

IMPLEMENTATION OF MODULAR MANUFACTURING IN THE CLOTHING INDUSTRY IN KWAZULU-NATAL: A CASE STUDY

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ABSTRACT

There are many challenges facing the clothing and textile industry in countries worldwide, and South Africa is no exception. Intense competition from both the domestic and international markets is crippling both the clothing and textile industries. However, with a reservoir of experience and expertise within the industry, it could re-establish itself as a forceful industry with an ability to challenge competitors both domestically and internationally through a focus on added value, exceptional quality and the effective application of all resources through technological innovation. One such innovation in the clothing industry in South Africa may be the use of modular manufacturing. Qualitative narrative interview as well as text analysis results on the experiences of individuals through the implementation of modular manufacturing are presented and evaluated as a case study.

OPSOMMING

'n Verskeidenheid uitdagings staar die kleding en tekstiel industrie wereldwyd in die gesig. Suid-Afrika is ook hieraan blootgestel. Intense kompetisie in nasionale en internasionale markte het tans 'n besonder negatiewe uitwerking op die kleding en tekstiel industrie. Daar is egter 'n goeie bron van ervaring en kennis in die bedryf wat kan meehelp om die besondere kompetisie die hoof te bied. Dit kan geskied deur te fokus op toegevoegde waarde uitsonderlike kwaliteit en die effektiewe aanwending van hulpbronne deur tegnologiese innovasie. Een so 'n innovasie in die Suid Afrikaanse kleding industrie kan die aanwending van modulere vervaardiging wees. Kwalitatiewe narratiewe resultate van onderhoude sowel as teks en inhoud analise van die ervarings van werknemers tydens die implementering van modulere vervaardiging word en as 'n gevallestudie aangebied.

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1. INTRODUCTION AND RESEARCH METHODOLOGY

The SA clothing industry shed over 67 000 jobs in the past three years [4]. There is a possibility that more jobs may be shed in Durban (KwaZulu-Natal). The South African clothing industry has diminished in size to form the cut, make and trim (CMT) industries that find it difficult to negotiate wage increases as production costs escalate beyond proportion. If the lay-off of workers continues in the clothing industry, it would increase the unemployment rate, thus impacting on the economy.

Aspects that influence the clothing and textile industry include issues such as mechanisation and automation, research and development, expertise and skills base, quality orientation and, above all, the eradication of import quotas. Other factors influencing the decline in the clothing industry in South Africa include some of the following:

- An inability to adjust to the change in the industry.
- Possible lack of effective performance management and leadership qualities.
- Family-owned businesses which were operated conservatively with low investment and a lack of managerial qualities.
- Lack of knowledge, skills and training strategies in the industry.
- Lack of strategic thinking and positioning.
- A pressurised industry.
- Working in "silos".
- Lack of efficient communication.
- Internal politics within organisations [1].

The research methodology adopted in this investigation included a literature review of available documents on the industry as well as interviews and discussions with organisational staff and leadership in a case study context. This methodology is similar to that recommended by Cooper and Schindler [8].

Research results are presented in an integrated format where data from literature and other available documents are discussed, together with own research data gathered from interviews and questionnaires used in the case study. Text and content analysis [13] are also used to evaluate qualitative narrative data obtained from interview transcripts so as to provide a necessary focus on interpreted narrative data from the modular manufacturing case study. The interpreted narrative results are supplied and discussed to provide a necessary context for the case study data. This narrative data tended to be vague and may seem to be without focus to some, and especially to decision makers. For this purpose a five-point Likert scale is used to transform, for example, verbs, adverbs, nouns and adjectives used in interview transcripts on management research questions into semi-quantitative data. If an adverb or adjective created a very negative response to the text reader, a value of 1 was awarded and, for a largely positive response, a value of 5 was awarded. This positivist research method employed was derived from, for example, work presented by Alexa et al [13] as well as Lacity et al [14].

2. COMPETITIVE POSITION ANALYSIS OF THE CLOTHING INDUSTRY

The following competition context information was obtained during the clothing case study investigation:

- A competitive climate with an atmosphere of dislike among clothing manufacturers.
- Manufacturers were threatened by new entrants into the market.
- There was fear of new and substitute products.
- The bargaining power of suppliers and buyers was extensive.

South African clothing manufacturers face market pressures from both the domestic and the international marketplace in terms of material inputs, garment costs, technology and machinery. New manufacturers entering the current domestic markets are increasing the competitive pressure in the industry [4].

While these issues have an impact on the clothing manufacturing organisations, other factors such as environmental impact, socio-economic factors and government regulations have also impacted on the industry.

2.1 A competitive climate among manufacturers

With a growing number of clothing manufacturers in the domestic markets, the shrinking of larger manufacturers and the relocation of parts of larger organisations to non-metropolitan areas, the climate in the clothing industry in South Africa is very sensitive. The situation worsened due to non-communication among the supply chain. Retailers and manufacturers only sub-contract orders to local manufacturers with whom they have built relationships. The CMT organisations are dependent on the main (larger) organisations for work. There is a struggle

among manufacturers to obtain work from their suppliers as price competition is the determining factor in the placement of orders for manufacture [7].

