# Cutting room management system economics essay

In today's highly competitive global market, manufacturers face constant pressure to reduce costs, offer greater product selection, and deliver products faster. Like many domestic manufacturers competing in today's international marketplace, the apparel industry has been forced to upgrade its responsiveness to customer needs. As a result, smaller orders are placed in a more dynamic fashion, requiring the efficient production of smaller lot sizes. Effective and economical production thus depends upon the interaction of many system components, one of the most critical being an efficient workflow control system.

The cutting room maintains documents and books for the various cutting operations they perform. Generally the books and registers they maintain are require a lot of manual entries and the timely retrieval of previous records is a problem as these records are very vast.

The focus of this project is on the means employed by the cutting room manager to instruct, monitor and control the processing of fabric cutting room and personnel. Documentation during and after cutting is designed to authorize the issuing of materials from store , control the spreading, cutting and bundling activities, facilitate the analysis of losses and quantify losses against costed values.

Cutting room is constantly challenged to cut costs on material usage. A small percentage of fabric saved during cutting can reflect a decent savings in the financial records of the company. The Marker making solutions are used constantly to minimize fabric usage while making markers. Another area where cost cutting can be done is by making an effective cut plan. An effective cut plan will make sure that garments are cut within the limits of the accepted quantity (as 5% extra delivery is allowed by the buyer against ordered goods), the required quantities are cut with minimum number of cuts (saving labor & time).

In most apparel industries, size mix i. e. how many and which sizes should be combined, in a marker is actually a very complex set of permutation & combination. The number of variables & possible combinations in most cutting problems exceeds human abilities.

This projects aims to defining a system for effective management of cutting room and at the same time connecting it to fabric inventory so that track of the fabric in inventory can be made as most of the times the roll wise information of the fabric in inventory is not known and fabric issue is not made against a cutting instruction. Most of the time the fabric sent from fabric store is more than actual requirement of cutting instruction for a particular day so effective track of the consumption of fabric is not made in case there is no provision of returns of excess from cutting room. So designing of the system for effective flow is a need.

## OBJECTIVE

To design a system which manages the activities that happen in a cutting room. The system should represent a model of cutting room and activities are recorded into the system.

## SUB OBJECTIVES

The system is to be connected to the fabric inventory or database thereby maintaining record of each roll which is fed for cutting.

To generate roll allocation plan for the cutting schedule to minimize remnants.

To issue fabric against a cutting instruction.

Proper Roll allocation & comparing the actual material requirement for a production order against the roll in the inventory.

Effective management of end bits form of end bits, minimizing it & also tracking end bits. Storing and keep record of the remnants generated in the cutting room after the spreading and making them available for further use.

Generating of effective reports from the cutting room.

## REVIEW OF LITERATURE

Cut your losses: practical tips to improve fabric yield in the cutting room.

Fabric accounts for 25-40 per cent of the cost of making a garment, so controlling or negotiating fabric consumption has a significant impact on the bottom line. In this article Robert Broadhead addresses the process of estimating fabric yields, the complications involved in offshore contracting, and how to be as accurate as possible in predicting/negotiating fabric costs.

Fabric accounts for 25-40 per cent of the cost of manufacturing a garment, so accuracy in this area is critical. It's been said a lot over the years, but is worth repeating here: no other single refinement in production can provide substantial cost savings as easily as fabric control.

Controlling or negotiating fabric costs has become more complicated as overseas manufacturing and cut-make-trim (CMT)/package programs have grown. Before work went offshore, in-house fabric yield estimates and final production consumption reflected the efforts of the cutting department (either the manufacturer's or a local contractor's) and was readily known and monitored.

However, it is surprising that many businesses do not track the variance between the actual cost of fabric at the end of production and the estimated cost of fabric on the bill of materials. This can significantly impact the bottom line.

To have a truly effective material utilization, one need to look at all the factors that can contribute to fabric losses in cutting room. It would be impossible to eliminate all losses in the cutting room, but incremental improvements in material utilization could significantly improve the bottom line.

