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A SIMULATION BASED RESEARCH OF ALTERNATIVE ORGANIZATIONAL STRUCTURES IN SEWING UNIT OF A TEXTILE FACTORY

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In textile industry, productivity, flexibility, and quality must be improved and maintained to meet the challenges of an increasingly competitive word market. Simulation has been widely used in the investigation and evaluation of organizational structures and alternatives. In textile industry, meeting the demands of customers or market changes, to make cutting right and standard, to have cutting time short and perfect, the use of new technologies and transformation into progressing organizational structures get importance for productivity. The processing time of right cutting directly affects the cycle time of the end product. In this study, the research of current organizational structure and the use of alternative organizational structures on meeting customer demands on cutting unit of a textile company are made by using ARENA® Simulation Software. Selecting the most productive organizational structure by simulation based approach to evaluate parameters is the purpose of this study and the results are evaluated.

1. INTRODUCTION

In textile manufacturing, Turkey started to seek the ways of Branding for its products to be able to compete with China and Far-East countries having low labor cost. The most important factor that affects the Branding is re-structuring for products of high and standard quality and customer satisfaction. With the increasing quality and productivity understanding in production unit, the importance of right and perfect cutting besides quick operation timing is quite clear.

Simulation modeling and analysis have become a popular technique for analyzing the effects of changes mentioned above without actual implementation of new technologies or assignment of resources. Many manufacturing systems can be easily and adequately analyzed with discrete event simulation models (Banks et. all, 2001). Simulation has long been accepted as an effective approach to design and analyze production structures. In many manufacturing organizations, increasing process flexibility is becoming more important while the reliance on product cost to measure manufacturing performance is being lessened.

Due to restructuring of production, the role of new technologies in a company has increasingly changed over the past several years. Quick change in fashion with the higher and standard quality induced by the use of new technology which is one of the most important factors of international competition in textile and Ready-To Wear (RTW) industry, forces producers to make structural changes in their manufacturing systems. To be able to use the quick change in fashion as a competitive advantage companies must meet the demands in short time by quick production and this obligation brings out the need to employ new technology and organizational change.

This paper considers and explores design of organizational structure and alternatives in a sewing unit. These actions should not simply be related to "new technology and sewing automation", as the achievements which might possibly ensue are mainly obtained by carefully merging the information flow into material flow in such a way that to affect each other when external inputs (commands or disturbances) apply (Acacia et. all, 2003).

A new technology offers many advantages over many advertences over confessional machines, such as higher productivity, more consistence in quality, higher precision, and reduced set-up times

The firms aim at competitiveness, with focus on styling and on critical processing tasks, while the work-intensive phases (e.g. sewing) are eventually decentralized where operators' wage is smaller. Is this an effective set-up? (possibly) yes, on conditions that:

- The market accepts the full amount of ready made suits or dresses, delivered by (large-enough) season's batches (to optimize the productivity on tactical horizons),
- The flexibility is included by 'quick-response' techniques, so that extra items are managed on-process, to personalize size or details (as case arises, on the operation horizons).

These two conditions are consistent with simple rules, such as:

- To aim at work-plans *leanness*, with visibility on cost build-up and quality transfer,
- To focus on the core business and to remove 'intangibles', which make the business with 'little' benefit.

Leanness entails decisions, based on benchmarks, with purport on management tasks (to distinguish administrative or bureaucratic requests) and on technical issues (to plan out product and process innovation). Preliminary step for effectiveness is the setting of performance ranks, at the strategic, tactical and operation levels of the manufacturing engagements, to exploit flexibility through a properly sophisticated govern framework (Acacia et. all, 2003).

2. AIMS OF ORGANIZATIONAL AND TECHNOLOGICAL CHALLENGES

Implementation of high technology production system during the 1980s and 1990s has helped -to same extend- in sharpening the competitive edge of companies by reducing manufacturing lead times and increasing flexibility. However, more potential for improvement lies hidden in the departmental structure of an industrial organization (Zülch et. all, 2001).