2.2 The threat of new manufacturers

The clothing industry is susceptible to new entrants setting up facilities on an ongoing basis. This is because start-up capital investment is low and it can be operated from residential premises. Although the garment production industry is easily accessible it is not attractive because of the low rate of pay.

However, with employment and retrenchment on a regular basis, manufacturers tend to exploit the workforce by paying lower wages than those set by the National Bargaining Council for the industry. Machinists are placed in a situation where they have no choice as machining garments is the only skill they have.

The cost of production, the domination of the established, larger organisations and the demand of retailers demoralize the clothing manufacturing industry. The education level of employees in the industry is low and this shows the lack of concern towards improvement in the industry.

2.3 The threat of substitute products

Garment imports are a threat to the domestic market as consumers substitute the domestic product with the import product as it meets the needs of the consumer. The imported product is considered more favourable in terms of cost factor. The retailing industry is moving away from South African products and thus sources the majority of its products from overseas. The South African clothing manufacturers are experiencing low production output and diminishing profit levels as they find it difficult to compete with the cost of imported garments. Previously there was an agreement between China and South Africa to prevent Chinese imports into South Africa [11]. Note however that the quota on Chinese imports has already fallen away two years ago due to interim developments in relations.

2.4 The bargaining power of buyers and suppliers

Retailers are supply chain leaders in the clothing industry. The voice of the clothing manufacturers is suppressed through bargaining power and multiple sourcing approaches of retailers. Christopher [7] mentions that the South African markets changed considerably and thus increased the purchasing power of customers. Retailers are focusing their attention on quality of products, reliability in service delivery, and cost of products as criteria to reduce the number of suppliers.

Retailers are typically using the "play off" tactic against manufacturers to become cost competitive. Demand is volatile and is one of the major problems faced by the clothing industry. This threatens the existence of manufacturers [1].

Retailers focus their strategy towards quick response in an attempt to improve customer satisfaction. There are a limited number of manufacturers who use process improvement strategies in order to meet the demands of the market. Clothing manufacturers and designers who differentiate themselves through the application of strategies in process improvement, cost leadership and design development are able to stay ahead of the competition.

Textile manufacturers that supply the clothing manufacturers are inconsistent in terms of price, quality and delivery. Although most textile mills are situated in close proximity to manufacturers, their fulfilment of orders is poor, which in turn causes a delay in the entire supply chain. A few manufacturers (4%) of a sample taken are sourcing their fabric and other trim materials from China, India, Pakistan and Hong Kong to the detriment of local textile manufacturers [2].

2.5 Uncertainty in the clothing business

There is uncertainty in the entire value chain of clothing manufacture. If a delay is encountered in one area, the entire supply chain is affected. The scheduling of production orders is a complex task and has to be done accurately, using software technology. Understanding the complexity of clothing production enables an organisation to schedule orders accurately, thus determining capacity utilisation.

The garment manufacturer should be able to determine the complexity of the order through the application of work study principles, so that bottlenecks can be avoided. This would improve the utilisation of resources and improve the productivity of the organisation. It is therefore necessary to use the appropriate methodology for the evaluation of job complexity in clothing production in order to meet the demands of the market.

Some problems faced by clothing producers are summarised below:

- Throughput time per unit: The time to complete one unit of production vs. the time to complete the order.
- Inventory between processes: used as buffer stock, machine breakdowns, line balancing. It may extend completion time.
- Critical paths: need to be arranged in parallel or in serial. This could affect the production process.
- Bottleneck operations: need identification for action.
- Plant utilisation: estimates effective use of resources.
- Minimum order size: affects the production process in terms of set-up costs and has a bearing on cost per unit.
- Change-over/setup: the loss of production when there is a style change.
- Rejects and repairs: evaluates capacity lost through repairs and costs lost through rejects [1].

The critical issues in clothing production scheduling are bottlenecks, line balancing, and machine set-ups during changeover and capacity utilisation. These factors require in-depth evaluation when scheduling the production process.

The production planner in the clothing industry is faced with the task of scheduling production, bearing in mind the complexity of styles and fashion. The clothing industry is always grappling with bottleneck operations, critical operations and changeovers, and the work study personnel could assist in correcting these problems. The industry does not typically use software applications to address these issues and relies on experienced personnel in the organisation. Future research could evaluate this and assist in developing such a package that would reduce the impact on the production of garments [1].

2.6 Supply chain time reduction

The sharing of information between the processes (fabric manufacture, fashion design and manufacture, and retailer) in the supply chain would assist in the reduction of time between processes.

Research and development in the design of fashion garments going back into textile production and forward into the retailing industry would enable the projection of orders to be simplified. Thus, effective communication within the supply chain and the sharing of information could stimulate the entire value chain, thus addressing problems, understanding the various value-adding operations and creating an industry that could be more forceful towards external competition [10].