Width Utilization – careful measurement of the actual fabric received at a factory typically will show that more than 50% is at least ½ inch to 1 inch wider than the minimum purchased width. This excess fabric width almost always goes into the trash – yet it is usable and, if utilized properly, can save money. It requires the following actions:

Measure the width of & sort fabric when it is received. .

Plan markers by fabric width.

Issue cutting orders by fabric width.

Marker & Marker copies – while copying the marker, regardless of the process used, length and/or width growth or shrinkage can occur. Marker growth can be more than 2% in extreme cases, but can be reduced to less than ½ % with proper machine adjustment. Following points should be taken care of for accurate marker & marker copies:

In case of computer plotted original makers, keep the marker paper & the plotting of the marker in the same environment where the cloth will be cut.

Maintain a check marker, plot it at least once a week, & measure it accurately to do the required adjustments.

While using the ammonia or alcohol method, allow the marker copy to air dry, laid flat for 2-3 hrs, before using I to mark the table.

Spread planning – It is an analysis of the rolls of fabric available to be spread on existing sectional markers. The result is a plan of how many pairs/plies from each roll should be placed on each marker to minimize remnants. The requirements of this type of system to work properly are:

Three or more marker plus remnant marker must be used on each cutting order.

The markers must be different in lengths.

Fabric flaw cutouts will require recalculation of the remaining fabric roll& a resulting change in the spreading chart.

The remnant marker is newly included in the chart calculations. It only is used for remnants remaining from the main sections.

Table Marking – More fabric is wasted in marking the table than in any other aspect of the spreading process. Tables constantly are being marked for spreading where unnecessary gaps are allowed between markers, start/finish line are purposely moved outward and splice marks are elongated. It is strongly urged that markers be prepared off-line by taping the individual marker sections together line-on-line with wide adhesive tape.

End Bit Monitoring

An end bit is a piece of cloth that is longer than the length required to lay up one

complete size. End bits of course will come in all different lengths, and unless you

‘ splice’ there will be pieces of fabric which are shorter than the length of the lay being

layed, these pieces should be treated with great respect. They should be measured, have a

sticky label attached with the length on it, and then folded and put into piles of similar length to be used on smaller markers later. There is no point in keeping fabric for panel

replacement unless there are important reasons to do so, so one must produce garments

from all of the available fabric. The ‘ off cuts’ (pieces too small to make a garment) will

be used to replace smaller parts of the garments that need replacement. The logic behind

this is that if a large panel in a garment is replced then all of the profit on that garment is lost.

Cut order planning – The dot com way stitchworld

It is interesting to note that ‘ size mix’ (how many & what size in combined) in a marker is a mind boggling permutation & computation but actually decided by the CAD operator or “ cutting master” hypothetically and not through any scientific process.

Generally the ‘ size mix’ & marker combinations (how many different types of markers are needed for a given order quantity) are generated based on factors like size & color ratio. There are some infrastructural constraints like lay height, lay length, & working out the most optimum cut plan

There are many optimal Cut Plan solutions, induced by interplay of many dimensions. The different, but often conflicting, dimensions are:

Less Fabric – Maximizing the extreme size-mixing. This is emphasized upon when the order quantity is high & the fabric is also expensive.

Less Labor & Time – Minimizing the no. of lays, leading to saving in spreading cost.

Fewer Markers – Minimizing distinct ratio, i. e. minimizing the no. of markers to be prepared. This is especially useful when one need to commit constant no. of sewing machines & workmen for order completion.

More Balanced Production – Minimizing deviation in layer height across lays. This needs to be done when the order quantity is low & the time & cost involved in marker making process is more compared to spreading & cutting.

More Balanced Packing – Simultaneous production of garments of all sizes. At times of urgency, interim lots can be sent to the purchaser without waiting till the whole order complete.

