

JANUARY 20, 2022

ACBA6000 CONSTRUCTION MANAGEMENT

PROGRAMME CONTROL

MORGAN LEWIS
UWTSD

Table of Contents

<i>Introduction.....</i>	<i>2</i>
<i>Programme Control.....</i>	<i>2</i>
<i>Critical Path Analysis.....</i>	<i>4</i>
<i>Productivity</i>	<i>5</i>
<i>Delays.....</i>	<i>6</i>
<i>Outcome.....</i>	<i>7</i>
<i>Conclusion</i>	<i>8</i>
<i>References.....</i>	<i>10</i>

Introduction

Having received planning consent for an innovated community hub in SA1 with construction proposed to start on the 6th of March 2023 a programme of works is required. A Gantt Chart covering the programme from concept design to handover has been created. This report will discuss key features of the Gantt Chart and establish the critical path, covering cost and resources at RIBA Stage 4, Building Services Design.

Programme Control

With the construction date set the planned programme provided has been utilised to provide a suitable critical path on all RIBA Stages. RIBA Stages and their key features have been noted with more in-depth detail on cost and resources found at Stage 4. Duration throughout the chart has been estimated and can vary based on external factors which have not been accounted for in this programme. Certain tasks have been giving simultaneous starts or finishes, this is to propose the most efficient form or working based on the tasks. All tasks requiring prior work have been appointed a predecessor based on their individual needs. Dates have been set according to the desired start on site date provided by client. Issuing a Gantt Chart allows all team members to establish their role and responsibilities in providing an efficient work force. Details on resources have been included to assess rates and cost distribution. Resources such as labour and materials have been complete for RIBA Stage 4, Technical Design as seen below in Table 1 and Figure 1. In Table 1, a standard rate has been input for the required labour at Stage 4. The included rates are based on the work required by the listed professions to complete the works

Table 1 - Cost Details Table Stage 4

COST DETAILS

Cost details for all work resources.

Name	Actual Work	Actual Cost	Standard Rate
Labour	0 hrs	£0.00	£0.00/hr
Mechanical Engineers Initial Team	0 hrs	£0.00	£45.00/hr
Electrical Engineers Initial Team	0 hrs	£0.00	£45.00/hr
PH Engineers Initial Team	0 hrs	£0.00	£45.00/hr
BIM Coordinator	0 hrs	£0.00	£30.00/hr
Mechanical Engineer QA	0 hrs	£0.00	£35.00/hr
Electrical Engineer QA	0 hrs	£0.00	£35.00/hr
PH Engineer QA	0 hrs	£0.00	£35.00/hr
Construction Manager	0 hrs	£0.00	£40.00/hr
Planning Advisors	0 hrs	£0.00	£25.00/hr
Compliance Manager	0 hrs	£0.00	£25.00/hr

to a high standard. Hourly rates allow for the Gantt Chart to estimate overall expenditure for this stage of works. Using the cost distribution chart can also assess whether there are any possible discrepancies across different materials or labour costs. Allocating the appropriate budget to both materials and labour prior to setting the baseline means it is easy to re-calculate and modify following any

potential delays. In this case, the data shows that material costs outweigh labour. At different stages of construction this ratio can fluctuate. Exporting data and recording it against progress can monitor any potential risks or delay and assists in the monitoring process of complex jobs. In this instance, it would be feasible for the design team to conclude on how satisfied they are with overall cost distribution, resource distribution as well as general project overview.

