The Critical Path, Delay Analysis and "Windows"

By

Roger Gibson

Reprinted from
Construction Law Journal
Issue 7, 2008

Sweet & Maxwell Limited
100 Avenue Road
Swiss Cottage
London
NW3 3PF
(Law Publishers)

THOMSON
SWEET & MAXWELL

The Critical Path, Delay Analysis and "Windows"

By Roger Gibson*

LT Causation; Construction contracts; Delay; Design defects; Power stations; Remedial works

Introduction

In the latest instalment of the *Mirant Asia v Ove Arup*[1] dispute in the Technology and Construction Court (TCC), H.H. Judge Toulmin CMG Q.C. made some key observations in his judgment which are important in respect of "delay analysis". However, before commenting upon these observations, I will give some background information to both the project and the dispute.

The facts

The project was the construction of a coal fired power plant at Sual on Luzon Island in the Philippines. The construction of the plant was carried out by a consortium of several companies and the client was the Philippines Government power company. One of the consortium companies changed its name to Mirant Asia-Pacific Construction, and this company awarded a contract to Ove Arup for the design of the foundation slab for the power station's boilers.

The site for the power station was located on Banguyao Point which is at the end of a hilly peninsula. In order to build the plant, a large section of the hill had to be removed by excavation and blasting. Arup's design for the boiler house foundations was based on assumptions regarding the bearing capacity of the finished ground level.

In the event, in April 1997, two of the main foundations of the boiler house, designed by Arup, dropped. Remedial works had to be carried out which impacted on the erection of the steelwork support for the boilers which had already commenced.

* Roger Gibson, Project Planning Consultant, Adjudicator and Expert, Gibson Consulting Limited. He is the author of *Construction Delays: Extensions of Time and Prolongation Claims* (Taylor and Francis, 2008). The book can be ordered from the publisher's website, or from major book retailers.

[1] Lessons to be learned from *Mirant Asia-Pacific Construction (Hong Kong) Ltd v Ove Arup and Partners International Ltd* [2007] EWHC 918 (TCC).

The dispute

The action was commenced by Mirant against Arup in 2002, and the first hearing took place in the TCC in the spring of 2003. A second hearing took place in late 2003 which concerned the remaining issues on liability. Judge Toulmin issued his judgment in July 2004 and the matter was taken to the Court of Appeal where the judgment was upheld.

Both the TCC and the Court of Appeal had decided that Ove Arup had been negligent in the design and was liable for the consequential damages of that negligence.

At the latest hearing, which took place in the TCC in December 2006, Mirant was claiming some £38 million. This sum consisted of liquidated damages, rectification costs, acceleration and other time related costs.

The judgment

Although the remedial works to the boiler house foundations caused significant delay and cost to the boiler erection work, Judge Toulmin's conclusion was that Arup were not liable for the time-related cost incurred.

In examining Mirant's claims, Judge Toulmin indicated that it was necessary to investigate and establish as to whether the remedial work to the boiler foundations were on the critical path for completion of the project.

Judge Toulmin made the following observations and statements on "the critical path" at [129]–[130]:

> "As computers have become more sophisticated, the critical path analysis has been enabled to become more sophisticated. This has become an invaluable tool which enables a complex construction Project to be managed with better available information. The analysis will identify at a given date which important aspects of the Project are falling behind the programme, particularly if they are on or close to the critical path, what if any is the impact on other aspects of the programme and where additional resources need to be placed. It will also demonstrate where activities are ahead of what is planned and enable a decision to be taken on whether planned activities need to be rescheduled.
>
> It is also used as a tool for analysing, as at the given date, what has caused any delay that has occurred and what is the extent of that delay."

Judge Toulmin had some observations on the "windows" method of delay analysis, stating at [131]–[136] as follows:

> "Windows analysis is the most accepted method of critical path analysis. As Pickavance [referring to *Delay and Disruption in Construction Contracts* by Keith Pickavance], makes clear at page 572 of his book, 'Windows' (and 'Watersheds') are not methods of analysis in themselves: they are merely aspects of conducting the critical path analysis. In essence they represent the division of the overall construction period into smaller periods into which each new set of corresponding progress can be entered into the programme and analysed.

