Individual Research Paper

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Comparison of Manufacturing Performance of Three Team Structures in Semiconductor Plants

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Executive Summary

This article by Diane Bailey, the author, lays out characteristics of three types of improvement-team programs used in a sample manufacturing sites. These three programs include Continuous Improvement Teams (CIT), Quality Circles (QC), and Self-Directed Work Teams (SDWT). According to needs of quality improvement in productivity process, many manufacturing companies intend to utilize skills and knowledge of employees in believes that participation in work decisions leads to high team performance. This refers to team-based programs or improvement-team programs. Improving employees' capability broadly comes from various kinds of corporate activities such as training programs, empowerment, participation, decision-making improvement, and so forth. All of these improvement-team programs target to the same outcome that is the "team-based quality improvement". However, each program approaches to employees in a different manner, especially in different work environments.

To determine the effectiveness of each improvement-team program, Diane Bailey examines a sample of eight manufacturing sites. The author hypothesizes that the preconditions of the cognitive model - team programs emphasizing increased levels of autonomy, extended training, and modified tasks - will lead to better performance. This leads to her perception that among those types of improvement-team programs SDWT seems to be mostly effective and practical for the manufacturing field, with the QC and CIT following. In the study, the author primarily used a qualitative and quantitative methodologies to examine how differences in those three program designs affect the manufacturing team performance, and to determine if which type of improvement programs was mostly competent in the manufacturing plants.

Background and Concept

By definition, a team is a small number of people with complementary skills who commit to standing a common purpose, set of performance goals, and approach for which they hold themselves mutually accountable [1] [4]. Three issued improvement-team programs are the philosophy programs that primarily place on similar concepts and purposes. However, each improvement-team program was originated from different philosophers. The terms of continuous improvement program (CI) and self-directed work team program (SDWT) were coined by American philosophers, whereas, the term of Quality Control Circles (QCC) or Quality Circles (QC) was first found in Japan in the early 1960s and brought to the United States in the early 1970s [2].

According to the threats of Japanese success in manufacturing fields, U.S. manufacturers have been interested in Japanese practices and determined which factors brought Japanese into the success so easily. Many researches found that the improvement-team program was considered to be one of the most promising approaches for improving Japanese workers' productivity [6]. In doing so, U.S. manufacturing plants have adopted these approaches to the fields.

To survive in a huge competition of the global business, many manufacturing plants have been trying to improve product development processes and business reputation by emphasizing on the

team-based work system [3]. Most of the time products and services, which customers need, are in form of a high product quality and fast service that are always compared with other products in the market. Therefore, to meet the customer needs many companies are most likely to perceive a significance of driving the improvement-team programs into one part of their business strategies. Nevertheless, some have got success but some have not. An important issue is not that if companies should push those improvement-team programs into the business strategic planning but which program they should be most appropriate and chosen for their corporate cultures and organizational environments.

This article has made substantial contributions to the manufacturing team-performance improvement in U.S. The author shows comparison and contrast of three improvement-team structures, which include CI, QC and SDWT programs, in a sample of eight semiconductor plants. In architectural structure, the author first defines traditional workgroups, then describes three major types of team programs as CI, QC and SDWT which are documented within the semiconductor industry [7]. Each team program is distinctly structured: CIT existing in parallel to the traditional workgroups, QC existing in a single functional area, and lastly SDWT existing in the same functional and shift line as the traditional workgroups but have greater responsibility and enlarged duties.

Methodology Used

According to different team structures and distinct team approaches, independent and dependent variables were set up for analysis. The methodology of this article was based on two research methods: qualitative and quantitative approaches. In the qualitative approach, the author made a private determination by basing upon personal observation, interview data, and questionnaire survey. In the latter approach, an analysis of variance (ANOVA) was used to determine team performances in terms of the productivity of direct and indirect labors as well as the wafer scrap percentage (three dependent variables – Figure 1). The analysis of variance was analyzed and assessed in production records & workforce data, and self-report measure sections.