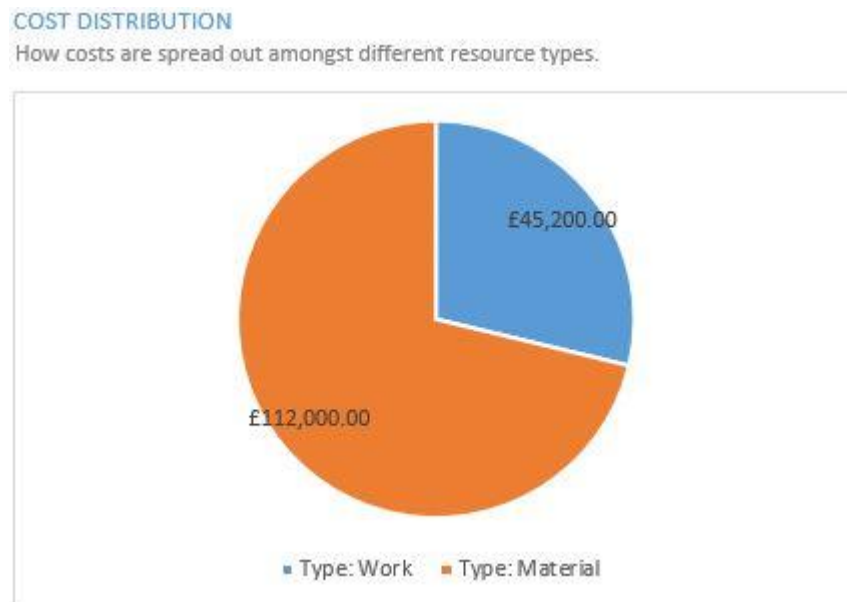


Figure 1 - Pie Chart on Cost Distribution

The workforce required for Stage 4 has been accounted for and the required hours per profession listed. An initial team of MEP Engineers will need to carry out the design work. Mechanical Engineers will additionally provide a report on Part L of the Approved Documents and Electrical Engineers will need to provide luminaire schedules based on their designs. Due to this work their associated hours will be higher compared to others. A BIM Coordinator takes part in clash detection from all the MEP Engineers and will assist across the whole design process. Once a design has been submitted it is recommended that the client quality assures the work by sourcing an alternative consultancy. This is common practice within the industry and can prevent complications before construction begins. Often, once a design has been approved it is provided to the manufacturer of choice to confirm final detail and specification on equipment. This will add to the time needed by the MEP Engineers and BIM Coordinator to incorporate the new data and information into their design. A baseline has been set for the project which is continuously monitored against the progress of each task throughout the duration of the job. Utilising the baseline allows the programme to pinpoint where any issues might arise further into the project, and it also allows the potential to see possible areas to pick up on this lag. The baseline for the community hub can be found in Figure 2. This sets a reference point for the project based on upfront estimates for tasks, cost, and duration.

RESOURCE STATS

Work status for all work resources:

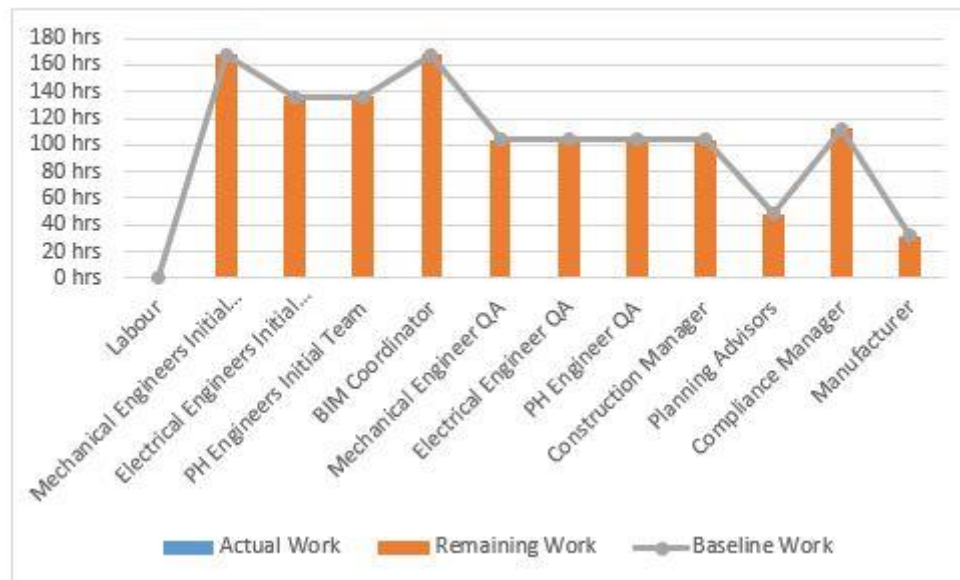


Figure 2 - Resource Stats with baseline

Productivity is imperative on more complex projects which include various contracts, sub-contracts and client set milestones. It is important to set the baseline in the programme to potentially flag any issues in productivity levels.

