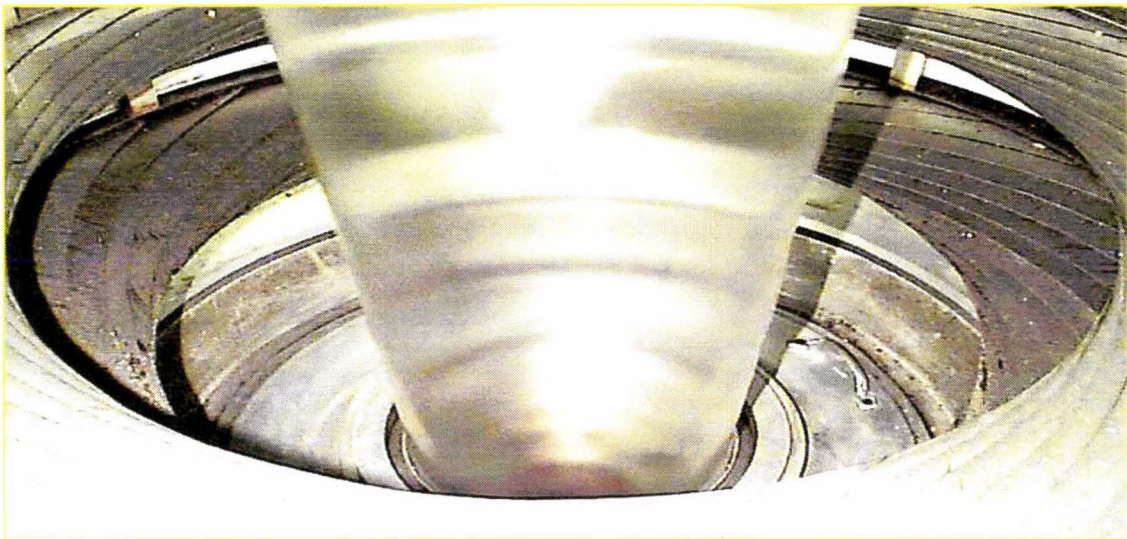


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THE PRO-t-CON PROJECT

THE DEVELOPMENT OF A SYSTEM FOR
CONTINUOUS PROCESS IMPROVEMENT USING
PRO-t-CON PROCESS OPTIMISATION
SOFTWARE AT AEP FILMPAC LTD.



A thesis submitted to the Faculty of Technology and Engineering, Massey
University, in partial fulfilment of the requirements for the degree of
Master of Technology
In
Quality Systems.

Paul Kenneth Moynagh

October 2000.

ABSTRACT

This project details the work done to develop a methodology for process improvement at AEP Filmpac in Auckland, New Zealand. The company had purchased a process optimisation software package called Pro-t-con which they intended to use to improve the operating conditions for each product on each machine in the plant. Early use of the Pro-t-con software produced a number of questions as to its ability to optimise processes as effectively as expected. Thus research was done to test the effectiveness of the package and analyse its strengths and weaknesses. The results of this work suggest that Pro-t-con although very easy to use is limited in its ability to effectively optimise processes. Statistically it lacks the rigor of Classical and Taguchi design of experiment methods and cannot resolve processes with interactions or non-linear factors.

At the outset of the project the plant did not possess a system for suitably storing and retrieving machine set-up information, thus any improvements made to the settings one day would not be available for use the next time that product was run. Consequently in order to longitudinally develop process settings it was also necessary to develop a setting sheet system to support the process improvement initiatives.

The combination of a methodology for continuously improving processes and one for actually undertaking experiments to exploit such a process produced a coherent 10 step method for general process improvement. This method was used successfully on a variety of processes at plants in Auckland and Sydney.

DECLARATION

I declare that this is my own, unaided work. It is being submitted in partial fulfilment of the requirements for the degree of Master of Technology at Massey University. It has not been submitted before for any degree or examination in any other University.