2.7 Throughput time compression

The application of automated machinery in the laying of fabric, and computerized cutting enables a reduction in labour, thus reducing the cost of the cutting operation and enhancing cutting room performance and productivity [10]. This must be weighed against the current cost of labour in the cutting room for a cost-benefit calculation.

If there is communication through computer-aided technology between design and cutting, this would further enhance the operation in the cutting room. Automation in the cutting room could assist in the reduction of problems experienced with striped or checked fabric and of eliminating imperfections in the fabric [10].

One of the issues that the automation of the cutting process experience is that the laying procedure does not identify non-conformances in the fabric. This could be addressed and rectified by the textile manufacturers during the weaving process. If this is not feasible, the remaining processes in textile manufacture, namely the washing/printing phase, the dyeing process and finally inspection using special machinery such as a photo-spectrometer, would assist in identifying fabric flaws, which could be rectified.

Process improvements could also be made in the machining and pressing departments in clothing manufacture. There are advanced machine technologies that are programmable, fully automated machinery that could assist in reducing the time of the machining process. The latest technological developments have machinery that could perform a number of sewing operations with minimal human interference [5].

There is advanced technology in the ironing department as well. There are automated pressers that reduce the number of operations, thus reducing the time of pressing.

Thus the entire supply chain could use machinery that would be able to reduce the time of production of garments but need to apply the latest technology, not forgetting the fundamental methodology of process improvements. The improvement process addresses the quality of production, reduces the risk of accidents by reducing fatigue of operators, and focuses on the competitive position of organisations [1].

3. CONCEPT OF MODULAR MANUFACTURING

Modular manufacturing was the “buzzword” during the early 2000s and the latest technology as an innovation that could improve performance in the clothing industry, especially for short production runs of fashion items. Another aspect of the methodology is that operators could sit/stand during the sewing operation, thereby enhancing teamwork, quality and output. It is based on self-managed teams in the production of garments. Production is organised in a synchronized manner that eases the flow of production through the various processes. To accomplish efficient performance, standard times are determined using work study principles for all operations. Workloads are distributed such that each activity has an approximate equal amount of work to balance the line of production efficiently.

The most important aspect of modular manufacturing is team members’ culture and attitude, with a high focus on understanding of improvement techniques applied in the industry. This allows operators to work as a family to attain high performance and productivity levels [16].

The concept requires the commitment of top management and an understanding of the dynamics of the concept. Without an understanding, the project could lead to failure. Finally, the choice of participants of the trial implementation of cellular or modular manufacturing is a critical factor that may determine the success or failure of the operation. It is advisable to start such a process with in-depth planning and a trial run to determine the strengths and weaknesses of modular manufacturing. The concepts of team-working, cellular/modular manufacturing are used interchangeably. The concept enforces the principles of team effort, performance improvement, total quality management and just-in-time (JIT) production. The concept further creates an atmosphere of belonging and a spirit of working together towards the achievement of organisational objectives. These concepts are also illustrated by Kalaoğlu et al [16] in their simulation of productivity of modular manufacturing in the clothing industry. Elements supporting some of the discussions on modular or cellular manufacturing in the following subsections may be found in [16] [17] [18] and [19].

3.1 Prerequisites for modular manufacturing

The planning stage of modular manufacturing implementation is of utmost importance as it is a dynamic change from the normal line operation. The planning should be done in stages so that information is gathered on the feasibility of the change.

3.2 Selection and recruitment of team members

The recruitment of team members is a crucial stage in the development of a module or cell. Members of the team are generally recruited within the organisation from areas such as the training school or from within the production line. Management needs to select members of the team that work effectively together. In general this sort of recruitment is regarded as desirable once a modular system is firmly established.

3.3 How much participation should be permitted?

In modular manufacturing, teams are generally self-directed and have a degree of autonomy. For example, when a new clothing style is introduced the company would provide the operations in sequence, but if the team suggests a better way of constructing the garment, they are allowed to put their ideas into practice. Where suggestions are made and implemented, it enables people to take ownership and pride in their work.

3.4 Planning for modular manufacturing

Successful implementation demands careful planning. Figure 1 shows a typical layout plan of a cell for modular manufacturing with ten operations. Inputs into the process start at operation 1(IN) and move within the cell until the garment is complete (OUT).

The matrix in Table 5 provides a typical guide plan as to the allocation of tasks to the various operators and helps to provide a balance in the content of the tasks allocated. The operations are listed horizontally and allocated to operators vertically. As an example, operator A would perform operation 2 and 3. It is important that operators

are multi-skilled in order to perform more than one operation within the modular manufacturing cell. This basic approach to modular manufacturing was used in a case study described in the next section.