Heuristics Algorithm

The term heuristic is used for algorithms which find solutions among all possible ones, but they do not guarantee that the best will be found, therefore they may be considered as approximately and not accurate algorithms. These algorithms,

usually find a solution close to the best one and they find it fast and easily. Sometimes these algorithms can be accurate, that is they actually find the best solution, but the algorithm is still called heuristic until this best solution is proven to be the best. The method used from a heuristic algorithm is one of the known methods, such as greediness, but in order to be easy and fast the algorithm ignores or even suppresses some of the problem's demands. ( http://students. ceid. upatras)

## Alternative formulations for layout problems in garment industry

Before cutting, several layers of cloth are put on a cutting table and several templates, indicating how to cut all material for a specific size, are fixed on top of the stack. The problem consists of finding good combinations of templates and the associated height of the stack of cloth to satisfy demand while minimizing total excess production. considering high fashion clothing which is made by specialized designers in small quantities. It is sold only in exclusive shops. Typically, extremely expensive fabrics are used. The high cost together with the limited demand make it worthwhile to produce with minimal excess production, which is defined as the number of pieces which are produced above demand. Before production, demand data is gathered both from placed orders and forecasts. A demand set for a specific piece of clothing is composed of the demands for all the different sizes. The cloth is spread out in several layers on a cutting table. The number of layers of cloth is limited by the length of the knives and the thickness of the cloth. For each size a stencil or template is made where all the different parts of the article are placed in the most economic way, such that they can be cut with minimal loss of exclusive fabric A good overview of solution approaches forgenerating good stencils can be found in Dowsland and Dowsland (1995). An application of the apparel trim placement problem is described by Grinde and Daniels (1999). After the spreading, the selected stencils are fixed on top The number of stencils which can be cut in the same operation is limited by the length of the cutting table. Since all the stencils have approximately the same length, the maximal number of stencils on the table is independent of the combination of the stencils used. A feasible combination of stencils is called a cutting pattern. It is quite possible that such a pattern contains several times the same stencil. After the cloth is spread on the table and the stencils are fixed on top, the cutting operation can start. For these high fashion and very expensive garments, spreading of the cloth, fixing of the stencils and cutting are time consuming and costly operations. Consequently we want to keep them at a minimum. The problem is now to find cutting patterns and associated stack heights which minimize total excess production for a given demand.

The original layout problem is very similar to the fixed charge cutting stock problem (FCCSP). Haessler (1975) and Farley and Richardson (1984) proposed heuristics for solving FCCSP. However, the second part of the objectivefunction is different. In the FCCSP, the cost of trim loss is minimized, whereas we minimize the cost of overproduction. We need to stress that for our low-demand, high fashion clothing the cost of being near optimal, i. e. too much overproduction, can be very high, whereas for the high demand clothing industry this is not so much a problem. This cost issue, together with the fact that we are dealing with real life problems, justifies our search for better optimal solutions. Farley (1988) described a planning model for a cutting stock problem in the clothing industry. He argues that this problem differs from the traditional cutting stock problem because of the unique characteristics of the production process such as the laying, stacking, cutting and sewing operations. Farley also makes an explicit distinction between high-turnover garment, for which overproduction and stock is allowable, and high fashion clothing, for which stock and overproduction should be kept at a minimum. He noticed that the planning model he described is effective for high turnover garment, but not for the made-to-order garments because too much oversupply is generated. The model proposed here is explicitly focused on the high fashion clothing with little demand. Farley's model maximizes the total contribution margin and takes into account demand and capacity constraints. It is used as a planning tool but it cannot be used for solving our scheduling problem. A problem closely related to this is the cut order planning (COP) for apparel manufacturing, described by Jacobs-Blecha et al. (1998). The problem consists of finding how to spread the fabric, determining how many layers to use and assigning various sizes to sections of the spread. The underlying assumptions, however, are not the same as those here and hence a direct comparison is not possible. COP allows for example different stack heights on one cutting table. The authors adopt a minimal cost approach. They consider the actual fabric cost, spreading cost, cutting cost and the marker making cost. The following constraints are taken into account: demand, a limit on the table length and an upper bound on the ply height. As it is very difficult to solve their model optimally, they resort to heuristics. Their test data consist of 20 orders, with 1-6 sizes per order and are based on real life problems. They conclude that one of their heuristics is as good as or better than the commercial packages. Elomri et al. (1994) also consider a cutting problem in the clothing industry. Their problem consists in choosing cutting patterns and associated heights from a small library of available patterns. The objective is to minimize total operating costs while satisfying demand. A linear approximation of the cost function is used. The most important costs in the objective are the costs for cutting and fabric.

