

White Paper - Frontier Analyst® in use

By Asia Hussain & Matthew Jones, Banxia Software Ltd

Version 4.0, June 2018, for Frontier Analyst version 4

1 What is Banxia® Frontier Analyst®?	1
2 Why should I be interested in Frontier Analyst®?	1
1 Some benefits of Frontier Analyst®	2
3 Is it Expensive?	3
4 How does Frontier Analyst® work?	3
5 Frontier Analyst® in the "real world"	5
6 Graphical displays and tables	5
7 The next step	7

Frontier Analyst® is developed and published by Banxia Software Ltd.

Full information, this document and a working demonstration of the software are all available free of charge at www.banxia.com or on request by email to info@banxia.com or by calling Banxia on +44 (0)1539 815660.

1 What is Banxia® Frontier Analyst®?

Frontier Analyst® is a performance measurement tool from Banxia® Software Ltd. for determining the efficiency of a number of 'business units'. A common example of a business unit is a shop which is part of a retail chain, but a unit can be any organizational division which performs fundamentally the same task, with a similar set of 'inputs' (resources) and 'outputs' (products or services). Other examples of units include wards in hospitals, bank branches, regions of forests and distribution depots.

Frontier Analyst® takes a number of the inputs and outputs, and performs an analysis (using linear programming) to determine the relative efficiency of the units 'processing' the inputs and outputs. The technique used is called data envelopment analysis (DEA). Some of the units will be deemed to be 'efficient' and may be considered as representing the 'best practice' available. The software tries to optimize the rating of the other units. This results in data about how much each unit needs to improve if it is to match the best performers. Typically, an inefficient unit will be trying to match characteristics from more than one efficient unit. (The inefficient unit is said to have a peer group, with which it is compared).

The main benefits of the analysis are twofold: the performance is based on taking all the available data into account, so it gives a good reflection of overall performance; and because it is a peer based comparison the targets set for improvement are realistic - and therefore more likely to be achievable.

Frontier Analyst® is typically used at the beginning of an improvement process. Even when it is used regularly to provide updates on performance, its main purpose is as a key input to an action plan to achieve some of the potential gains identified by the software. A typical project will see between 10% and 50% of the potential improvement actually achieved and in any organization that will mean real bottom-line impact.

2 Why should I be interested in Frontier Analyst®?

It is imperative that businesses remain competitive and that public sector organizations give value for money, this usually means seeking efficiency improvements. Every organization has a lot of information about its operations or has the ability to gather such information should it choose to. The problem is usually making good use of this information. Purely financial measures of performance are no longer sufficient to ensure long-term competitiveness. This is where Frontier Analyst® comes in. Frontier Analyst® takes the data from your existing systems and uses a mathematical technique to combine all the performance ratios into a single efficiency score. More importantly, it tells you where your business units can improve - based on the performance of their peers. This means that the targets for improvement are objective, realistic and achievable.

A review of Frontier Analyst® in the American journal OR/MS Today stated that:

"Public policy makers and business managers need improved analytic tools to enhance decision making. There is a continued, growing need to find ways to increase efficiency in both the public and private sectors. DEA represents a promising method of addressing this need. The availability of specific DEA software applications, like Frontier Analyst, will help to de-emphasize the mathematics of the analysis while hopefully increasing its conceptual understanding and usefulness as a decision making tool." OR/MS Today

2.1 Some benefits of Frontier Analyst®

- Easy to use
The graphical displays provide all the information you may require, providing a visual representation of complex information. High level summary displays show statistical information with detailed displays when you want to drill-down into your data.
- Integrates easily into existing systems
The smart data import wizard allows quick use of data that already exists in other software systems such as spreadsheets and databases.
- Variety of reporting options
All of the displays (text and graphs) can be copied to the clipboard for inclusion in custom reports. The built-in report generator (with optional designer for customizing reports) allows you to produce a variety of printed reports for distribution. The Publish-to-web option allows for distribution via intranet and extranet.
- Peer-based analysis
Frontier Analyst® provides improvement targets that are based on what a unit's peers are actually achieving, so they are much more realistic and easier to 'sell' to managers.
- Established technique
Data envelopment analysis, the technique used in Frontier Analyst®, has over twenty years of research behind it and a proven history, which Frontier Analyst® makes accessible to all organizations.
- Objective and comparative analysis
Frontier Analyst® can take many different factors into account in a single optimization process, so that an overall performance score is produced instead of a plethora of separate ratios, which are difficult to compare and potentially confusing.
- Training and consultancy available
Frontier Analyst® has been designed to be very easy to use (and independent reviews back this up). If you want to kick-start your use, then you have the re-assurance of knowing that training is available and there are independent consultants who can help you.
- Real "bottom-line" impact
Frontier Analyst® is used by organizations and consultants in over 60 countries world-wide because it has real bottom-line impact.