Paul Kenneth Moynagh

This

Twentieth day of October 2000

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1.0 - INTRODUCTION

The flexible packaging industry is very competitive. AEP Industries is the second largest manufacturer of flexible packaging products in Australasia. In order to compete effectively in a competitive commodity market it is necessary to not only be better than the competition in the present, but also be better at getting better for the future. There are many initiatives that promote the improvement of a company's competitive advantage, one of the most important of these is continuous processes improvement .

The management of AEP Filmpac understood this concept and on the recommendation of AEP Industries International, purchased a process optimisation software tool called "Pro-t-con". The intention was to apply Pro-t-con to a variety of Filmpac's manufacturing machines in order to identify optimal operating conditions and thus improve their processes. Pro-t-con came highly recommended by various European plants within the AEP group where it had made significant improvements to their processes in terms of throughput and quality.

This work reports on the development of a system to support Pro-t-con and investigates the suitability and effectiveness of Pro-t-con within AEP Filmpac in Auckland.

1.1 WHY PRO-T-CON?

The Management of AEP Filmpac identified an urgent need to improve the manufacturing efficiency of their operation. A substantial investment in new equipment was made during 1997 and 1998, however despite restructuring the company to simplify aspects of the manufacturing operation, the potential of these new investments was not realised. A process optimisation software tool called "Pro-t-con" was thus purchased with the view of applying it to each product on each manufacturing machine to identify optimal operating conditions. Pro-t-con came highly recommended by various European plants within the AEP International group where it had helped them to make significant improvements to their processes in terms of throughput and quality. It was expected that

the software would enhance the competitive position and long term viability of the company by helping to exploit its machinery constraints more effectively.

GS Technology marketed the Pro-t-con software worldwide and approached AEP Filmpac regarding its purchase. Steve Tilly from GS Technology thus visited Filmpac and gave a demonstration of the software on Machine 9. He spent three days organising and conducting experiments with 35 micron Palletfast stretch cling film and achieved a significant improvement in the machine's output through the study. This confirmed the value of Pro-t-con for Filmpac and they thus undertook to purchase it.

1.2 AIMS

The aims of this research are to

- 1) Develop a system for applying PRO-t-CON process optimisation software to the AEP Filmpac plant.
- 2) Analyse the performance of the software and system.
- 3) Make suggestions for the future development of the system and software.

1.3 OBJECTIVES

- 1) Define the necessary systems and procedures required to achieve a substantial and permanent improvement in the current machine operating conditions and to enable continuous improvement to take place
- 2) Demonstrate, on selected machines, a significant increase in plant output potential through application of the ideas developed in (1).
- 3) Demonstrate, on selected machines, the potential of the systems defined in (1) to reduce variation in machine output and quality.
- 4) Improve product quality and consistency on the companies' key products.

The establishment of a system for continuous improvement will help to reduce variation between runs of the same product and longitudinally develop the company's variety of products. This will make it more difficult for competitors to enter such markets and ensure that as customer expectations rise so too does the company's ability to satisfy

them.

A significant increase in output and quality will allow Filmpac to re-evaluate their products in terms of their competitive dimensions i.e. cost, time, quality and flexibility. A reduction in process variation will enable better planning of resources and make it easier to reliably meet customer demands.

The achievement of the above objectives will help the company to maintain and grow their competitive advantage over other manufacturers in an aggressive market.

1.4 THESIS STRUCTURE

The literature review follows this section and discusses issues relevant for achieving the project's aims. A brief methodology section follows to describe the project's approach and introduce the three key areas of work.

- 1) A 10 step approach to process improvement,
- 2) The development of a setting sheet system for documenting and saving machine settings.
- 3) An analysis of the Pro-t-con software.

The project then comes together again for an overall discussion and conclusions.

1.5 BACKGROUND

AEP Industries NZ Ltd. is a division of AEP Industries Australasia and operates plants that produce a wide range of flexible packaging products. Blown film extrusion, flexographic printing, laminating, and bag converting processes are utilised in these plants.

