Production Line Optimisation

Introduction

Systecon Consultants have been involved in innovative approaches using optimisation techniques to solve production line problems.

Initially a number of simple steps are taken to define the footprint of the problem for instance:

- What defines the production line
- What are resources required - machines, personel, etc.What is the flow of material
  - To achieve the end products
  - What are the necessary raw material and components
  - Are there any intermediate items in the production processIs it a production line or process - a step-wise transformation of raw material and components into end products

In all processes there will be a number of properties or parameters that can influence the process and its outcome. These influences must be identified and quantified, for instance:

- Materiel
  - Quantity, access to and availability of required materiel in the successive steps of the process
  - Quality of the materiel
  - 'The load', in essence end-product demandResource
  - Access to and availability of machines, personel, etc.
  - Capacity of machines, personel,etc.
  - Skill level of personel
  - etc.

Before any analysis of the process begins, the objectives and indicators must be stated and preferrabely to be quantifyable. The following are simple examples:

- The timely delivery of the product to end customer and the means to ensure this are
  - The availability of resources
  - The availability to materiel - raw material and buffer stocks
  - The possibility to shorten production lead times
  - The possibility to shorten order lead times
  - The production line 'load' in advance
  - The stock end productsThe minimisation of or drive towards low production costs including the investment of capital bound in stockThe balance between maximum delivery performance with minimum production costs, that is cost-effectiveness

One key question that will need to be resolved is the need and location for any stock and the investment required in it. All processes will aim to maximise production to meet just the order and minimise the need to place any production into stock awaiting an order.

A simple statement that belies its complexity. For instance it means the balancing of stock to buffer against uncertainty in demand and leadtimes and stock to improve the chance of timely delivery. This lead to the question 'To what degree is it possible and economically sensible to:

- Ensure the access to and availability of resources
- Avoid disturbances in the production process
- Ensure and lower the order leadtimes for materiel
- Ensure the 'load' in advance

We will now examine a 'real life' problem that was the production line for an intermediate compressor case for an aircraft engine The problem to be solved was defined by:

- A description of the production line or process
- The order leadtimes
- The production step leadtimes
- The quality of materiel
- The customer end product demand (marshalling time and waiting time tolerance)

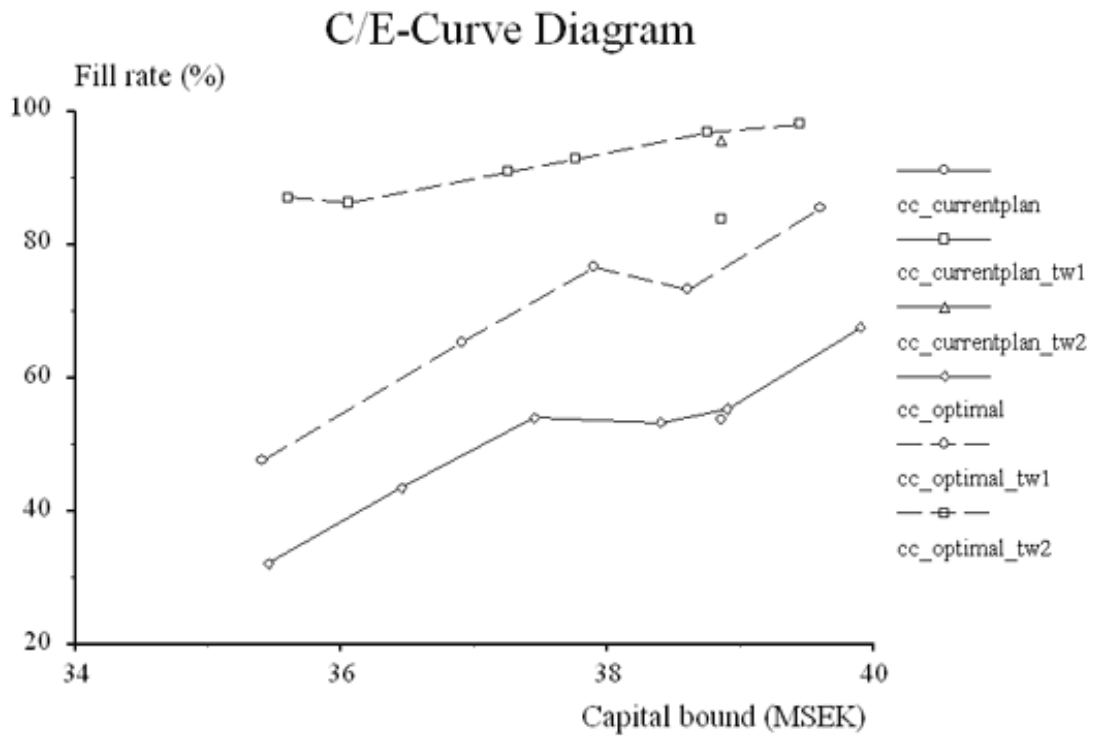
The aim of the study was to optimise the stock levels (end products, intermediate items in buffer stocks, components and raw material) whilst seeking to maximise the delivery performance and minimise the bound capital(investment in stock).