3 Is it Expensive?

No. The single-user version that can analyze up to 75 business-units costs just £395 (+VAT). If your business turnover is £1,000,000 and you can identify savings of just 0.0004%, then it has paid for itself. If 75 units is not enough, Banxia Software can supply licenses with analysis capabilities up to an 'unlimited' business unit capability, at very reasonable prices (for example, a license for 1,500 units is only £1895 (+VAT)). Frontier Analyst® helps you identify the prime targets for realistic and achievable efficiency savings.

As well as saving money from efficiency improvements, you also save yourself the time it would take to sit down with your favourite spreadsheet and develop a similar system. Frontier Analyst® is 'ready-made' so you don't have to spend time designing complex linear programming solutions and debugging your spreadsheet. It has a range of easily understood graphs and tables (with copy to clipboard facility), a report generator, a Publish-to-web, summary graphs and a data filtering capability. How much is your time worth? Frontier Analyst® is a tried and tested tool, used in over 60 countries world-wide, with a well researched technique at its heart, available off the shelf.

4 How does Frontier Analyst® work?

Frontier Analyst® is based on a technique called data envelopment analysis (DEA). DEA originated in the public sector where there was no 'profit' figure by which operating units could be compared. Banxia® Frontier Analyst® is the first software to take the technique and make it accessible to everyone, through a user friendly interface and a range of graphical outputs which make all the information readily accessible and understandable, allowing you to focus on the benefits of performance improvements.

The mathematical model behind Frontier Analyst® is described in full in the paper "Frontier Analyst® in depth", available free from Banxia® Software Ltd. The principles of operation are as follows:

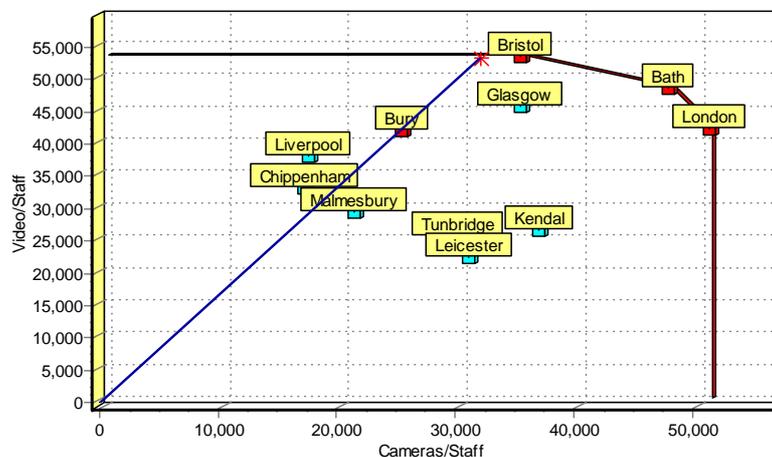
Let's take, as an example, an imaginary retail chain. Each shop is a different size, some are in small towns and some are in large cities, but they are all performing similar functions. Depending on their location, they have a certain floor area and a certain number of staff. The chain sells two product lines: cameras and videos; and it also sells warranties for them. The company gathers some basic statistics about their sales operations in various branches.

	Floor space	Staff	Cameras	Video	Warranties
Bury	1200	3	75000	125000	14700
London	2400	12	612000	502000	56000
Glasgow	1800	7	245000	318000	43000
Bath	1300	4	190000	193000	35000
Chippenham	900	3	50000	98000	14500
Liverpool	2000	7	120000	263000	139400
Tunbridge	1240	3	89000	76000	59000
Leicester	1190	3	92000	66000	74000
Malmesbury	860	3	63000	87000	76800
Kendal	940	2	73000	52500	12000
Bristol	1460	5	175000	266000	28500

The question for management is which branch is performing best, and how can they improve? You could take the total sales per member of staff, or you could simply take the profit per store but this gives a broad picture, and no indication of where improvements could be made. Looking at just the ratio of camera sales per member of staff will tell you who is doing best at selling cameras, and similarly video sales per member of staff will give you another set of scores. But perhaps some shops are effectively camera specialists - they may appear low in some ratios, but be doing reasonably well overall. What is needed is a way of combining all the scores together and getting an overall picture. This is where Banxia® Frontier Analyst® comes in.