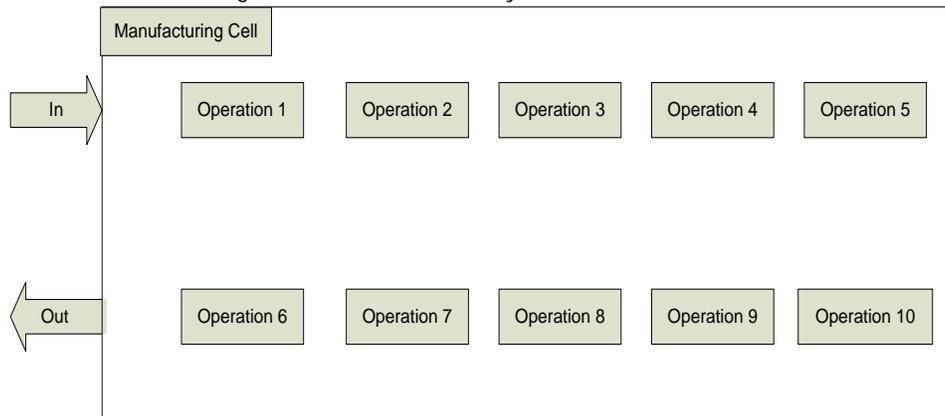


Figure 1: The layout of cellular/modular manufacturing

Operative Operation	A	B	C	D	E	F	G	H
1							■	
2	■							
3	■	■						
4		■	■	■				
5		■	■	■	■			
6			■	■	■	■		
7					■	■		
8						■		
9						■	■	■
10								■

Table 1: Skills Matrix: Guide plan

4. CASE STUDY HISTORY AND CONTEXT

A qualitative case study research approach is used in the evaluation of this implementation of modular manufacturing in the clothing industry in KwaZulu-Natal. The case study production facility manufactures men's and ladies' fashion wear and operates in a small town in KwaZulu-Natal. Currently, approximately 300 people work in the plant. The factory opened in 1970 and implemented modern technology for that era. The facility had 16 supervisors and a plant manager.

The plant manager agreed to perform a pilot project on team-based cellular manufacturing as orders of 100 units were received. The sewing department reverted to the bundle system due to larger orders. Due to the inconsistency in the order sizes the organisation abandoned the Eton system (overhead rail system) and reverted to the bundle system of manufacture. The plant followed conventional management practices before the 1980s but started changing as new management came on board. There was very little interaction among employees and management and there was an autocratic style of management.

Before the year 2000 the production facility was accustomed to lot sizes of between 2000 and 10000 units per order. Currently, there are lot sizes of approximately 100 units per order. The garments were previously not as complex in construction as the ones received currently. The factory was flooded with high lots of work-in-process

throughout the plant. Employees who were loyal and had been employed for the last 30 years said that the environment in which they worked was hostile and they had done the same operation for several years.

5. RESULTS AND DISCUSSION

As the research methodology was exploratory [8] and aimed at making people feel comfortable with the pilot study and not be daunted by completing exhaustive questionnaires, this section provides a qualitative narrative discussion of the experiences of the people involved in the implementation of the current modular manufacturing. Names have been changed to protect confidentiality. This section represents the summarized interpreted narrative results of views of 10 interviewees. The interviewees felt that Management Commitment and Education/Training are the most important aspects of any initiative in the organisation.

Results obtained with text and content analysis of transcripts represents the qualitative opinion of one analyst of transcripts of interviewees' comments for illustrative purposes. To be more objective one may employ the average of a number of readers of the text. Some examples of transcript of an employee's narrative comments that have been content and text analysed are as follows:

- *Any project has to have the "blessings" of management and the buy-in from employees for it to be successful. The manufacturing and managing director of the organisation initiates the process of change as money in terms of labour is involved. Sometimes it can go into thousands of rands, but we must be able to see the benefits.*
- *It must add value to our organization as you know that the clothing industry is in dire straits at present and we would like to be the best.*
- *Roy was the key driver in securing management commitment.*

More detailed information on transcripts may be obtained from the doctoral thesis of Ramdass [15].

The following issues identified as important during implementation of modular manufacturing were addressed during the case study interviews. Qualitative interpreted narrative results are generally provided and discussed first and then followed by some text analysis results of narrative results.

5.1 Management commitment

Any change in the organisation stems from top management. Commitment from management drives the process of change and nothing can be achieved if management does not support the initiative. Once management gives their approval any change is possible, but employees need to understand and support the changes for it to be successful.

Management realised that in order to counteract the threat of imports they would try out the team-working concept although employees wished for "the good old days." They could not afford excessive piles of inventory on the machine floor. Employees were delighted that the plant manager supported the initiative and frequently visited to find out how they were performing. An employee of the team briefly summarized how he felt and mentioned that any project has to have the support of management and the acceptance from employees for it to be successful. The managing director of the organisation initiated the process of change as funding in terms of labour is involved. Support from management, especially in terms of funding, is important for a project of this nature.

The planning, organising, leading and controlling of the pilot project are important as it would benefit the organisation over a period of time. The clothing industry is in need of radical change that would be able to counteract the competition faced. Employees were thankful that they had commitment and the necessary expertise from the management team.

