Project Governance & Control,
The Building of the Crystal Palace

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The Building of the Crystal Palace

The Crystal Palace was built in London for the Great Exhibition of 1851. To put this in historical perspective, this is just 35 years after the Battle of Waterloo brought an end to the Napoleonic wars, and 60 years before Henry Gantt began his work.

A Brief Synopsis of the Building

The Crystal Palace, was a building the size of a modern shopping mall: 1848 feet [563.3 meters] long, 408 ft [124.4 m] wide and 108 ft [32.9 m] high, with a roofed area of 772,784 square feet [71,794m² ] about 19 acres [ 7 Hectares ]. The sketch plans were approved on the 11th June 1850:

Whin the ‘design’ approved, tenders were sought from industry and the design proposal from Fox, Henderson and Co accepted. Work started on the 15th July 1850, possession of site was granted on the 30th July, the first column was erected on the 26th September and the formal contract signed on the 31st October. The initial construction in Hyde Park required an existing row of elm trees to be preserved within the structure:
The design was highly modular, based on the largest sheet of glass then available measuring 10 inches wide by 49 inches long. And the construction process was highly mechanised with substantial off-site fabrication¹.

¹ For more on the construction see: [http://en.wikipedia.org/wiki/The_Crystal_Palace](http://en.wikipedia.org/wiki/The_Crystal_Palace)
The Great Exhibition opened on the 1\textsuperscript{st} May 1851, the construction time was 8 ½ months. It was a fantastic success with 2,444,241 public visitors, slightly more then the total population of the city at the time (estimated at 2,350,000).

The name Crystal Palace was created by the general public during the exhibition period and remained associated with the building when it was sold to a private company and moved from its location in Hyde Park to a new site in the South of London. The structure was relocated to a hill in the suburb of Sydenham as a venue for other shows and exhibitions.

![Fig. 4 The rebuilt Crystal Palace in Sydenham (now Crystal Palace)](image)

The building was destroyed by fire on the 5\textsuperscript{th} December 1936 (an event witnessed by my Mother).

![Fig. 5 “This is the end of an age” Sir Winston Churchill](image)
To appreciate the significance of this building, the suburb it was located into, the local football club and the parkland that housed the recycled building all retain the name Crystal Palace.

**Governing and Controlling the Construction**

My interest in this project is very much focused on the project controls and governance aspects of the management of this remarkable endeavour; and during a trip to the UK in mid 2013, I spent an enjoyable, but frustrating day browsing through the reports of the Royal Commission responsible for the whole of the exhibition and its legacy.

The Victoria and Albert Museum holds copies of the five reports of the Royal Commissioners responsible for constructing the exhibition buildings and facilities and staging the Great Exhibition. Reading through them, looking for information on the management of the construction process several aspects stand out. The first is, the first report was not written until after the exhibition finished. And the major disappointment was the fact the construction was contracted to the engineering firm Fox, Henderson and Co, and as a consequence, the actual construction management processes were not documented by the Royal Commissioners.

![Fig. 6 The very fragile nature of the report prevented a better image being captured.](image)

However, the use of graphical images to convey complex data is apparent, as demonstrated by this high quality chart detailing attendance against a range of daily factors. The chart clearly
demonstrates the ideas embedded in William Playfair's *Atlas* of 1801 were understood and in general use (Royal Commissioners are rarely adventurous). The various diagrams include line graphs, histograms and date scales but unfortunately only relate to the period the exhibition was open to the public.

Fig. 7 For comparison, a chart by William Playfair from 1821.

Detailed records of the construction process are also reported by the commissioners. Information on the construction workforce on site indicates sophisticated record keeping, as can be seen from the table below, the workforce on site peaked at 2145, supported by many more off site engaged in the fabrication and transport of the component parts to Hyde Park.

![Table of workforce](image)

Fig. 8 Record of the on-site workforce.
Recognising the risks associated with using relatively untried technologies in such a monumental structure, quality control was given a very high priority. Inspectors and superintendents were appointed and quality control processes included stress testing components and load testing foundations implemented.

And as would be expected, the accounting of all costs, including the construction costs was precise to the Farthing (1/4 of a penny). The exhibition was a popular and financial success with a final profit of £186,436 18s and 6d (in pounds, shilling and pence). These profits were used to found the Victoria and Albert Museum and the Science Museum in London.

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2 For a description of pre-decimal English currency see: http://resources.woodlands-junior.kent.sch.uk/customs/questions/moneyold.htm
There is also an interesting recognition of the problems of building such a massive structure in such a short time from a very basic initial design. There were many improvements in the design implemented as the work progressed causing the builder to incur a substantial loss, particularly as finishing late was not an option.

The Commissioners recognised this issue and made provision to compensate Fox, Henderson and Co for the losses that could be justified. Their original tender was £79,800, an additional £35,000 was approved in November 1851 and a final payment of £4,505 1s 5d closed the accounts after taking into account the sale of the structure for £70,000 to Fox, Henderson and Co for re-erection in what's now the suburb of Crystal Palace.

This understanding of the problem and willingness to work collaboratively to resolve it was no doubt helped by the presence of Sir William Cubit on the Commission. He owned a leading construction company and was a founder of what is now, 180 years later, the Chartered Institute of Building. However, for any Royal Commission to be able to properly dispense public money systems needed to be in place to properly quantify and cost the consequences of the changes needed to complete the building. This suggests sophisticated cost accounting processes within the building company as well as the Royal commission.
Conclusion

The reports of the Royal Commissioners show a very fine appreciation of governance. The objective of governance defined by Sir Adrian Cadbury Some 150 years after the Crystal Palace was built and the Great Exhibition staged is to “holding the balance between economic and social goals and between individual and communal goals. The governance framework is there to encourage the efficient use of resources and equally to require accountability for the stewardship of those resources”\(^3\). This defines governance as a pragmatic process focused on outcomes, not the blind imposition of undue process.

The Royal Commissioners demonstrably achieved those objectives by ensuring adequate compensation to the builder and ensuring the preservation of the Crystal Palace despite Parliament voting against retaining it in its original location. Flexibility was shown when needed allowing work to start months ahead of the contract signing which in turn allowed the exhibition to open on time but financial and quality controls were strict and effective.

Additionally, the results of the building contract strongly suggest the project was effectively controlled and managed. But unfortunately whilst there are tantalising glimpses of sophisticated systems that could effectively manage extended off-site supply chains, large workforces and mechanised production; whilst dealing with the small tolerances allowed in

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modular cast iron, none of these have been preserved in the records of the Royal Commissioners. This is probably understandable given the Commissioners were the customer, not the builder and they had the overall responsibility of staging a massive event but it is disappointing.

The primary objective of my research\textsuperscript{4} was to identify the processes used by Fox, Henderson and Co to sequence, schedule, organise and manage the construction of a very large building in a remarkably short timeframe, with particular emphasis on time management. These records were not found and consequently, we still don’t really know or understand how the major construction works of the 18\textsuperscript{th} and early 19\textsuperscript{th} century were managed.

\footnote{This paper is one of a series looking at the history of project management and project controls. The research was focused on filling the gap in knowledge of project controls during the industrial revolution.}

For more on the development of the concepts supporting the creation and use of bar charts see: http://www.mosaicprojects.com.au/PDF_Papers/P182_The_origins_of_bar_charting.pdf

For more on the development of scheduling in the 20\textsuperscript{th} century see: http://www.mosaicprojects.com.au/PDF_Papers/P042_History%20of%20Scheduling.pdf