Frontier Analyst® takes all the values and, using linear programming, generates an overall efficiency score for each unit. Those units doing best in any particular ratio are deemed 'efficient'. For the rest of the units it tries to optimize their performance relative to their 'efficient peers'. The result is a set of potential improvements for each input (resource) and output (product/service) in the business process. And because the method automatically takes account of relative differences, a shop in our example that excels in camera sales will be compared with other similar shops.

The principle is shown in the two-dimensional 'frontier plot':



2-dimensional frontier plot from Frontier Analyst®

In this example, you can see that "Bristol" has done the best in the video/staff ratio, and that London has done best in the cameras/staff ratio. "Bath" is doing better than each of them in one of the dimensions, but not better in both dimensions. Together, these units form what is known as the "efficiency frontier" - the representation of "best practice".

You can see that "Bury" has a line through it from the origin to the frontier. Bury's position along the line represents its relative efficiency - if it was to move along the line to the frontier, it would then be efficient. Bury's score in this case is 78.3%.

Another thing to note about the graph is that the units are typically compared with other units doing similar performance. For example, Kendal is selling more cameras than videos, as is the efficient unit London which would be in Kendal's peer group. The analysis will compare Kendal with London, and Liverpool with Bristol.

This, in principle, is how Frontier Analyst® works. Once you add in all the data values, it becomes "n

dimensional" and can no longer be shown on a single graph - you have instead to use the result information provided by the scores and the potential improvement information. The wide range of graphs in Frontier Analyst® make the results readily available. Frontier Analyst® can handle up to 32 variables (inputs/outputs) and from five to an 'unlimited' number of business units, depending on the license purchased.

5 Frontier Analyst® in the "real world"

Frontier Analyst® has proven benefits, it helps you get a good overall picture of your organization's performance and where potential improvement might be made. But does it fit easily into your work?

Right from the beginning, Frontier Analyst® has been designed to accept data from all common sources. This is done using an import wizard which can read data from the clipboard or disk file. It automatically detects the data format and sets the options appropriately. This means that you can simply prepare the data in your existing spreadsheets and copy and paste them to Frontier Analyst®. If your data is in a database, simply export it as a comma or tab delimited file - Frontier Analyst® will take care of the rest.

Once your data is imported into the Frontier Analyst® database, you have just a few steps to take before you get results. First, select the appropriate type of value for the various variables you have. A value can either be an input or an output. If it is an input, then you can choose between 'controlled' and 'uncontrolled'. An uncontrolled input is one which is outside your direct control, typically things like "floor space" (because of fixed term leases and the inability to change space requirements rapidly).

Next, you select the optimization to be performed. The primary choice is between maximizing the outputs for the inputs used (getting more out of the process) or minimizing the inputs to produce the same output (reducing resources used).

Further options control whether the analysis should assume constant returns to scale or variable returns to scale. Constant returns to scale means that, for example, if ten people can manage 100 transactions per day, then twenty would manage 200 transactions per day. With variable returns the number of transactions, for twenty people, would be either more or less than 200 (increasing or decreasing returns to scale), acknowledging a non-linear relationship between inputs and outputs.

Advanced users can control the "weighting" of an input or output. Many users may choose not to use this function, but it allows you to ensure that consideration is always given to what you identify as an input or output of overriding importance. But a word of caution here - some analysts might argue that using weighting removes some of the objectivity of the analysis. Frontier Analyst® gives you the choice.

The final analysis option is "zero substitution". Zeros (and negative numbers) cannot be used in DEA because the optimization cannot multiply a value of zero to obtain the required result. It is recommended that the user manually changes the data to have suitable values, but this option allows the data to be quickly tested by substituting a value any time a zero is found in the data.