1.1.1: COMPANY HISTORY

Alex Harvey Industries (AHI)

Filmpac was started in the early 1970's as part of what was then AHI. An amalgamation of fledgling plastic film manufacturing companies was put together on a new site in Mt Wellington, Auckland, to form a powerful new company to take advantage of the growing demand for flexible packaging. AHI Plastic Film Company was born, flexible packaging was coming of age and waxed paper was a thing of the past. The company very quickly became a producer of a wide range of products centred on bread packaging, agricultural films, packaging for New Zealand's primary produce such as meat and butter and a broad range of industrial packaging products, such as shrink and stretch cling films.

Borden

Through the various mergers and acquisitions that took place, the company grew to be the largest and most diversified film manufacturing plant in New Zealand. In 1990 Borden, an American based company founded on the food industry, acquired the flexible packaging division of what was then Printpac UEB.

AEP

In late 1996, AEP Industries Inc. purchased the worldwide packaging group from a troubled Borden. Three specialised plants were set-up in New Zealand as separate divisions.

Filmpac focussed on polyethylene and PVC films for general packaging. The emphasis was on extrusion with flexographic printing and bag making to support it.

Flexipac specialised in printing with strong bag converting capabilities. A small extrusion operation supported their laminating requirements.

Liquipac specialised in producing a range of pouches for packaging liquids.

Similar operations were also set up in Sydney and Melbourne to make up the Australasian group.

1.1.2: COMPETITORS

The flexible packaging industry in New Zealand is extremely competitive. This is particularly so in the polyethylene films sector that Filmpac operates in. Due to the relatively low cost of entry and the flexibility of film manufacturing, printing and bag converting processes, it is relatively easy for small companies to enter the market. With a single extruder, printing press and bag machine a wide range of products can easily be produced.

1.1.3: SALES INITIATIVES

Filmpac has pursued a strategy of being the market leader in many high volume sectors of the flexible packaging market. In many of these sectors, Filmpac has secured the business of the market leaders and the secondary suppliers, often with sole supply contracts.

Many of Filmpac's customers are subsidiaries of large multinational organisations. As such, these companies have access to international benchmark pricing. The "commodification" of packaging in most cases sees it viewed as a pure expense and an area of focus for companies to cut cost. Over capacity in the flexible packaging industry, results in most manufacturers being eager to fill this capacity, thus packaging manufacturers are easily played off against each other by their customers.

1.1.4: COMPANY PERFORMANCE

The following graphs (Figs 1 to 5) show details of the last six years of actual results and a projection for the year 2000.