## Documentation and control of fabric usage.

The cutting room maintains documents and books for the various cutting operations they perform. Generally the books and registers they maintain are require a lot of manual entries and the timely retrieval of previous records is a problem as these records are very vast.

The focus on the means employed by the cutting room manager to instruct, monitor and control the processing of fabric cutting room and personnel. Documentation during and after cutting is designed to authorize the issuing of materials from store , control the spreading, cutting and bundling activities, facilitate the analysis of losses and quantify losses against costed values.

The large contracts are divide into small but economic batch sizes that are suitable for the processing in cutting rooms. The details of these individual batches are entered on a cutting instruction , which authorizes the issue of fabric and provides essential information for the spreading and cutting. While the cutting instruction accompanies the material during its passage through the cutting room, the situation is monitored by entering data on the cutting instruction record.

Management must control both the output of the cutting room, to achieve production targets, and also the various processes to ensure that materials are efficiently used. The fabric reconciliation record provides a comparison of the actual usage and costed usage and reports variances. This forms link between the cutting room activities and financial control projections as materials compromise approximately 40% of the manufacturing costs , should be regarded as vitally important.

Cutting Instruction is the main documentary output of cut order planning process. As a minimum requirement of cutting instruction it should have the following information

1. the fabric to be processed.

2. the marker to be used.

3. the number of plies authorized

## Fabric usage control

The essence of fabric reconciliation is that for each lay a comparison is made between costed and actual usage of fabric, and the variance is reported. This document Plays an important role within management as it ties together what management planned to do with what they have achieved. Fabric reconciliation takes place after the fabric has been cut.

## Documentation & management functions.

Managers need to use documents but documents are no substitute for management. A manager who enters data on documents is not doing the work of a manager but is better described as a clerk. Documents are useful only when they allow managers make informed decisions which change the way the activities are undertaken.

Cutting problems are NP-hard Thus, only small size problems can be solved optimally.

These problems are solved using either integer linear programming or dynamic

programming, or branch-and-bound, depending on the type of problem. But most of the cutting problems use heuristic algorithms.

Although any given solution to such a problem can be verified quickly, there is no known efficient way to locate a solution in the first place; indeed, the most notable characteristic of NP-complete problems is that no fast solution to them is known. That is, the time required to solve the problem using any currently known algorithm increases very quickly as the size of the problem grows. As a result, the time required to solve even moderately large versions of many of these problems easily reaches into the billions or trillions of years, using any amount of computing power available today. As a consequence, determining whether or not it is possible to solve these problems quickly is one of the principal unsolved problems in computer science today.

Because (COP) is NP-complete, efficient algorithms for realistically sized problems will necessarily be heuristic in nature. This insight leads to the need for analyzing (COP) for characteristics that can be exploited for development of heuristic methods. Jacobs-Blecha et al. (1998) describes the heuristics developed for (COP), the reasoning behind these types of algorithm, and justification for the evaluation techniques.

