“Keeping track of both ends.....”

AUSTRALIAN MADE

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Modelling the muddle.
Convergence, Digital TV, Internet, Non Linear Systems, Servers, High Speed Networks and other Technology options make it increasingly difficult to design and implement systems. Management and Design Teams now use Mathematical Techniques (Modelling) to help asses the information and make decisions. In an article of this size it is not possible to fully explain Modelling, however the techniques, worked example and references presented here will provide a sound start.

Introduction to Mathematical Models or Simulation.

Mathematical Models use Mathematics to simulate a System, the designer then tests the System on a Computer before it is built or purchased.

The Models created here are very simple, they use a “Starting Point”, “Ending Point” and a “Trend Curve”. The current situation is compared to the “Trend Curve” which directly provides a “GOOD”, or “BAD” answer.

It is assumed that the individual creating the Model understands the Topic being modelled, as some skill is required in selecting the points and the Trend Curve. Apart from this restriction, its simplicity ensures that it may be easily applied to many types of problems.

The worked example uses “Linear Trends”, other Trends are briefly explained at the conclusion of the Example (extending the method to include the effect of multiple Trends is covered elsewhere).

How to Create a Mathematical Model.

1. Select a System to examine or “Model”.

2. Determine a specific “Attribute” of the System to observe. Obtain its “Start Value” and “End Value”.
(Tip: start with a very simple "Attribute" to observe first, with experience work toward the more complex "Attributes")

3. Determine the “Parameter”, that when changed, will effect the behaviour of the item in (2) above. Obtain the “Parameter’s” Start Value and End Value.
(Tip: start with simple and direct relationships between the "Parameter" and the "Attribute", with experience more complex relationships may be investigated)

4. Determine the “Trend” or Direction of the Model.
(Tip: this should initially be a simple "Trend", with experience more complex "Trends" may be used)

5. Draw the Model.

6. Indicate the GOOD, and BAD Areas on the Model.

7. Observe and monitor the model’s performance against the current situation. Report the results and adjust the model if required.

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Example (using the above procedure): Create a Model to examine effects of Data Compression.

Refer Fig. 1 whilst reading the following:

1. The model will examine the degrading effect of "Data Compression" on a "current" Mass Storage System.

2. Topic of Interest is the "Usage" of the System, measured in %.
The Start Value = 95%, assumption: wide availability (networked), facility is of use 24 hours per day and little down time for maintenance.
The End Value = 30%, assumption: below this figure not viable to keep System in operation.

3. The Rate of Compression will be altered (increased).
The "Starting Value" is 10% (deliberately away from 0, as it avoids complex behaviour when a process is starting).
The "Ending Value" is 90% (deliberately away from 100, as there are frequently residual effects at this point eg. Use for historical/archiving).

4. Trend design and assumptions:
Item of equipment will be superseded as technology advances.
Before the System is purchased we need to test the factors that will cause it to loose value (Usage).

   The Trend's decline is based on the principle:
Increasing Compression (sophisticated mathematics and hardware), will cause our system to "appear" slow, old and comparatively expensive as the new generation use higher levels of integration, are cheaper to produce and operate.
This action will be continual and be a relatively "well behaved process" without any sudden changes.

5. The various points are plotted on the Model (Fig. 1).

6. The regions are also plotted on the Model (Fig. 1).

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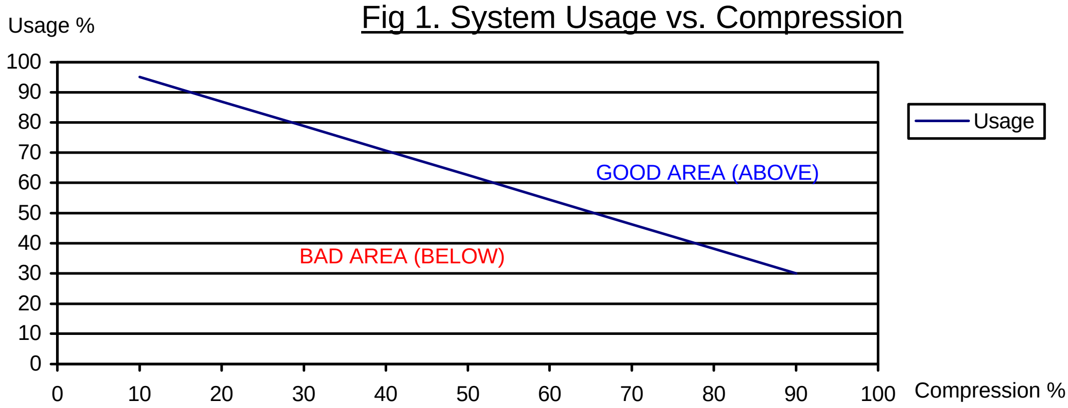
7. Analysis:
- The Model documents the assumptions in a very clear and highly visible form.
- The Model does not tell us "when" or "how long" the process will take (outside the ability of this Model).
- The Model does indicate the regions where our "Usage" is "GOOD" (System worthwhile keeping), and "BAD" (decisions about it's future must be made), thus it serves as a benchmark or reference against which further decisions may be made.
- Examples:
  Current rate of compression is 10% and USAGE is 95%.
  Trend Equation: Usage (%) = -13/16 * Compression (%) + 825/8.