Figure 2 provides results of a Qualitative Text Analysis for Management Commitment in implementation of modular manufacturing obtained from interview transcripts such as the one mentioned above. 1 indicates acceptance with commitment and 5 indicates excitement with commitment. A mean value of 3.5 with standard deviation of 1.5 determined by text analysis indicates relatively positive appraisal of Management Commitment for the modular manufacturing implementation by the interviewees.

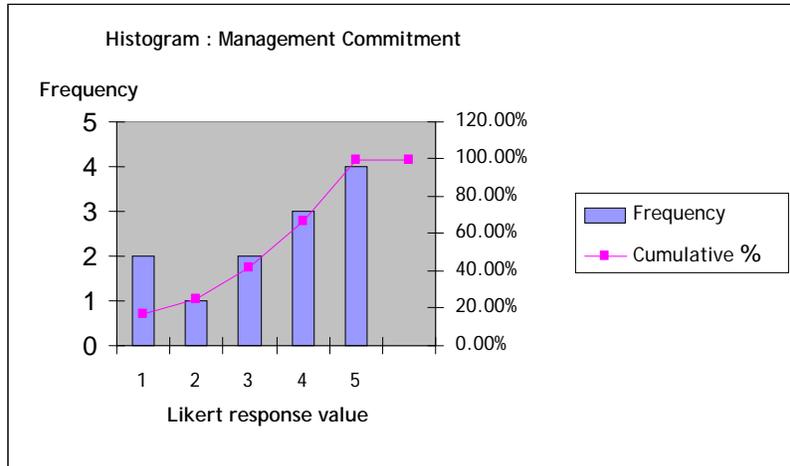


Figure 2: Qualitative text analysis - management commitment

5.2 Education and training

A number of training sessions were held with the team of employees to provide orientation with the objectives of the pilot project. Employees held discussions regarding their concerns so that everybody understood their role in the project. The researcher explained that this was a pilot project for the purpose of adding value to the organisation and if it did not work, they would go back to the assembly line system using the bundle system methodology.

The organisation invested in training and development of employees on an ongoing basis. It was mentioned that training of employees in the latest developments would enhance employee skills and workers would embrace changes in future. Another employee's experiences was that people would be willing to change if they knew what the change was all about and how it would impact on their work. Mention was made that employee involvement from the very outset would clear any negativity that may be spread through the grapevine within the organisation. It was said that management discussions behind closed doors regarding changes are unhealthy for an organisation. Open communication and the building of trust among the people are extremely important.

An employee mentioned that learning can only take place by change in attitude and behaviour. She mentioned that training makes employees aware of the current occurrences, what employees should expect and the manner in which barriers could be reduced. This is a great motivator for the workforce.

Employees were enlightened on the benefits of teamwork and how it could change the entire organisation. An employee mentioned that training made them understand the current status in the clothing industry and how they could rise above the competition. It was mentioned that they are setting an example for the industry to follow and they could be the best manufacturer in the clothing industry. The advantages they experienced created team spirit and they found that they were responsible for the making this project a success.

Another employee mentioned that the concept would be ineffective and that government intervention was the only way that the industry could be saved. The researcher interacted with the individual and convinced him of the way forward.

The employee admitted that he was sceptical and did not want change, but since there was communication with management and training of workers, he would "go with the flow." The comments suggest that a project such as this needs education, training, communication and management support.

Open communication is important in a project. The sharing of information between management and employees enhances the success of the project. It was mentioned that the dissemination of too much information and the interpretation of the information could cause problems within the work environment. The "grapevine" misinterprets information and employees become despondent. It was mentioned that 15 years ago operators were not allowed to speak and at present communication is encouraged in teamwork [12].

An employee mentioned that this was quite a change for them. It was mentioned that approximately 15 years ago the floor manager had an elevated office at a centralised point on the machine floor where there was a clear view of all employees. Management by walk about (MBWA) has become a prominent feature in the clothing industry. It was mentioned that the manager should be a part of the team on the production floor, know the employees by name and understand the problems experienced. Much could be achieved if team work is implemented throughout the organisation and all employees strive to achieve the mission and vision of the organisation. Human assets need to be appreciated to enhance their motivational level. Working together could “change a mountain into a molehill,” as mentioned by an employee.

It was mentioned that employees were often ignored and management made all the decisions. Issues such as product quality, customer expectations and productivity were never disclosed to employees. A motivated workforce can achieve labour efficiency without the pressure from management. It was explained that communication among the employees and management improved quality of production and an empowered employee could definitely add value to the organisation, no matter what problems were faced.

It was mentioned that customer focus and expectations, together with quality and on-time delivery is an organisational problem, and not only the responsibility of the floor managers. The team effort created a change in the working climate with information sharing that enables employees to better understand the operational aspects of an organisation.