> The term 'Windows analysis' refers to the regular reviews and updates undertaken by the contractor, normally monthly. These periods of time would be described as monthly windows. Unlike previous monthly reviews, the planner would use sophisticated software programmes to plot which activity or activities were on and which were near to the critical path each month. The programmes would take into account those activities which had started early or had been delayed. Also built into the programmes would be the progress of those activities which had started since the previous monthly window. This would enable the employer and the contractor to analyse over the relatively short periods of time what changes had occurred, and identify what problems needed to be investigated and put right.
>
> The analysis would also identify delay, enabling those concerned to investigate and, if appropriate, agree the cause at an early stage. A monthly review would, in a complex Project like Sual, have enabled the consortium to see what activities were at or close to the critical path and to take urgent action where necessary. It would also have enabled a much more sophisticated retrospective analysis of the delay to be undertaken than that which was able to be carried out.
>
> As Pickavance makes clear, the essence of windows analysis is to provide a snapshot at the point at which the analysis takes place. It is a method of discovering the effect between a particular event or series of events within the time frame and the effect of one or more events on the total contract period.
>
> Pickavance also notes that if the critical path analysis takes place using less frequent intervals, for example at watersheds, i.e. critical benchmarks in the Project some months apart, it will be necessary to retain and review detailed records in order to provide reliable data. Clearly the longer the interval between windows, the more likely it is that the review will be inaccurate (particularly if the records are poor). In such cases, where something has gone wrong which requires blame to be attributed, there is likely to be more room for discussion and dispute as to who is responsible for losses which occurred in the period between windows.
>
> In this case forms of the windows or, perhaps more accurately described, watershed analysis are used by the experts to attempt to re-create the critical path using, in Mr X's analysis, three benchmarks and covering a period from April 1997 to October 1998 and in Mr Y's analysis, four benchmarks covering a period between April 1997 and October 1999. The fact that these benchmarks cover extended periods of time reduce the overall reliability of the analysis which was carried out. I will deal with these matters in detail later but I refer to them now primarily to give some background to terms which will be used in the course of my analysis of the facts."

Under the sub-heading, "The Programming Experts", Judge Toulmin gives his observations on "the critical path" and "delay analysis". The judgment states at [565] to [575] as follows:

> "1. The critical path can be defined as 'the sequence of activities through a Project network from start to finish, the sum of whose durations determine the overall Project duration'.

2. Duration is only the shortest time if activities on the critical path are carried out in the shortest time.
3. There may be more than one critical path.
4. It is important to look at activities at or near the critical path to understand their potential impact on the Project.
5. Windows analysis, reviewing the course of a Project month by month, provides an excellent form of analysis to inform those controlling the Project what action they need to take to prevent delay to the Project.
6. Without such analysis those controlling the Project may think they know what activities are on the critical path but it may well appear after a critical path analysis that they were mistaken.
7. A less reliable form of critical path analysis is the watershed analysis. This analyses the Project in terms of a few key events. It may be a sufficient check in the course of a Project to analyse what changes, if any, may need to be made in the Project at the time of a benchmark event.
8. Both windows analysis and watershed analysis are used frequently to analyse delays at the end of a Project. A watershed analysis will be less reliable particularly if the gaps between the watersheds are lengthy. It does not show the pattern of events between the watersheds. This may be very important where a number of activities are at or near the critical path. What the watershed analysis provides is a snapshot at the particular time when it is carried out.
9. Float in a programming sense means the length of time between when an activity is due to start and when it must start if it is to avoid being on the critical path. Float can also be used to refer to the additional time needed/allowed to complete an activity over and above the shortest time that is reasonably required.
10. It is, of course, obvious that the analysis is only valid if it is comprehensive and takes account of all activities.
11. As the claimant readily acknowledges, it is merely a tool which must be considered with the other evidence. The question of whether or not the failure of the Boiler foundation caused delay to the commencement of the Reliability Trials and if so what delay is a question of fact. The evidence of Programming Experts may be of persuasive assistance."