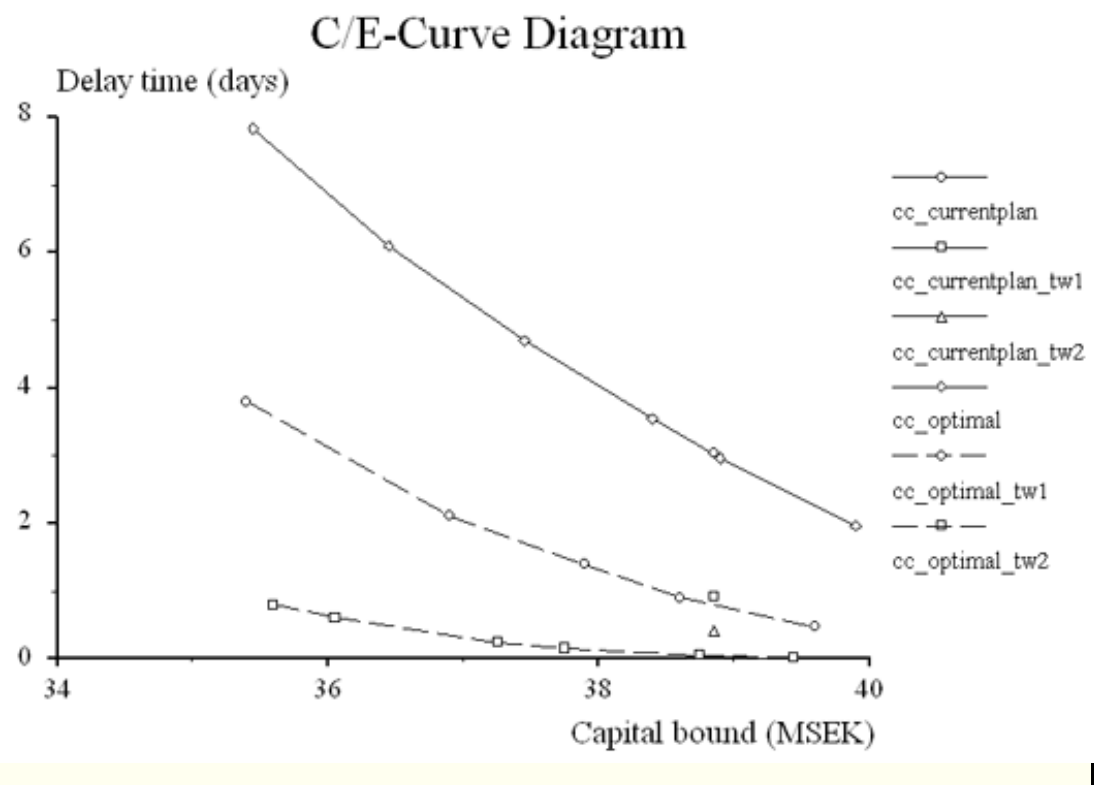
Raw materiel enters the production line with the front and rear assembly produced first, followed by assembly and finally the compressor case.

The data required was held in SAP R3, where the data described in application-oriented terms. It was therefore necessary to transform this into data definitions and format that would be understoon by OPUS10™. This was achieved by using a Modelling database that:

- Extracted the subset of data required for the C/E-analysis (process, process step, process step input or material)
- Provided functionality to transform data to Opus10™ format (a macro to set up Opus10™ input tables)

The study began by analysing the delivery performance of the current strategy using OPUS10™ to analyse existing stock levels and the associated Delay Time and Fill Rate allowing for a Delivery Tolerance of upto 2 weeks.