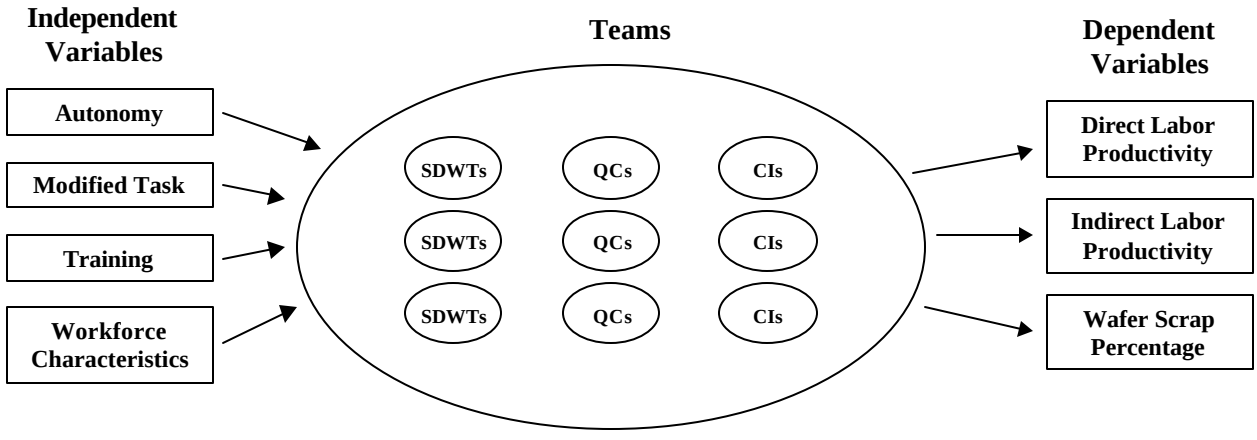

Figure 1: *Relationship between improvement-team programs and outcome variables*

The author examined a sample from eight semiconductor fabrication facilities (fab) representing seven major firms. The study data was gathered during site visits, typically four to five days in duration made to each of the eight fabs in one-year period. The quantitative data was collected at the workgroup level. The data covered one to three months and was gathered from production records within six months of the visit. In addition, the qualitative data was gathered to provide understanding of the team programs. These data were gained by interviewing with employees at every job level, distributing questionnaire surveys, which were drawn from Van De Ven and Ferry's [8], per workgroup at each fab, and observing team performances at each visit.

Results and Analysis

After identifying all variables for those three team-improvement team programs in a sample of eight fabs, the author could numerically depict the results in three issued categories which primarily included the direct labor productivity, the indirect labor productivity, and the wafer scrap percentage. In detail, the results of this research were discussed in two sections, quantitative (statistic) results and qualitative results. Obviously, the results from those categories were opposite to the author's initial prediction; the CIT program ended up with the best performer rather than the SDWT program. As many limitations in this research were shown, the strengths and weaknesses of this research will be analyzed.

Strengths:
The following section explores the strengths of this research.

- The results of this research were clearly presented in a table format, giving readers an opportunity to address each issue.
- The analysis was discussed in both quantitative and qualitative formats from which readers could see obvious results.
- Since the quantitative method had been appropriately used, the outcomes of qualitative method are more reliable.
- In addition to the analysis of variance, many data collection methods strengthened the results in the qualitative method.
- The research gives a good insight for readers and facilitates manufacturers involved in deciding whether which type of improvement-team program is appropriate to their plants.

Weaknesses:
The following section explores the weaknesses of this research. Some of them are inevitable due to concepts, research methodology and data collection method used in this research.