The next paragraph of the judgment is also important:

> "To these propositions I add the proposition that if a retrospective delay analysis is being conducted on a Project, the analysis must include the time to the end of the Project, otherwise activities may occur which will take them on to the (or a) critical path after the date of the final window or watershed. In this respect Mr X's analysis which ends in October 1998 is seriously flawed."

Judge Toulmin's conclusion was that the defective boiler house foundations did not cause critical delay to the project. There were other parts of the project works that were the responsibility of Mirant, which were in more critical delay. Furthermore, the remedial works to the boiler house foundations were accommodated within the revised programme and did not, at the time, cause critical delay.

Therefore, although the defendant, Arup, had breached its contract, this had not caused the claimant, Mirant's, loss. The judge dismissed all of Mirant's damages claims against Arup.

Commentary

First, let me stress that this hearing and the judgment concerned an assessment of damages and was not directly about extensions of time.

This judgment emphasises the importance of a reliable critical path analysis when assessing the extent of delay to a project. The latest hearing in this dispute was chiefly about how to assess the impacts of competing causes of delay.

Judge Toulmin considered that it is important to look at the other work activities that were close to the actual critical path at the time of an event. In his judgment, he emphasised that, "It is important to look at activities at or near the critical path to understand their potential impact on the Project."

The judgment contains support for the "windows" method of delay analysis, and makes the following observations on this technique at [132] and [569]:

> "The term 'windows analysis' refers to the regular reviews and updates undertaken by the contractor, normally monthly. These periods of time would be described as monthly windows".
>
> "Windows analysis, reviewing the course of a project month by month, provides an excellent form of analysis to inform those controlling the project what action they need to take to prevent delay to the project."

Finally, this judgment reinforces the need for a reliable critical path delay analysis for the totality of the project to establish the real cause or causes of critical delay. As Judge Toulmin commented at [570]:

> ". . . without such analysis those controlling the Project may think they know what activities are on the critical path but it may well appear after a critical path analysis that they were mistaken."

Conclusion

So, what lessons in respect of "delay analysis" do we learn from the *Mirant v Arup* judgment? Judge Toulmin gave some good advice and useful guidance, which can be summarised into the following five items:

1. "The analysis will identify at a given date which important aspects of the Project are falling behind the programme, particularly if they are on or close to the critical path, what if any is the impact on other aspects of

the programme. It is also used as a tool for analysing, as at the given date, what has caused any delay that has occurred and what is the extent of that delay"

This is the nub of a good and reliable "delay analysis".

2. "There may be more than one critical path".

An important observation, which is often not appreciated by those reviewing a "delay analysis".

3. "It is important to look at activities at or near the critical path to understand their potential impact on the Project".

This is a good point, which should be followed by anyone carrying out a "delay analysis".

4. "If a retrospective delay analysis is being conducted on a Project, the analysis must include the time to the end of the Project, otherwise activities may occur which will take them on to the (or a) critical path after the date of the final window".

Again, sensible advice which is sometimes overlooked in a "delay analysis".

5. "The term 'windows analysis' refers to the regular reviews and updates undertaken by the contractor, normally monthly. These periods of time would be described as monthly windows. Windows analysis is the most accepted method of critical path analysis. In essence they (a 'windows' analysis) represent the division of the overall construction period into smaller periods into which each new set of corresponding progress can be entered into the programme and analysed. The essence of windows analysis is to provide a snapshot at the point at which the analysis takes place. It is a method of discovering the effect between a particular event or series of events within the time frame and the effect of one or more events on the total contract period".

This, in the author's view, is an excellent explanation on the "windows" method of "delay analysis".