Critical Path Analysis

To ensure an efficient work force is in place some tasks have been set to start or finish alongside similar tasks, where applicable. When setting out a programme it is best practise to allow suitable time frames for each task, however it is possible to carefully schedule tasks to create a more critical path. Critical path analysis allows for the most efficient way of carrying out tasks and allowing for a project to run in a smooth manner (Kenton, 2021). By utilising critical path analysis, it allows for pre-planning and

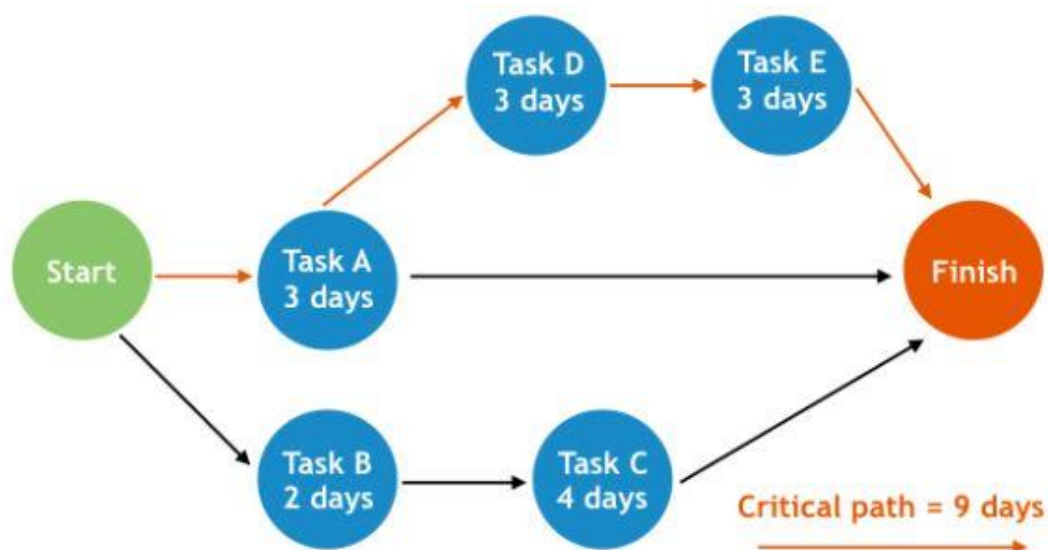


Figure 3 - Critical Path Method Diagram (O'Loughlin, 2016)

monitoring from an early stage which can potentially reduce the risks closer to construction. For a complex project such as the innovative community hub, a critical path has been created to complete the project in the shortest and most efficient use of time (Ramos, 2022). Tasks have been purposefully organised to produce a more efficient outcome. Creating a critical path diagram can allow for the float to be calculated. Float is the number of hours that might not be being used to its full potential. An example of a critical path diagram has been provided in Figure 3. The diagram shows a critical path of 9 days from start to tasks A, D and E to finish. The calculation is based off how efficiently these tasks can be carried out, either alongside other tasks or depending on how much time they might need to complete. As shown in the diagram, task A and B can begin simultaneously, however task C cannot commence without both being complete. In this instance it would mean any labour or materials from task B would be in float 1 day until task A is complete to be able to move on. Therefore, this would not be the most efficient route and not the critical path.