  1. We speculate that Compression will increase by 10% per year. Thus Usage must not decrease by more than approx 8.1% per year for the System to remain viable - System life: approx 8 years.
  2. We speculate that Compression will increase by 20% per year. Thus Usage must not decrease by more than approx 16.25% per year for the System to remain viable - System life: approx 4 years.
  3. We speculate that Compression will increase by 30% per year. Thus Usage must not decrease by more than approx 24.4% per year for the System to remain viable - System life: approx 2.5 years.

  - Examining (3) above from another perspective: in 2.5 years, the System must be designed, installed, paid off, have met it's running costs and returned a profit.
- The above is frequently what Management needs - a simple and well-constructed model of the technology, its future and any limitations.

- Before presenting it to Management, the financial people could add relevant information to the Model (write off time, depreciation, etc). This will reinforce the technical information by bringing all the factors together in a common format and highlight any interrelated factors.

Fig 1. System Usage vs. Compression



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Using this Modelling Example for other Applications?

- By changing Usage values, it may be used for a VTR, (Digital or Analog).
  (VTR may not operate 24 hours/day and availability may be different).

- By changing Usage values, it may be used on a transmission System.
  (profitability/traffic requirements of the system).

- By adding more components it would be possible to provide a complete Model of an entire Edit Suite or Production Facility.

Other Trends.

The Trends presented above are “Linear” and very useful in many Models.

Figure 2 contains two additional Trends:

- Trend "A" (Linear) has been copied from Fig 1 for reference.

- Trend "B" is a Polynomial (Quadratic).
  It falls away faster than the Linear (A), passing through 30% point earlier. In our example we would use this to model the case where our System is being superseded reasonably quickly, new systems are being installed at an increasing rate. **We are likely to encounter problems far sooner**.

- Trend "C" is Exponential.
  This is a very sharp and sudden curve. In our example we would use this to model the case when everyone abandons their current Systems in favour of the latest, **driving the viability of our System into question very rapidly**.

Figure 2 (with the Financial Information Included) goes a long way to satisfying Management’s need for quantitative data suitable for planning decisions.

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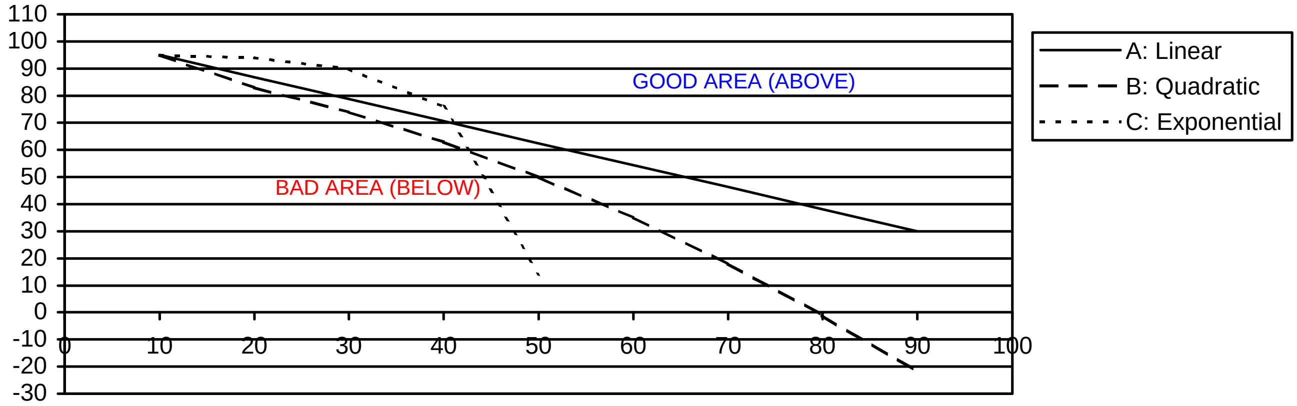
Fig 2. System Usage vs. Compression - 3 Trends



Conclusion.

With an understanding of the Technology, the situation (or context) and some basic mathematics, it is possible to:

- Gain great insight into the impact of technology.
- Obtain quantitative data suitable for planning decisions.
- Provide a method to monitor decisions and progress.
- Anticipate problems.
- Satisfy Management's need for information.

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