The implementation process outcome indicates that active employee participation with knowledge sharing could improve the performance of the organisation. Sharing information about the costs that go into production and the financial position of the organisation makes employees understand the importance of “right the first time, every time.” With work study officers involved in the process, all work measurement and method study evaluations were done with the team that shared ideas on methods and ergonomics. With the adoption of transparency in all activities employees understood their situation and that of the organisation.

Figure 3 provides results of a Qualitative Text Analysis for Education and Training in modular manufacturing from interview transcripts. 1 indicates acceptance, and 5 indicates excitement with the concept. A mean value of 3 with standard deviation of 1.22 determined by text analysis indicates relatively average appraisal of Education and Training commitment and activities for the modular manufacturing implementation experienced by the interviewees. This is also substantiated by the qualitative discussions on the topic provided previously in this section.

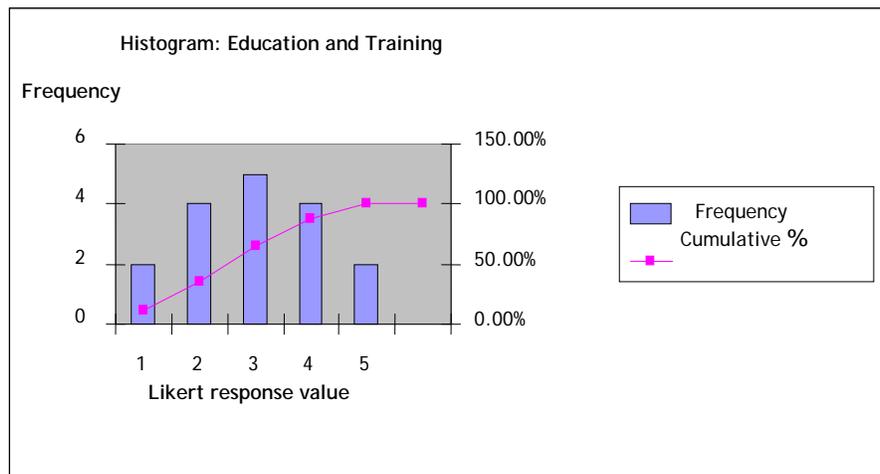


Figure 3: Qualitative text analysis: Education and training

5.3 Benefits of the new system

Encouraging results were achieved with a participative management style. On a general note, the sharing of information created a positive atmosphere. Due to the fact that this was a learning curve for the purposes of the research, some of the benefits did not materialize. The ability of the employees to multi-skill helped overcome the effects of absenteeism. Employees, who normally sat at their machines for the entire day with one task, were

now given the opportunity to teach and learn from others to resolve problems and become efficient team players. This was a challenging task.

The organisation benefited overall as the productivity of the line improved by 10%, while labour efficiency improved by 15% and the morale of the employees improved with education, training, open communication and above all, being treated with dignity. Absenteeism had minimal effect on the cell, and employees going on a personal break were supported by the team.

The changing of jobs created better efficiency as operators became attuned to multi-tasking with a reduction in boredom as operators normally performed the same task for many years. It was, in a sense, a revival of energy that was experienced during the project.

It was mentioned that modular manufacturing produced the garment quicker, with no work in progress. There was an improvement in the visibility of tasks and operators, as there was minimal work in progress (approximately two units per operator). The team approach seemed to push the garments faster. It enabled operators to respond to customer requirements much quicker. Work in progress has been reduced from a week to a day. People were taking responsibility for their processes as there were no rejects as the team ensured quality at each stage. Education and training improved the morale of the team with an improved output performance. Indirect labour was eliminated as members performed both direct and indirect operations. Supervision among team players was reduced as each member took ownership of the performance of the group.

Figure 4 provides results of a Qualitative Text Analysis for Benefits of Modular Manufacturing from interview transcripts. 1 indicates few and 5 indicates many. A mean value of 3.45 with standard deviation of 1.04 determined by text analysis indicates a relatively large number of benefits for the modular manufacturing implementation experienced by the interviewees. This corroborates with the qualitative discussion on benefits experienced as provided previously in this section.