Productivity

Productivity is often associated with motivation and can really impact a project timeline. If motivation is low from involved parties or individuals it can be difficult to complete tasks efficiently. Programming a plan of work can keep teams structured and organised however in some cases, it might require incentivisation to motivate. Incentives are used frequently in workplaces, and they are not all financial. Incentives can be useful to the client in complex projects as it gives everyone involved a common goal. Profit-sharing can be a great motivator and has seen successful results several times. Studies such as Bryde and Joby's in 2007 on performance and reward found a case study where a project that completed under budget used the overflow of money as a reward split between contractor and client (Bryde & Joby, 2007). However, it is important to consider that introducing this form of incentive can cause risk of contractors or client undercutting prices if it means financial gain. To avoid this risk there are alternatives such as good management and verbal recognition. An article published by Forbes wrote that 66% of people would quit their job if they felt their work was not appreciated (Lipman, 2017). Implementing a strong management team with good communication can effectively motivate workers along with appraisal towards performance (Rupp & Smith, 2003). Having this structure in place also works in favour for setting expectations clearly. (Appelbaaum & Kamal, 2000) quotes Grant (1997), when discussing the importance of clearly stating what is expected of employees in their role. The journal mentions that 85% of people surveyed did not think that their job description was a true representation of their role. Setting clear and specific expectations in the contract will outline duties and responsibilities for both client and contractor. When setting an incentive for multiple teams working together it can be beneficial to opt for financial reward. Proven studies do however show that in many cases employees can receive the equivalent motivation from other incentives such as job satisfaction, verbal appraisal, and structured management. These forms of incentivisation can be

included within the contract and can be influenced by the chosen contract. In instances where teamwork is relied on heavily throughout a project the contract is set out to encourage this. Alliance contracts are frequently used on complex projects as they create a collaborative environment and share the risks between client and contractor. The approach undertakes a more “no fault – no blame” of working which can benefit both sides of the contract. A case study in Australia found that this method of work was successful in over 200 projects with 50% of projects coming in under the deadline (CMS, 2022). In many cases, where a pain share and gain share type of contract is used the project has benefitted from higher rates of job satisfaction and productivity (Mignot, 2011). This works hand in hand with the methods of incentivisation employees find most effective to their productivity levels. Creating a contract on shared risk allows for more collaborative workforce and in return can keep motivation and productivity high with proven positive results on project completion. Accepting a risk sharing approach on the contract also creates a better working condition for problem solving (Shaw, 2021). When delays occur during larger complex projects it is vital that client and contractor are working together and not against each other. Risk sharing contracts hold benefits for both client and contractor including greater chance of early completion and delivery on targeted costs (Ross, 2001).

Delays

Following the completion of the Gantt Chart the MEP Consultancy have notified the client of newly received information regarding COVID transmissions and would like to redesign parts of the plans. Delays are often expected in construction especially on more complex projects. Often these delays arise from external factors such as weather or market conditions however it is always possible that these can come from internal teams. The redesign is predicted to take 4 weeks, with the already allocated 6 weeks this would cause large delays to the overall construction time and completion date. Due to the new information on time scale, it is possible to appropriately modify and update the Gantt Chart to suit and evaluate the outcome and how this affects the remainder of the project. With the delay taking place during Stage 4 of the RIBA Stages of work it will directly affect the remaining stages from construction to handover. By inputting the delay estimates into the programme of works the outcome can be determined as well as alternative routes to create a new critical path. Although it is not possible to predict delays, there are preparation that can be put in place to best control a project timeline. One of these would be a programme, others include setting milestones and recording the projects progress. Additionally, contracts can include early warning systems where parties are required to notify each other of any foreseeable issues or delays for the duration of the project. Introducing steps like this to the contract can not only allow for delay analysis as soon as possible but can also maintain a strong relationship between client and contractor. A contract should include all details on delay protocols.