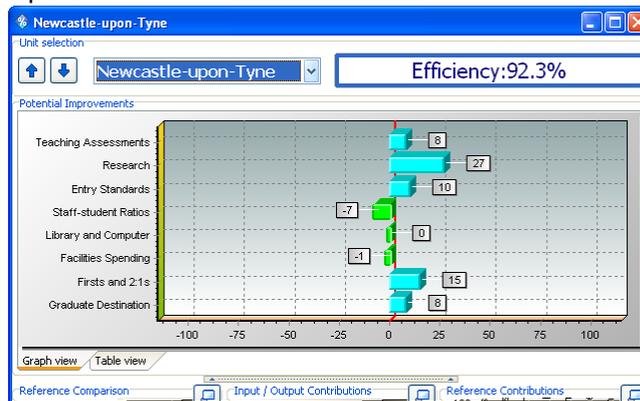
6 Graphical displays and tables

Frontier Analyst® offers a range of graphs and tables. The primary output is an efficiency score for each unit, along with a graph and table for the unit's potential improvements. Summary graphs provide quick insight into the data, so that you can concentrate on the important areas.

The printed report facility allows you to print summary sheets or fully detailed pages for each unit, perhaps for distribution to the rest of the management team. Don't forget that you can also copy and paste all the graphs and tables to your spreadsheet or word-processed reports.

If you have a copy of the full-colour brochure then you can see nearly all of the displays in colour.

Data viewer	The data viewer is a built-in data entry and editing sheet. You edit the data and control which business units and variables are included in the analysis (for “what if” experiments). Filtering allows you to exclude units from the analysis according to value, text or date.
Efficiency scores	The main results display is an efficiency scores table. But this is just the start. At the simple click of a button many more useful and easy to interpret displays are available to you. You can sort the scores table in different ways, and include different sections of the data. The distribution graph shows the spread of efficiency.
Unit potential improvement details	The potential improvements graph shows the target input and output levels needed for a unit to become “fully” efficient. This is important because they are peer-based targets, so they should be achievable. You can also see the numerical data behind these results, and copy the graph and data to the clipboard for inclusion in your management reports.



Reference comparison	The reference comparison helps to highlight a unit's weaknesses. It shows you the relative performance of the unit compared with its closest peers (its “reference set”).
Summary displays	The summary graphs provide a quick insight into where the greatest efficiency gains can be made. You then use the other graphs to investigate the details. The pie chart shows the total improvements possible. If a ‘slice’ is large, it is worth investigating, but if it is small, there is little to gain by improving that variable.
Frontier plot	The frontier plot shows how data envelopment analysis works. Consultants and managers often use it as a means of explaining to colleagues how the analysis works.
Reference set frequency	The reference set frequency shows the number of times an efficient unit appears in the inefficient units' reference sets. The higher the number, the more representative of ‘best practice’ a reference unit is.
Reference contributions	The reference contributions display provides information on which members of a unit's reference set have contributed most to setting its targets for potential improvement. This identifies the key units to

	compare its performance against.
Correlation detection	Frontier Analyst® includes two plots that allow you to detect correlation between your input and output variables, and between the variables and the efficiency scores. This allows you to identify factors that are effectively representing the same criteria and factors that are synonymous with efficiency.
Printed reports	Frontier Analyst® (Professional edition) includes a report generator to allow you to print and distribute the analysis results. Purchasing the report designer option allows full customization of your reports (you can include company logos and rearrange the order of the presentation). All the graphs and tables can also be copied to clipboard for inclusion in your own word-processed reports and presentations.
Publish to web	The Publish-to-web allows you to put your results onto the organization's intranet or extranet for review by interested parties.

7 The next step

This white paper has given you:

- An overview of the many benefits of using Frontier Analyst®
- An idea of how Frontier Analyst® works
- A picture of how it fits in with your existing data sources
- A summary of the output results (with colour pictures in the separate brochure)

If you are keen to start using Frontier Analyst® in your organization, then licenses start from as low as £395 (+VAT) for a single-user version capable of analyzing 75 units. If you try Frontier Analyst®, like it and want to extend the analysis capability you can upgrade at any time by paying the difference between the cost of the license that you already have and the cost of the analysis capability that you would like to upgrade to.

To order Frontier Analyst® call UK: +44 (0)1539 815660 or visit our web site at <http://www.banxia.com> where secure online ordering is available.

If you want to know more about the data envelopment analysis technique used in Frontier Analyst®, then ask for the "Frontier Analyst® in depth" paper. This is a much more technical document.

Further information and screen-shots are available on our web site at <http://www.banxia.com>. If you would like to ask questions, please email us at info@banxia.com, or call UK: +44 (0)1539 815660.