The successful implementation of a cutter system is dependent on arriving at a satisfactory solution to interrelated engineering, management, organizational, and human resources issues. Often lower than expected productivity gains were achieved due to a lack of consideration to human aspects in the design, operation, and maintenance of computer-automated technology.

New ways of managing, planning, and implementing cutter systems are needed in sewing unit to deal with rapid development of new technologies such as vision, off-line programming, and system integration, which permit a wide range of applications. For the successful implementation of cutter systems, the connection between product design and manufacturing process design must be understood. Advance planning for the implementation of cutter systems should be made with the objective in mind that it is not merely planning for new technology and equipment, it is planning for human beings.

In the presented analysis herein, particular thought was given to organizational structures because of the large scope for development of the new technologies and workers and the interdependence between disposition strategies and efficiency of the logistic system.

The use of advanced manufacturing technology, new organizational structures and new strategies of human resource management had a significant impact on the demand of labor and the labor market. For those qualified workers, which were underused in the production structures, new opportunities of more demanding work opened. They tried to find jobs which matched with their skills and qualifications. However such changes could not always be managed without any problems; it often took some time, before they could find a better job. So even highly qualified workers became unemployed; this kind of unemployment can be called "search unemployment".

This manufacturing technology will have a profound impact on the ability of the system to react to market needs and the perceptions of customers regarding the processes that should be undertaken, the time scales that the business should operate on and the cost involved. There will also be people issues arising from a technological perspective that sees a requirement to introduce new technology and information management systems. The introduction of new information management technology may also have a profound impact on the organizational structure of the business as communication patterns alter (Bradford and Childe, 2002).

There may be further impacts on the organization structure as decision making moves between people and traditional authority and accountability structures no longer reflect the practice of the business (Bradford and Childe, 2002).

Organizational change is a well established discipline that specializes in the analysis of the business organization, their strengths, their weaknesses and the optimal methods for getting from one state to the other (Bradford and Childe, 2002).

3. RESEARCH METHODOLOGY

Simulation is the main tool used in this study. For the design and control of production systems, simulation has proven to be a powerful tool. However, investigations of the market situation have shown that many companies are not willing to use simulation as a permanent planning tool (Schmittbetz 1998, Zülch et. all, 2002).

Analyzing production systems in a static as well as a dynamic way should support the analysis and design process. This is usually done by applying simulation tolls. For a successful re-engineering process, the production system has to be studied from a different point of the view. For the correct selection of modeling aspects, the global objectives of the company must be studied in detail (Zülch et. all, 2002). During this study it is verified whether the focus should be on information technology or the business processes. Reorganizing the company usually leads first to a business process-oriented approach (Scheer, 1994).

ARENA 7.0 simulation software was used for model constructions and analysis in this study. As the first step, a base model was developed which depicted a system without process variation. Model verification and validation was done by structured walkthroughs of model logic, extensive use of execution traces and by reasonableness of the animation.

4 EXPERIMENTAL ANALYSIS AND RESULTS

4.1 Case-1: Initial Situation of Sewing Unit

There are three things a company must do to compete effectively. They are:

- To provide an efficient well automated manufacturing system which will give the business a distinct advantage over competitors; To focus on the core business and to remove 'intangibles', which make the business with 'little' benefit.
- To determine the order-winning criteria (OWC),
- To control the process in such a way that the product meets the order winning criteria and maximizes profit (Hörte and Ylinenpää, 1997).

By considering these, the company wants to obtain the compatibility goals. Therefore, the company wants to improve the current cutting unit by employing a cutter system or by making some design changes for the minimization of the cycle time of the products, but also the cost is another dominant factor.

The cutting unit can be described as traditionally organized manufacturing system with a function-oriented departmental structure. Figure 1 shows the initial layout of the cutting unit. The company currently employs 22 workers in the cutting room. There are three identical manual spreading machines, which are operated by one worker for each. After the spreading, the fabric is cut according to the product model and numbered for the production control and part pursuit. After the numbering process, related parts are sent to marking table for the marking of the fabric for the designation of the sewing places. After all these operations, control for the cutting errors of the parts is done by two workers and if the parts are satisfied, two workers package them and sent to the sewing unit after the binding operation. Also there are four workers to assist the operations in spreading, cutting, numbering, marking and controlling stations, to prevent the bottleneck occurrence. The company works in one shift for five working days of the week.