Figure 1: Sales Tonnes

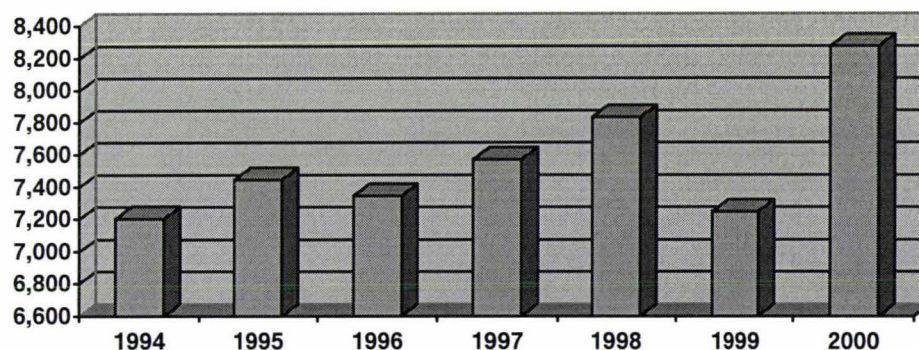


Figure 2: Sales Revenue - \$000

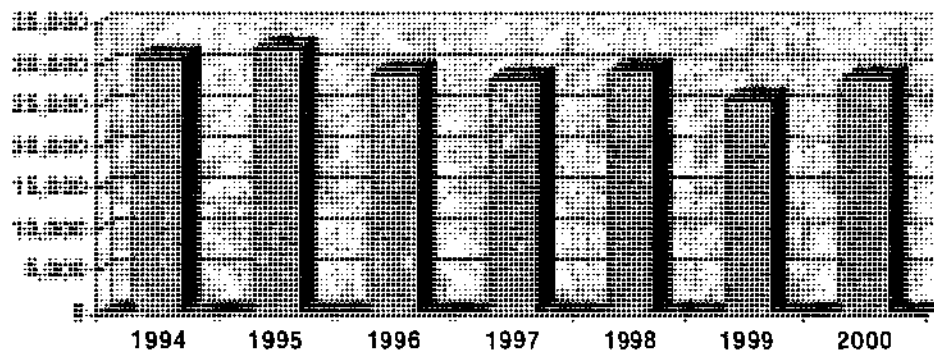


Figure 3: Capital Expenditure - \$000

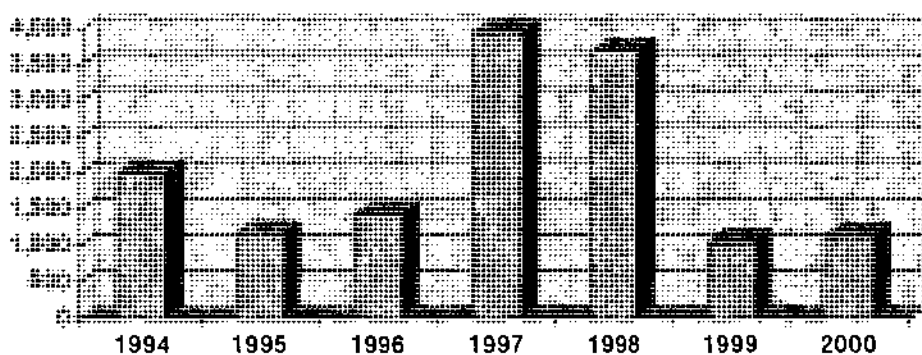


Figure 4: Total Employees

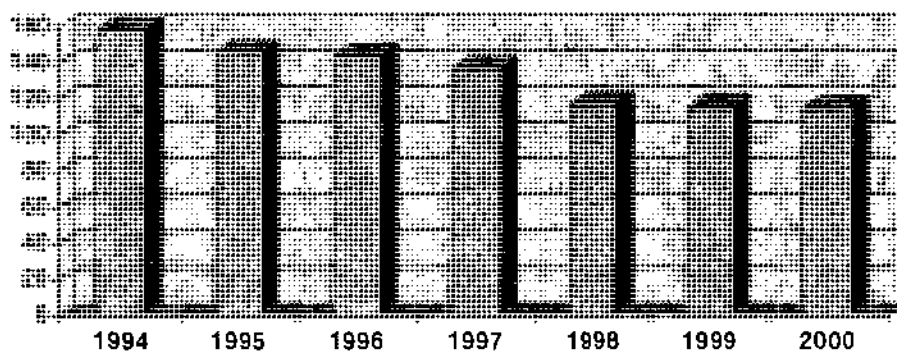


Figure 5: Operating EBIT - \$000

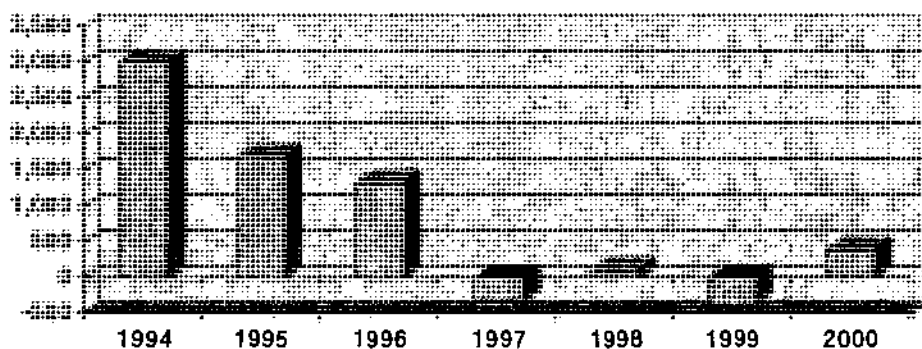


Figure 5 shows a rapid decline in profitability from 1994 to 1997, this was due to significant increases in raw material costs that were not passed on to customers due to competitive pressures. The company began to downsize and simplify their business while aiming to increase the volume of product made.