- One-year period of collecting team performance data is too short to be reliable beneath the inaccuracy of performance evaluation of the programs. Since employees usually take from two to five years to become a mature team [9], the data collection and evaluation process should prolong at least two more years so as that the research reaches a more reliable result.
- Not all respondents responded the survey of a team performance evaluation due to heavy production demands. To overcome this, all questionnaires should be considered the recently terminated projects. Therefore, it is very difficult to measure the reliable of responses unless documented responses are used.

- An inevitable hindrance of survey studies was subjectivity. There is no mention in the article how bias respondents had been prevented.
- The results of each team were not considered merely by the quantifiable end products. The dependent variable based both on the wafer scrap percentage and on direct and indirect labor productivities. Therefore, the benefits produced among each team are hardly measured.
- The author drew the assumption that participation in team program could be measured in terms of the team performance. This is not always true. The fact is that a degree of employee involvement is not the same in each team. Nor is the sense of voluntary. "Low volunteer rate" is an important factor that is destructive for improvement-team program [10]. High level of participation, however, does not indicate that employees are willing to work with other functional people.

Research Comparison and Contributions

Several main points of this research contribute to the literature. Because this study embarks on three improvement-team programs in a sample of manufacturing plants, the contributions from this study could provide some sights to those which focus solely on single improvement-team program in other workplaces. Ineffectiveness and unproductive performance of team-based programs are often found in several failure patterns. So are individuals of those team-based programs. This is because each team-based program has its own strengths and weaknesses in improving team performance.

To be flexible with diverse tasks and work environment, an organization has been considering how to exploit those benefits of team-based programs, but intendedly avoid their weaknesses. Many researches and studies have approached to this issue. For instance, Thomas et al addresses in his research that QC is a better practice when it is applied to a large group than a small group [10]. This is because members of the larger groups are more interested in and committed to problem-solving activities. In an opposite point of view, member's efforts tend to decrease as group size increases. Moreover, Allender infers that SDWT would achieve an optimum management goal if a corporate organization can implement them in the proper perspective [9]. An organization must not opt for aimless training for SDWT programs; rather, it must strive for quality circles and good training in problem solving. A low level of membership can lead to decreased motivation and ineffective problem solving. With the proper culture and good experience in improvement-team programs will be highly effective. Researches such these are mutually contributive to one another. Their purposes of studies are launched to similar aims, but different angles of aspects.

Bailey addresses her research hypothesis that preconditions of the cognitive models are capable indicators of leading to better performance. Although the result in this study belies the hypothesis of the research, this study depicts that the levels of employee involvement and work environments crucially impact the team performances. Several articles in such this area strongly support this hypothesis. Many other related studies show that to manage the key elements (situation, performer, response, consequences and feedback) of team-based program as an integrated whole can improve performance at every level of an organization [3] [12].

Related Researches and References

The study of improvement-team programs in research literature has been broadly approached. The approaches diversify from case studies to world/high-tech industry. Regardless of the former research of Bailey [7], there are many similar researches which address the performance of improvement-team programs various from traditional team-based program to three team structures as mentioned in the research, but none of which refers to comparison of performance of such those programs directly.

An example of such literature is an article by Clark et al which lays out a framework for organizing and leading a high-performance team, namely "heavyweight team", in technology industry [11]. Rather than explore the performance of a sample of four team-based programs, Clark et al points out specific challenges and their solutions in managing the high performance team organization, accompanied with an example of the changes necessary in individual behavior for team-based program to be effective. Another example is a case study by Robinson et al that addresses how to implement and create high-performance team dealing with the idea of semi-autonomous work teams, just-in-time management, synchronized manufacturing, and participative involvement [17]. However, the applicable method of performance evaluation in this case study is not brought forth for supporting the analysis of Bailey study.

Although Bailey did discuss the cognitive model of participation and individual involvement in team-improvement programs, there are some required issues that she should more mention about. These are Human Resource (HR) practices and contributions of HR department. On the fact of quality improvement in organizations, team-based work system has inevitably become one part of HR department. Dealt with HR bundles and manufacturing performance, Macduffie addresses his perception and comments on other similar researches of team-based performances and programs:

> *"… , much of the research on the performance of automotive assembly plants has overemphasized either the technical system or the HR system without fully exploring the interaction of the two systems and how it can affect performance"* [19, p.217].