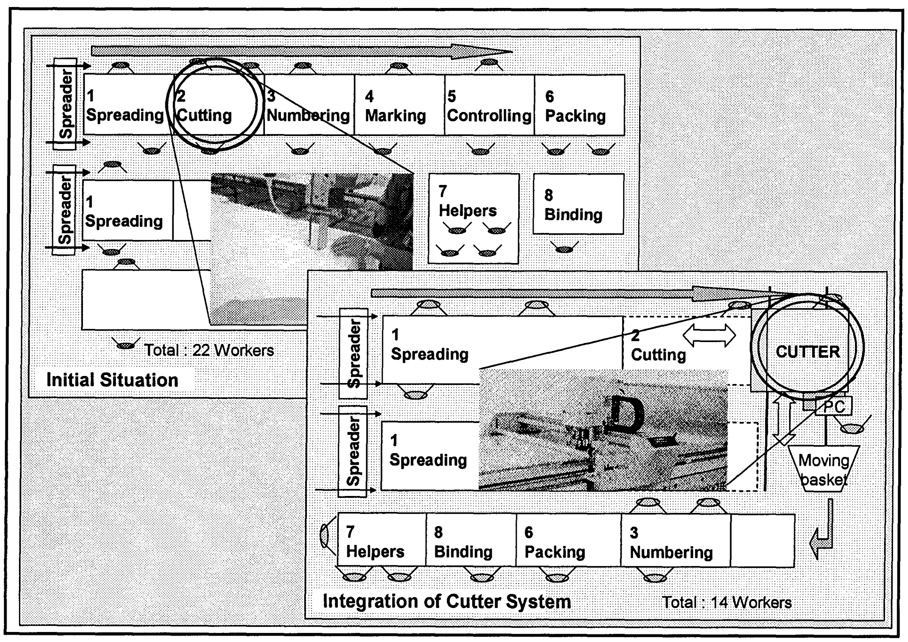

Figure 1 – The current situation of the cutting unit and after the integration of the Cutter System

Since salaries of the employees in textile industry are rather low in Turkey, turnover rate of workers is very high. Because of the learning period for every new worker, new personnel start learning by assisting the existing staff generally. Lying, numbering, marking and packing activities can be fulfilled by new workers, who are capable of doing these activities. In the following alternative models, it is assumed that the qualifications of the workers have been increased as a result of the reduction in the turnover rate of the workers.

Changing the Qualifications for Initial Situation

Variant A: In the first alternative model, it is assumed that the assisting workers are qualified to perform binding activities, so that they can be allocated to those jobs if needed.
Variant B: In this alternative model, it is assumed that the turnover rate of the workers has been reduced; hence workers in the cutting unit can perform all the activities. For instance the workers, who pack the goods, can also control the quality after the cutting activity. But the labor cost per hour will be increased.

4.2. Case-2: Integration of Cutter System

Variant C: It is assumed that the new technology has been integrated to the cutting unit. Based on the assumption that the demand has not been changed, new organizational structures and personnel allocations have been included to the new simulation model. Some activities, such as controlling the quality, are no longer necessary after integrating the new cutter to the unit. Thus, production speed will increase and the number of workers required in the unit will be reduced.

In the new system, 1 qualified worker, who can use the new cutter, 3 semi-qualified workers for lying activities, 2 workers to help the cutting activity, 2 workers for numbering, 2 workers for packing, 3 unqualified helpers and 1 worker for binding activity will be required. Hence, a total of 14 people will be allocated to the new cutting unit.

Variant D: In the last alternative model, the cost affect of working in two shifts in stead of one is analyzed. The labor cost is doubled in the second shift, but doubling the working hours increases the utilization of all the labors and the machine as the resources of the cutting unit.