1.1.5 MACHINERY

Filmpac Auckland is divided into three sections, Extrusion, Printing and Conversion. The extrusion facility consists of nine machines that vary considerably in their capabilities. Two of these machines are three layer co-extrusion lines and the capital spent in 1998 was for the purchase of Machine 1 from Maachi in Italy. This high output line is used to make much of the company's bread, form-fill-n-seal and lamination films. The other seven blown film extruders are mono-layer lines and vary in their use from high output industrial films to low output lamination films. Low Density, Linear Low Density and High Density Polyethylenes are used in these machines which are generally accompanied by a regrinding "Exact" unit for reprocessing trim. Corona treaters are included in six lines to produce a printable surface on the film. Six lines have Weighbatch gravimetric dosing systems and much of the pelletised raw materials are distributed to the machines through a silo system.

The printing facility consists of two high-speed flexographic printing presses (Uteco and Comexi). The eight colour Uteco press was purchased in 1997 to improve the performance of the printing facility as the demand for high quality printing increases. A microdot mounting machine was purchased in 1999 to improve the plate mounting process.

The conversion facility consists of a variety of machines for making bags, perforating, slitting and sealing. Two high speed Amplas Wicketers and one old FMC Wicketer are the backbone of the bread bag manufacturing operation. Two Gunters allow sealing and perforation of anything from rubbish bags to mattress covers. The slitter enables a wide extruded roll to be slit into narrower rolls for use in various products.

Scrap product is recycled and reused in a variety of low specification products.

1.1.6: WORK FORCE

The work force at Filmpac consists of a variety of skill levels, generally extrusion and conversion operators can be described as unskilled to semi skilled with varying levels of experience and ability with their specific machines. It was decided that the present experienced operators were incapable of running Machine 1 efficiently so a recent initiative in extrusion has been to employ qualified electricians to operate this new co-extrusion line and do small electrical jobs,. This has freed up these experienced operators for other machines and for training the new electrician operators. Printers are trade qualified, there being two per shift, help is provided by semi skilled print assistants.

The extrusion supervisor manages up to nine operators on an extrusion shift and helps with machine set-ups and problems. Supervisors have historically been promoted from good/experienced operators however recently a new supervisor was appointed from outside the company with no experience in the industry in an effort to broaden the knowledge base. Conversion is run by team leaders who also operate machines and Printing is run by the trade qualified team leaders who also run one of the machines. The plant manager oversees all these.

Because of the continuous nature of the extrusion process the plant must be run 24 hours a day 7 days a week. Filmpac has recently changed from a complicated mixture of 12 and 8-hour shifts to having all production staff on a 12-hour, two days on, two nights on, four days off shift structure. This requires that there be four shifts in each department and enables machines to be run more consistently without the need for significant overtime during busy periods.

1.1.7: WORK ORDER SYSTEM

Jobs are raised by customer service and sales staff in relation to customer requirements. This information is passed on to the planner who raises a work order and plans the product for a specific machine. Work order information is retrieved from MFG. Pro, the company's accounting system, and a work order developed. Work-orders contain important information for running a job including end use, product dimensions, material and specification details. The work-order print system is a "front end" used by operators and supervisors on the floor for printing out the work orders they are to complete for the day. The system is easy to use and requires only that the user type in the pending

work order number.

Runs vary significantly in length but generally the longer the run the better, as set-up costs become a lower proportion of the total. Often however sales staff promise a product without consultation with production, this causes an otherwise reasonable job to be interrupted so that the new one can be done. Consequently production is characterised by shorter than optimal run lengths and day to day planning. Also as many products can be made on a variety of the machines and these machines vary in their output, the time taken to complete an order can vary significantly.

Over one thousand products exist and these are identified by individual item codes. In many cases products are exactly the same in many dimensions but, for example, a change in width or roll length will require a new item code.

1.1.8: A TANGLED WEB OF KNOWLEDGE

In the manufacturing area of AEP Filmpac many operators have a note book of settings and tips for running specific products to help them next time these products are run. They tend to protect this information, as there is a feeling that it ensures their continued employment. Anecdotes of operators who have struggled for hours to start up a machine exist. Occasionally skilled operators are phoned up in the middle of the night to dictate machine settings over the phone so another shift can get a job going. As there is no documentation to suggest how the product should be run This produces the situation is that machines are set differently each time they are run, an obvious special cause that increases variation in the final product.