Heuristic development is based on the examination of typical industry cases that COP cost is dominated by total fabric length. It explains the experimental design that we used to establish this characteristic of the cost function. It should be noted that in some cases the cost factors that are consider in the model developed may have a significant role in the cost of cut order planning. For example, spreading costs may be very high due to negotiated labor rates; cutting costs may be driven up by manual or equipment parameters; or a large data base of historical markers may not exist, greatly increasing the cost of that process. However, they assumed that the statistical results, which confirm practitioners' intuitions, are valid for the types of problem addressed by their work, and therefore the model can be modified to reflect this assumption.

Note that under this assumption the only change in the model occurs in the objective function, where all terms go to zero except those involving the fabric length parameters. An alternative method for problem solution is to solve the linear relaxation and check the resulting solution for satisfaction of the integer constraints. However, this approach is not practicable: for realistically sized problems the number of variables prohibits explicit computation. Furthermore, most apparel manufacturers who would use these solution methods do not have sufficient computing capability on site to utilize sophisticated integer programming solvers.

Therefore the development of heuristic algorithms to solve (COP) focuses on finding computationally efficient procedures for finding good (i. e., relatively low cost) solutions to (COP) for a robust set of problem instances. They selected two types of algorithm for the development of such heuristics, constructive and improvement. A constructive algorithm takes the input data and builds a feasible solution using intuition, clues from the spatial aspects of the problem, and guidelines found in the mathematical model. An improvement algorithm begins with an existing feasible solution and attempts to change the solution in some manner so that the cost of the solution is reduced while feasibility is maintained. The value of the cost function associated with the feasible solution produced by one of these heuristic methods can then be compared with some numerical bound, or other benchmark solutions.

## CUTPLANNER

CutPlanner is a software package for use in the textile manufacturing industry for automatic cut order planning. CutPlanner takes a customer's order for a clothing item and creates a cut plan for that item, including different sizes and different fabric types or colors, which minimizes production costs. A cut plan is an assignment of sizes and fabric types to markers. For each of these markers, the required number of plies is computed to fulfill the order's specifics. The objective of CutPlanner is to minimize total production costs. They consist of the costs for the fabric used, and several production costs incurred by making the markers, preparation of the cutting process, and the picking of pieces to be cut

CutPlanner provides two different modes of operation to calculate material consumption:

1. Conventional mode: The user dictates the estimated yield values that specify the material consumption, which depends on the number of sizes in a marker.

2. Exact mode: CutPlanner engages an integrated automatic marker making engine to calculate the real material consumption. Here, the user does not have to supply any estimations: the software runs automatically.

## Genetic optimization of fabric utilization in apparel manufacturing.

In apparel manufacturing, cut order planning (COP) plays a significant role in managing the cost of materials as fabric usually occupies more than 50% of the total manufacturing cost. Following the details of retail orders in terms of quantity, size and colour, COP seeks to minimize the total manufacturing costs by developing feasible cutting order plans with respect to material, machine and labour. A genetic optimized decision-making model using adaptive evolutionary strategies is proposed to assist the production management of the apparel industry in the decision-making process of COP in which a new encoding method with a shortened binary string is devised. Four sets of real production data were collected to validate the proposed decision support method. The experimental results demonstrate that the proposed method can reduce both the material costs and the production of additional garments while satisfying the time constraints set by the downstream sewing department. Although the total operation time used is longer than that using industrial practice, the great benefits obtained by less fabric cost and extra quantity of garments planned and produced largely outweigh the longer operation time required.

# Cut order planning

Cut order planning (COP) is the first stage in the production workflow of a typical apparel manufacturing company. It is a planning process to determine how many markers are needed, how many of each size of garment should be in each marker and the number of fabric plies that will be cut from each marker. Marker is the output of the process of marker planning, which is the operation following the COP. Planning process using commercial computing to arrange all patterns of the component parts of one or more garments on a piece of marker paper,. Following marker planning, the third operation is fabric spreading, which is a process by which fabric pieces are superimposed to become a fabric lay on a cutting table. The last operation is fabric cutting. Garment pieces are cut out of the fabric lay following the pattern lines of the component parts of one or more garments on the marker, and then transported to the sewing department for assembling to be a finished garment.