4.3 Simulation Results

Technological change that renders existing specialized knowledge obsolete unless knowledge of new technologies can be easily transferred to lower-level managers, decisions involving choices of technology will be centralized. The simulation run length is 300 hours and 18 hours period of time is taken as the warm up period for basis, Variants A, B, and C. The simulation run length is 600 hours for Variant D where shift system is simulated.

The simulation results are summarized in Figure 2 for all models comparing to the initial basis. It seems that the results of Variant B where qualification of workers are increased are better than results of other organization models. In Variant B, the production time has been reduced meanwhile production rate and utilization are increased. On the other hand, the unit cost increases because of higher wage of qualified workers.

In Variant C where new technology cutter is used, it is a noticeable result that the unit cost and utilization are in very low levels. In this organization structure, it is possible to have higher utilization and increased production rate by using qualified workers.

In variant D where shift system production has been applied, the unit cost increases as a result of higher wave of workers of night shifts. Therefore, the rate of wages in the unit cost of a product is considered significant. Whereas, the production rate is not as much as high it is expected. The simulation results show that accumulation of products in the production site is a result of the bottlenecks in some work stations. The possible solution for this problem can be using qualified and productive workers. The production times must be balanced in work stations to obtain a continuous flow in the system. Some line balancing studies are suggested on the system for this purpose.

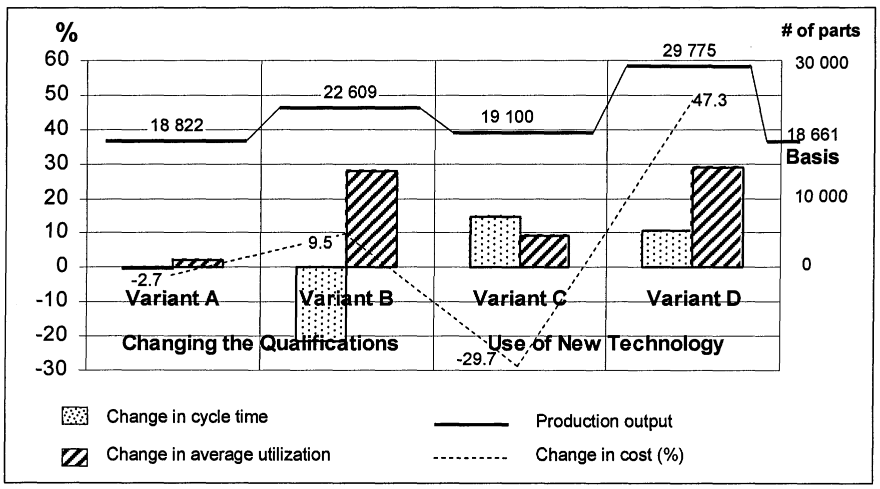

Figure 2 – Simulation results of the studied cases compared to the initial situation

The main issue is to have same qualified worker to work on same work stations for a long time. The location of the company has an important effect on the circulation of workers. The company is located in a city which is one of the popular cities in textile industry in Turkey. Therefore, it is not easy to keep qualified workers in the company for a long time.

5. SUMMARY AND CONCLUSIONS

The cutter system is usually introduced to increase industrial productivity by reducing manufacturing costs, increasing production output or capacity and improving product quality. The introduction of cutter systems can create a reduction in the number of workers, changes in skills and transfers from work locations. The workers who have to move to a less skilled job will fell the effects of cutters systems most directly.

For maximum benefits from the implementation of a new technology such as cutter systems, an understanding of the personnel qualification problems involved is necessary.

For automated cutter systems, there are some differences in the personnel qualifications of prior to cutting preparation flows relative to traditional cutting systems. Therefore, qualified workers are needed for preparation of designed cutting models and to move them to the cutter.

Consequently, the productivity per worker was significantly increased trough the integration of cutting and also less material handling and opportunity for damaging products. There were few options for improving the productivity further through layout changes.

From a people perspective, there was a real scope for improving morale and job satisfaction through cross-training. This could also improve productivity through flexibility.

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