Lacking of conducting HR practices in manufacturing plants and rendering HF contributions to work forces, organizations hardly attain highest benefits from employees. So does a research.

In another viewpoint, there are some related studies that provide insights of team performance prediction. One of those researches written by Lucius et al which renders an alternative methodology for predicting and measuring performance from individuals who are placed on teams [18]. This methodology is called "Sociometry" which can provide an alternative to other methods by measuring preferred pairings among team members across a number of tasks or settings. Case and research studies such these have supported and develop a strong framework for the analysis of Bailey study.

Conclusions and Recommendation

Overall, the conclusions of this research are clearly reported. The study indicates that SDWT is not the best performers in manufacturing plants as predicted. Rather, the traditional improvement teams, which include CIT and QC, are outperformed by workgroups in fabs. The hypothesis that the preconditions of the cognitive model will lead to better performance is contradictory with the results. The results of the article also controvert several related researches in three major findings of cognitive model of participation. First, participation in workplace utilizes worker skills and knowledge and thus improves performance. Second, workgroups with higher autonomy have better performance [12] [13] [14]. Third, better performance among participation schemes is in programs that stress participation in work decisions [15]. It is so interesting that why the results ended up with discrepant outcome. To explain this, several reasons of this contradiction are addressed as following.

According to work environments in fabs, independent variables shown in the study does not cover all of important factors for evaluating improvement-team programs. Many factors are often around the team performance, some of which include rates of voluntary [10], levels of team involvement [1], degrees of management supports [5], long-term achievable visions and goals [16], and so forth.

The participation schemes are not appropriate among low-level workers in fabs since the problems they deal with are not complex enough [5]. The problems they concern are repetitive tasks, as usually seen in manufacturing processes. Next, The workers in each improvement-team program were not well trained and educated. All training programs are provided to workers except mechanical skill training program. In addition, all workers in this study come from the former program (CIT), with which they are familiar, before being transformed to assigned programs (QC and SDWT) [5]. Moreover, the management support may not have supported their workers well enough. In order to achieve results and team improvement, management at every work level must support and understand to the team programs. Lastly, a high rate of failure to solve problems in team programs may cause team members to ineffective results if the rate of voluntary is not carefully determined.

Future Research

This research paper by Bailey gives a good insight of managing employees in manufacturing plants. Nevertheless, Bailey did not address some important points of managing teams, especially multi-functional and/or multi-cultural teams. For any future researches, I think that there are some areas on which could be focused. The following questions might be useful for the further researches, and can provide a more sound understanding of how these three types of improvement team programs will perform in different business environments.

- *Do cultures effect those three types of improvement-team programs in manufacturing plants? How would those programs effect to employees in multi-cultural teams? Which program is most applicable in such an environment?* The fact is that the increase of multi-national organizations and the global business environment has resulted in the need for employees to

be able to function effectively in diverse environments. Some of the barriers presented by multi-cultural environments. In creating cultural awareness and understanding, it is important to understand the issues associated with cultural dimensions such as individualism and collectivism, power distance, verbal and nonverbal communication, and management styles as well.

- *If the same research does in other types of businesses rather than focusing only on manufacturing plants, are the results from this research exactly alike? If not, which program is most effective?* James Evans and William Lindsay address an interesting issue that the Quality Circles program is most effective when it is applied to nonmunfacturing environment [2]. Working environments of one business are not always identical to those of others. Besides, the Quality Circles program is a philosophy concept developed by Japanese, comparing with other two programs that were coined by American. Whether or not the words of Evans and Lindsay are true, it, at least, would be interesting to understand and study how these three programs perform in other business types.

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