COP, the most upstream activity, plays a significant role in affecting the fabric material cost and the manufacturing cost in the cutting department. Based on the requirements of customer orders in terms of style, quantity, size and colour, it seeks to minimize the total production cost by developing cutting orders with respect to material, machine and labour.

In the cutting room, after the completion of COP and marker planning, spreading and cutting are then executed, and the time and costs required for these two operations will be affected by the quality of the cut order plans being developed. A good plan can improve the rate of fabric utilization.

The COP usually begins with a retail order comprising the quantities, sizes and colours of garments to be manufactured. The following example demonstrates how a cut order plan is derived. For simplicity, only the quantities of garments and sizes are considered. The details of the customer order are as follows:

# Size

# Small

# Medium

# Large

Quantity (in pieces)

300

600

400

The constraints on fabric lay dimensions are:

- Maximum number of plies for each lay: 75

- Maximum number of garments marked on each marker: 5.

The maximum number of garments produced per lay is 5Ã-75= 375 pieces and the number of garments required by the customers is 300+600+400= 1300 pieces. Therefore, the theoretical minimum number of lays is equal to 1300/375= 3. 47. This gives a practical minimum of four lays to cut the order. If the order is to be cut at the lowest cost, the lays need to be as long and deep as possible. One of the possible solutions is:

Small

Small

Small

Small

Small

Lay 1: 60 plies

Medium

Medium

Medium

Large

Large

Lay 2: 75 plies

Medium

Medium

Medium

Large

Large

Lay 3: 75 plies

Medium

Medium

Medium

Large

Large

Lay 4: 50 plies

An alternative of lay 1 is to have a four-garment marker and to spread 75 plies. This would reduce the cutting cost but was rejected because of the fabric cost since there would be 15 more plies and high fabric end loss, which occurs on both end of each fabric ply (more plies mean greater end loss). This solution has demonstrated that sizes Medium and Large are in the ratio of 3: 2. The marker for lay 2 can also be used for lays 3 and 4, thus reducing the costs of marker making.

This example shows that numerous other possible COP solutions can be generated. The COP problem becomes more difficult when the numbers of garments and sizes increase. The problem will be further complicated when the parameter of color is also considered in the plan. In addition, labors are needed to operate the spreading and cutting machines. As the fabric cut pieces will be transported to the sewing room for garment assembly, COP needs to consider the fulfillment of the demand quantity of cut piece from the downstream sewing room.

Current industry approaches in generating the COP range from manual ad hoc procedures by cut order planners to commercial software. However, many apparel manufacturers are still using rather primitive methods; they rely mainly on the expertise and subjective assessment of the planners to produce the plans. Therefore, the optimal COP cannot always be guaranteed. Commercial COP software is available for use, but the COP heuristics are usually kept by the proprietors as confidential. Apart from generating a COP with the right quantity of garments with right size and colour, there is little room for minimizing material, machine and labor costs.

Near-optimal COP solutions to reduce both materials and labour and machine costs using a genetic optimization model based on adaptive evolutionary strategies. The objective is to assist the production management of the apparel industry in the COP decision-making process and improve the quality of the decisions. It has been pointed out that the COP problem is NP-completeness in nature and it is feasible to use a heuristic approach to solve the problem accordingly by using constructive heuristics with intuition start and fine-tuning the solution with another improvement heuristic (Jacobs-Blecha et al., 1998).

## Roll Planning of fabric spreading

In the process of fabric spreading, the variance of fabric yardage between fabric rolls may lead to a difference in fabric loss during spreading. As there are numerous combinations the arrangement of the fabric roll sequences for each cutting lay, it is difficult to construct a roll planning to minimise the fabric wastage during spreading in apparel manufacturing. Recent advances in computing technology, especially in the area of computational intelligence, can be used to handle this problem. Among the different computational intelligence techniques, genetic algorithms (GA) are particularly suitable. GAs are probabilisti