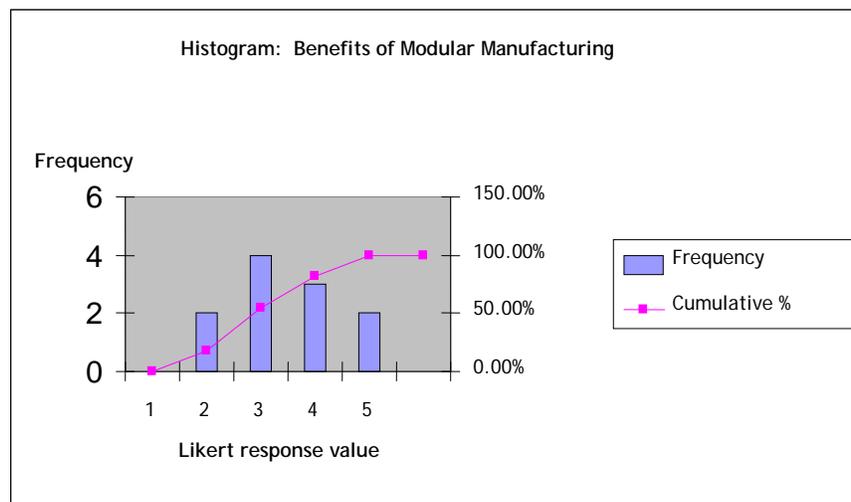


Figure 4: Qualitative text analysis: Benefits of modular manufacturing

5.4 Complaints about the new system

There were many challenges for the new system. Two employees complained and seemed to be negative about the system saying that they did not like moving around and were used to sitting in one place and working and did not like change. The concerns revolved around the following issues:

- multi-skills, education and training;
- team understanding and formation; and
- payment systems.

Figure 5 provides results of a Qualitative Text Analysis for Complaints of Modular Manufacturing from interview transcripts. 1 indicates few and 5 indicates many. A mean value of 3.5 with standard deviation of 1.31 determined

by text analysis indicates a relatively large number of complaints on activities for the modular manufacturing implementation experienced by the interviewees.

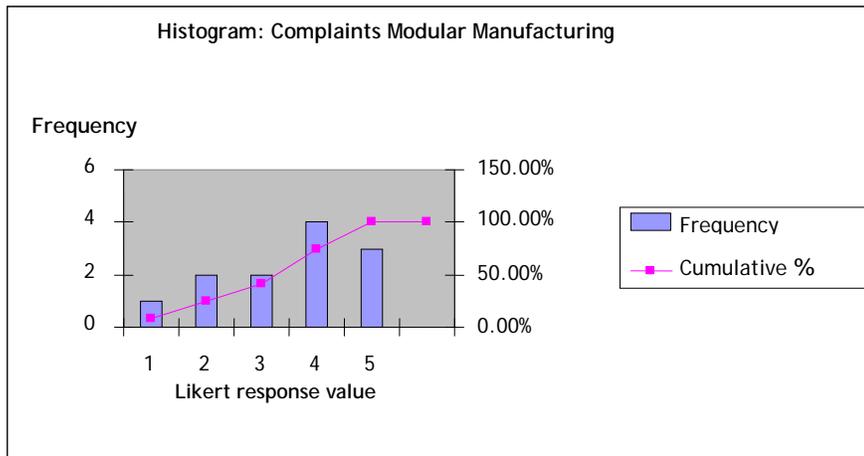


Figure 5: Qualitative text analysis: Complaints of modular manufacturing

5.5 Multi-skills, education and training

This was a drastic change from the norm as employees had not experienced change for a decade and preferred remaining in a comfort zone. Therefore ongoing training on innovative business processes is imperative for an organisation. The concept of teamwork (modular/cell manufacturing) was developed over 50 years ago, and operators in this plant were never exposed to it. It was mentioned that in order for employees to accept change, there needs to be open communication among employees with the required education and training.

5.6 Team understanding and formation

The composition of the team is of the utmost importance. Members need to understand each other, especially with regards to diversity. Therefore, team members need to be thoroughly interviewed to determine whether they fit into teams. A series of education and training sessions is required to create an understanding of the dynamics of team work. Personality clashes should be avoided, and should there be a problem, it needs to be addressed immediately [6].

5.7 Payment systems

The rate of pay of machinists is a contentious issue. Employees were willing to go through the training but wanted a higher rate of pay. Team members felt that they were not rewarded for their input.

6. RECOMMENDATIONS

Strategic focus for manufacturing excellence

The objective of the strategy for manufacturing excellence is based on three important variables, namely the improvement of quality production, cost and delivery through the application of several elements. Waller [19] Defines "quality as the development of customer closeness where the workforce understands customer requirements and aims to fulfil these requirements." The researcher concurs with [19] and considers the approach valuable for the improvement of modular manufacturing for the clothing industry. The points below provide a holistic approach to the strategic focus of organisations in order to excel in the manufacturing environment.

The organisation should develop a management approach that practices open and a participative management style that supports innovation. Achievable goals need to be set and measured against industry standards. A thorough understanding of production processes and capabilities are essential for effective performance. Barriers between departments should be removed in order to achieve optimal customer satisfaction across functional boundaries. Managers and engineers need to be seen regularly on the production line and there should be face-to-face communication on critical issues.

The organisation should institute a manufacturing strategy with a clear vision and mission with a long-term plan that is understood by everyone. There should be a philosophy of continuous improvement of

manufacturing operations that embrace globalisation and the impact on the organisation. The organisation needs to create a plan of action through the involvement of stakeholders in the decision-making process and examine strategies on a regular basis. Flatter structures would enable effective communication and the elimination of "silos" and encourage team-work between departments.

The organisation needs to adopt quality management principles in product, delivery and service in all operations and create operations that are adaptable to customer needs. Operations should be engineered towards the elimination of non-conformances.

