibility;
- Prepare the organization;
- Execute the transition plan;
- Integrate SDWTs into the organization;
- Support the evolution of SDWTs

Implementation is not a simple matter, but requires an enormous amount of planning beforehand. They should be implemented for sound business reasons, not because of the "country club effect" [3], [4] – this is where one vice president finds out at the country club that his cohort has

established self-directed work teams, and therefore, he has to have them too. Once they are formed, however, they need to be integrated into the organization and supported.

Major problems can occur in implementing teams when a company tries to do too much at one time -- as in the case of National Semiconductor's re-engineering of its IS organization [5]. The company imposed an almost overnight change to self-directed work teams when the changes should have been prioritized and slowly phased in. However, in those companies where the transition to self-directed work teams has made with planning and the necessary cultural changes, the results generally show a substantial increase in productivity, quality and employee satisfaction [6 – 9].

Available research publications indicate that the concept of implementing teams in organizations has progressed from Continuous Improvement Teams, through Quality Circles to Self-Directed Work Teams. The research shows that, with proper planning, self-directed work teams can make a positive difference to productivity. However, improper planning and a lack of management commitment to the concepts of self-directed work teams can sometimes lead to a reduction in productivity.

The purpose of this paper was to investigate the performance of several team designs in the high tech industry over an extended time period, as most of the previously published works were single site studies in the so-called low-tech industry. The use of productivity as a metric was quite legitimate, as most of the research papers show a major outcome of the successful implementation of self-directed work teams being an increase in productivity. The data collection, both subjective and objective, was very thorough. The objective results, which showed a decrease in productivity for the self-directed work teams, were apparently at odds with the results of other surveys of self-directed work teams. However, these were findings of

companies that had successfully implemented self-directed work teams. The results actually agreed with those of companies that had implemented teams without the necessary training, planning and support – this conclusion also appeared to be supported by the subjective data.

Overall, I believe that the findings agree with the current literature – that implementing self-directed work teams requires extensive management planning, buy-in, training and a change in culture in order to be successful.

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Possible Further Research Ideas:

1. Re-visit the fabs in this paper and examine the changes that have taken place since the survey of 1992/93. Are the team programs the same? If they are different, why?
2. Examine the experiences of a company introducing self-directed work teams from introduction to integration. Visits could be made at 3 month or so intervals to discuss the changes that have been made, the changes that need to be made and how the changes were actually implemented.
3. One of the issues with self-directed work teams is that of compensation. Several papers mentioned that the SDWTs should be able to implement their own compensation schemes and some schemes are discussed [10], [11]. It would be interesting to see how companies are addressing the compensation of self-directed work groups, how they reward the extra productivity and whether compensation schemes affect team performance.