Outcome

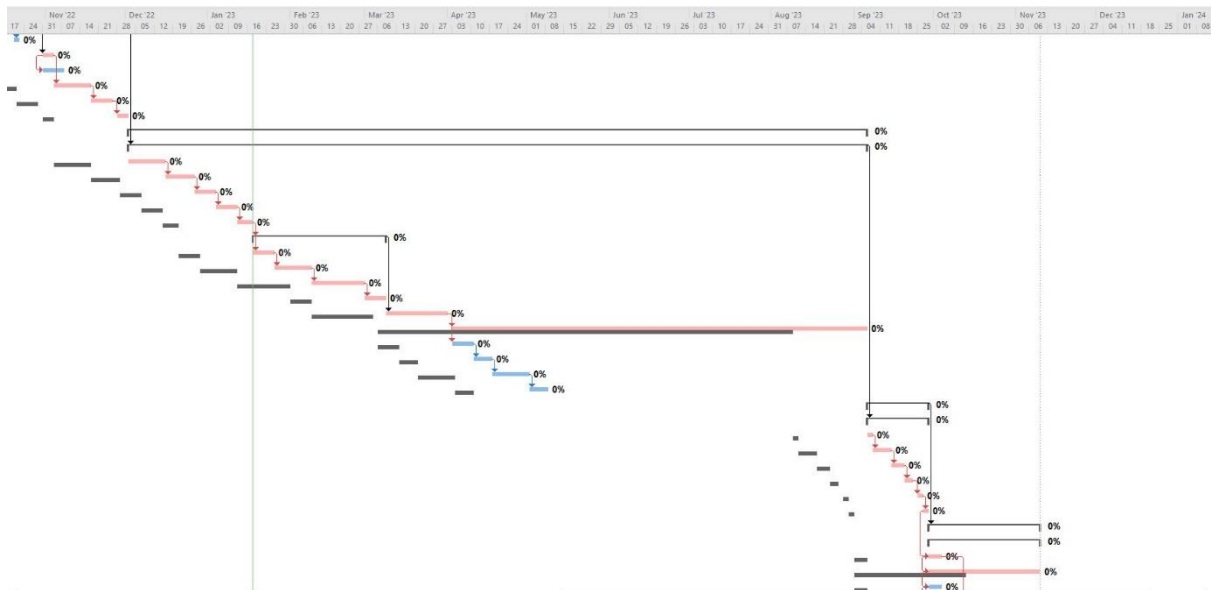


Figure 4 - Gantt Chart with added delay

The delay first takes place on the top left of the timeline shown in figure 4 where the delayed tasks are in red and any undistributed tasks following the delay are shown in blue. The original baseline is clearly displayed in grey showing a clear image of how the delay has impacted the project overall. Initially, the delayed task's successor has not altered however most steps have been pushed forward the additional 4 weeks. Due to the delay occurring at a late stage the likelihood of a later construction date is very high. With the technical design due to start on the second half of 2022 following the baseline timeline, and with the added delay we can stay within that half a year. However, as this information and detail is a requirement to continue with on-site internal works its possible to continue with external works. The contract stated a construction start date of March 6th, 2023, which aligned with the baseline of the original programme of works. Following the delay, the programme now estimates a start date of April 4th, 2023. Not only does this cause issues for the design team but additionally to any contractors or appointed sub-contractors. There are many forms of delays and in the construction industry they have been categorised into three types, delay event, culpable delay, and non-culpable delay (Suttling, 2020). Whichever category the delay comes under determines who is at fault (Skaik, 2017). In this scenario, the delay has been caused by the technical team and thus becoming a non-culpable delay. The team had received new information on a continuously changing event and needed to respond appropriately. A non-culpable delay is when contractor is not a fault and therefore the client must take responsibility. Often, this would require the client to consider or allow any requested extensions on time. By taking into consideration where the delay is and what tasks will be directly affected will allow for an alternative critical path to be created. Certain details of the project would be confirmed and fully specified by Stage

4 and therefore able to proceed. For example, the structural aspects of the project will have been complete and finalised by end of Stage 3. By modifying the programme of works to allow for the structural work to commence at an earlier stage shows that the delay is less impactful on the whole project as Figure 5 shows.