In order to preserve the environment, the organisation needs to eliminate harm to the environment by determining the impact of processes. The organisation should align the performance measurement system in all contexts to the organisation's strategic objectives.

Employees should be empowered to strive for the accomplishment of the organisations goals. A rapport should be created between management and employees by instituting coaching and mentoring, the promotion of team development, team problem solving and team performance rewards. This would enhance the creation of an enabling environment where change is embraced and fosters the development for continuous improvement and strategise the organisation towards technological advancement in order to improve quality, cost and delivery.

7. CONCLUSION

The modular manufacturing case study implementation was perceived by most of the employees interviewed in this case study as being superior to the traditional bundle system used in the clothing industry in the specific area of Kwa-Zulu Natal. This management approach for the clothing industry in South Africa may not work for all companies, but for many it has proved feasible. Using the case study approach, this research provides insight about key components in the transition to a team system used in modular manufacturing. One of the keys to success in this clothing manufacturing plant was having upper level managers committed to the team system because it takes a great deal of time and financial resources in the beginning and it does not happen without careful planning.

In addition, employees attributed the success of the transition to the plant manager. The manager not only harnessed the potential of the skills of the team, but empowered them to manage themselves. A successful organisation harnesses the potential of its workforce through open communication and the breakdown of barriers that prevent effective performance according to Basdeo [3].

The results from this case study indicate some elements that had a positive contribution in a qualitative sense on the implementation of modular manufacturing in the South African clothing industry. Key elements to note are management commitment, education and training and leadership that drive the organisation towards the attainment of organisational goals. The attempt at a qualitative text analysis of interview transcripts leads to statistical results that concur with the positive views on the team system expressed in this article. It is thus also concluded that text analysis may be a useful tool to analyse narrative results from interviews for decision making purposes.

8. REFERENCES

- [1] Adewole, A. 2005. 'Developing a strategic framework for the efficient optimization of information in the supply chains of the UK clothing manufacture industry', *Supply Chain Management: An International Journal*, 10(5), pp. 357-366.
- [2] Barnes, J. et al. 2004. *An analysis of the MIDP's contribution to the success of the South African automotive industry - Policy lessons for the clothing, textile and paper and paper products industry*, NPI Research Report.
- [3] Basdeo, S. 2005-8. Clothing industry consultant, Kwa-Zulu Natal. sonnybasdeo@telkomsa.net.
- [4] Bell, T. 2006. *Clothing chains wail over quotas is hypocrisy*, SA Media, University of the Free State.
- [5] Brown, S. 1996. *Strategic manufacturing for competitive advantage - transforming operations from shop floor to strategy*. Prentice Hall, New York.
- [6] Buxey, G. 2005. 'Globalisation and manufacturing strategy in the TCF industry', *International Journal of Operations Management*, MCB University Press 25(2).

- [7] Christopher, M. et al. 2004. 'Creating agile supply chains in the fashion industry', *International Journal of Retail and Distribution Management*, 32(8).
- [8] Cooper, D.R. & Schindler, P. 2006. *Business research methods*, McGraw-Hill. New York.
- [9] Esset, A. 2003. *The impact of trade liberalisation on workers in the textile industry*, Ecumenical Service for Socio-Economic Transformation/Economic Policy Institute/ KHIB Women's Centre, SA Media. University of Free State.
- [10] Forza, C & Vinelli, A. 2000. Time compression in production and distribution within the textile-apparel chain, *Integrated Manufacturing Systems*, MCB University Press. 11(2).
- [11] Inggs, M. 2007. *Clothing retailers seek an alternative to China*, SA Media, University of the Free State.
- [12] Van Staden, E. et al. 2007. *Corporate communication—getting the message across in business*, 2nd edition. Van Schaik, Pretoria.
- [13] Lacity, M.C. & Janson, M.A. 1994. 'Understanding qualitative data: a framework of text analysis methods', *Journal of Management Information Systems*, 11(2), pp. 137-155.
- [14] Ramdass, K. 2008. 'An engineering management framework for the SA clothing industry with a focus on Kwa-Zulu Natal', PhD thesis, University of Johannesburg.
- [15] Castro, W.A.S., Castro, R.C., Miro´n, S.I., Marti´nez, P.U.A. 2004. 'Modular manufacturing: an alternative to improve the competitiveness in the clothing industry', *International Journal of Clothing Science and Technology*. 16(3), pp.301-309, MCB University Press.
- [16] Kalaođlu, F. & Saricam, C. 2007, 'Analysis of modular manufacturing system in clothing industry by using simulation', *Fibres & Textiles in Eastern Europe* July / September, 15(3), pp. 93-96.
- [17] Warnock, I. 1996. *Manufacturing and business excellence strategies, techniques and technology*, 1st edition, Prentice-Hall, Europe.
- [18] Waller, D.L. 1999. *Operations management: a supply chain approach*, 1st edn, International Thompson Business Press, London.