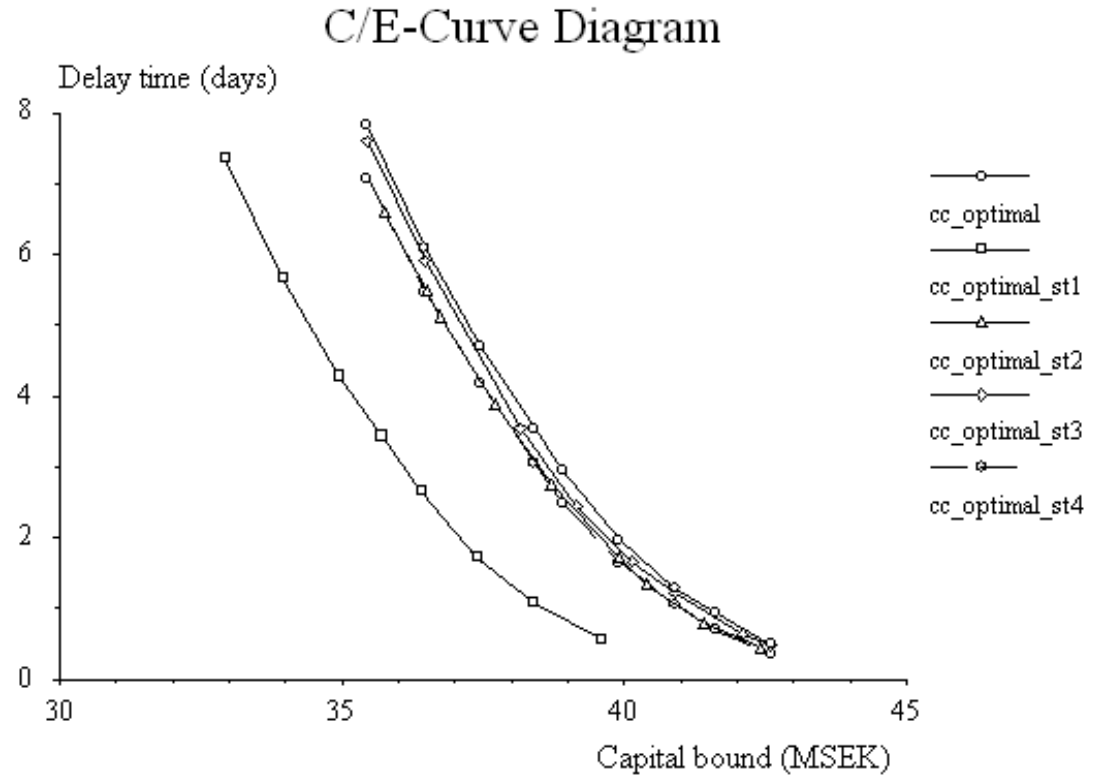


Figure: Analysis of current strategy showing Cost v Fill Rate

The initial conclusions concerning the current plan were:

- It is a 'well-trimmed' and 'well-understood' production line which was not surprising, as the line was selected as a pilot based on these criteria by an experienced production planner
- Assuming the delivery performance targets as produced by the current plan are
  - for a 0 week or 1 week delivery tolerance, the current plan is basically optimal
  - for a 2 week delivery tolerance, approximately. 6% could be saved

However there are two fundamental questions remaining taht need to be addressed:

- What is the "real" delivery performance target?
- Where should we be along the curve?

The study continued to address these questions by a Process Step Improvment looking at four steps in the production process:

- Order raw material
- Produce Rear/Front
- Assembly
- Compressor Case

The main question was one of sensitivity; if you could shorten the time for any of these steps by 10% which would provide the greatest benefit.

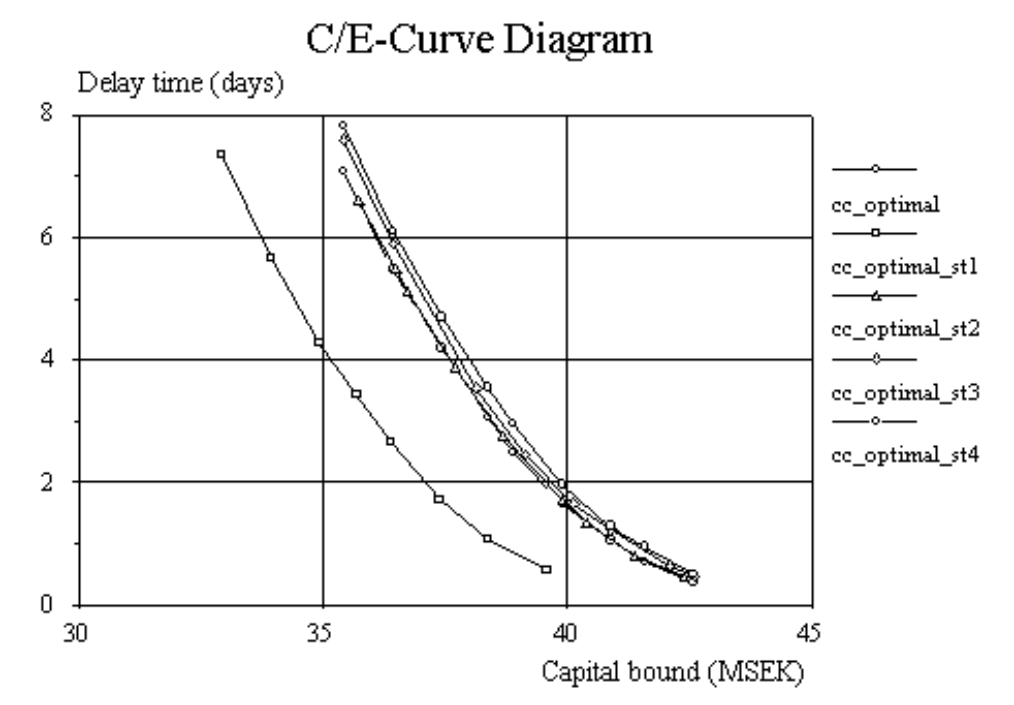


Figure: Analysis of optimal strategy showing Cost v Delay Time

The conclusions of the study have shown Opus10s has proven to be an excellent tool to analyse production lines related to stock issues:

- The strategy of the experienced planner for the well-trimmed production line was reproduced giving credible results
- The minimum cost for delivery performance target (C/E-curve) can be used to guide cost-effective improvements

The study has also revealed that there are less 'trimmed' production lines that should be studied and that. data is available and transformable.

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