Operating staff skill levels are limited, particularly in the area of line optimisation. Staff training has mostly focussed on the primary job functions of operating machines rather than on process optimisation and increasing the throughput of the process. Due to limited formal training and traditional empirical learning styles, the understanding of process fundamentals and their cause and effects is low. Consequently the settings used by operators to set up jobs are often far from optimal. No guidelines exist for the development of these settings and it is up to the operator to set it the way he feels is best. Depending upon the operator this might mean at a low output and unless the supervisor realises that the machine is under less than optimal conditions, that is the way it will stay.

Figure 6: Variation in output between runs of the same product (Machine 9)

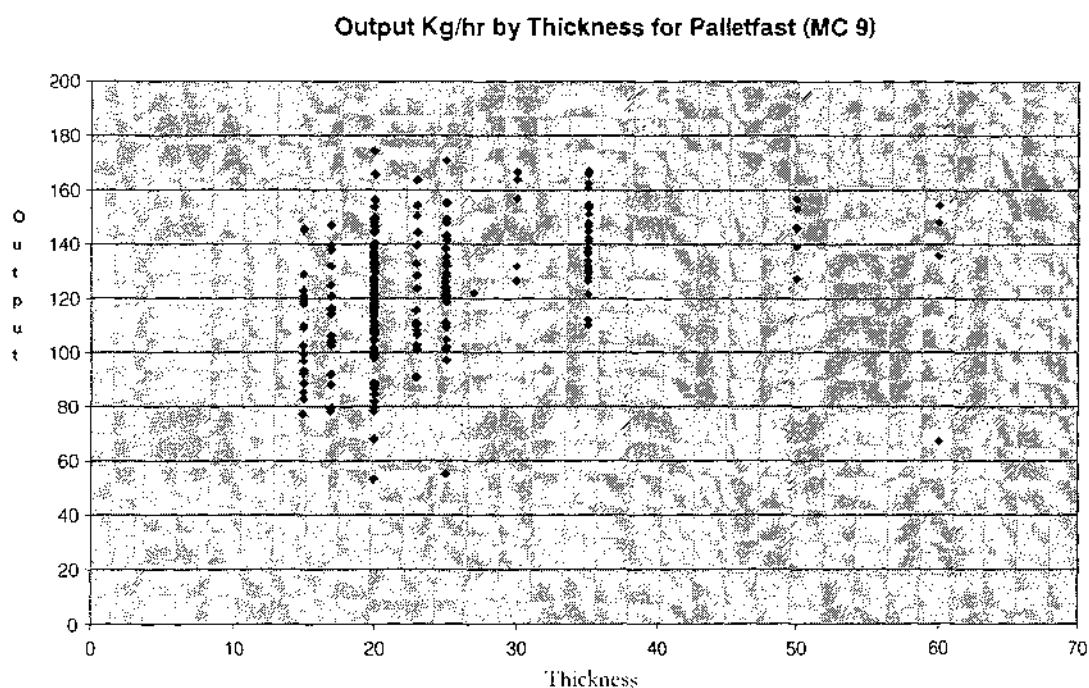


Figure 6 shows a worrying problem with the output from Machine 9. It can be seen from the graph that production rates vary from 80kg/hr. to 170 kg/hr. Machine 9, unlike all other machines in the plant, runs only one type of product (Palletfast stretch cling film (SCF)) and should therefore be relatively stable in its output. The variation in actual machine output seen above is likely to be due to a number of factors including: machine settings, operator ability, running problems, job changes and probably also reporting errors. This variation makes it very difficult to plan how long each job will take, to estimate the cost of the job and to guarantee the quality of the product. Such things frustrate customers, the planning department and the operators themselves as the decisions based on this poor information produce inaccurate plans, frequent job changes, poor quality and missed deliveries.

Such factors contribute against Filmpac's new machinery reaching its full potential.