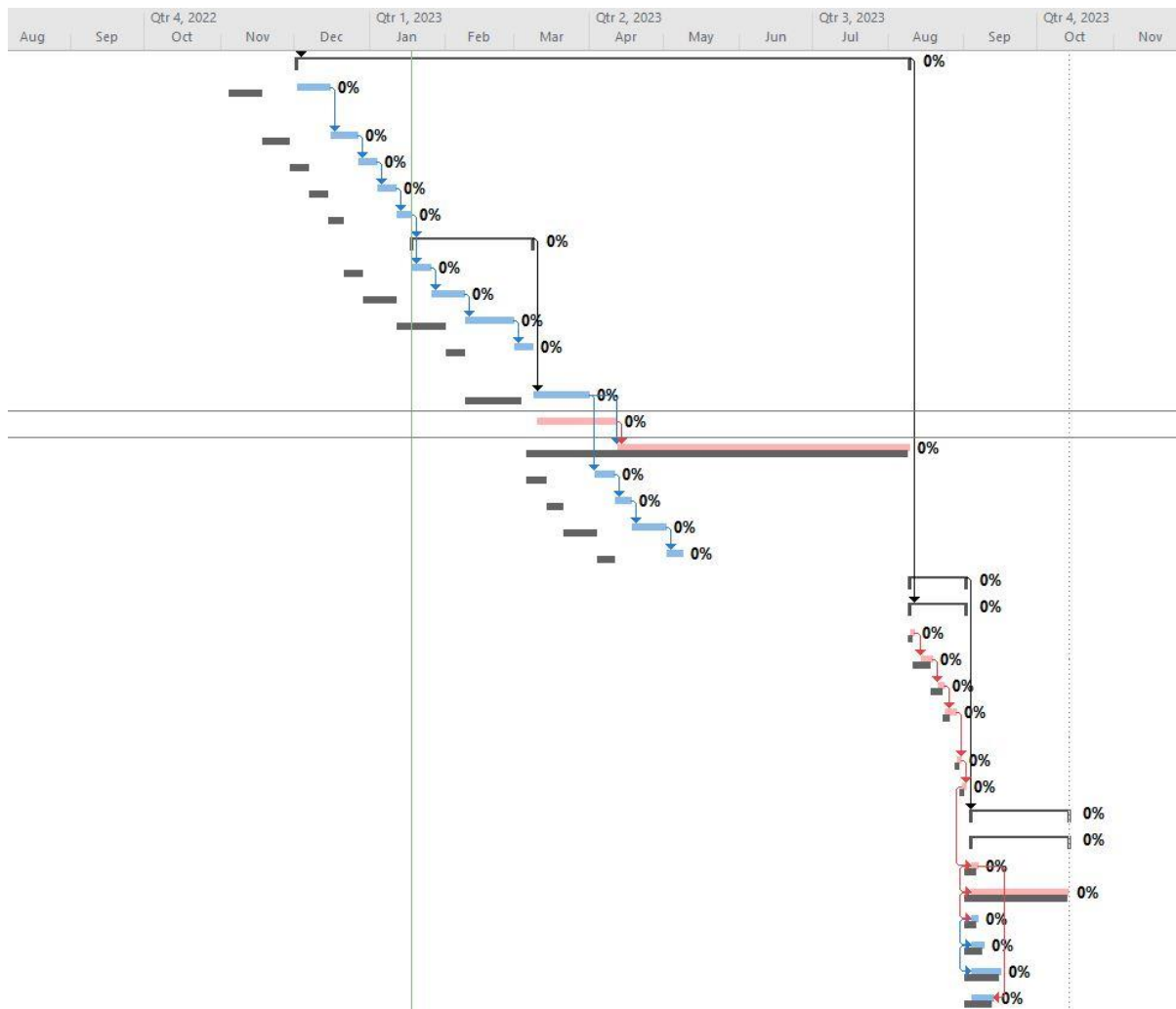


Figure 5 - Updated Timeline

By analysing where the delay might impact the most and exporting tasks not directly related it is possible to recalculate the critical path analysis with the added delay to create an efficient route to the desired start date. By doing so it is visible in the timeline that all delayed tasks are now aligned with the original baseline allowing for project to continue following the programme.

Conclusion

Delays can be inevitable in the construction industry which can put added strain on the client, the design team and contractor. Coordination and early engagement can help control these issues whether they are internal or external factors. Contract choice is important and can help or hinder a project.

Innovative working and collaboration between client and contractor will set the pretence for the duration of the project and is an additional feature when maintaining productivity. Alliancing has proven results in creating efficient workforces and results. Clear communication from contract to programme of works shows transparency of expectations from all involved which in return contributes to productivity. With a set programme end date it is even more important to establish milestones, any required incentives and continued collective working to reach a common goal.

References

- Appelbaaum, S. H., & Kamal, R. (2000). An analysis of the utilization and effectiveness of non-financial incentives in small business. *Journal of Management Development*, 738.
- Bryde, D. J., & Joby, R. (2007). Incetivising project performance in the construction of new facilities. *Journal of Facilities Management*, 147.
- CMS. (2022). *Contract Alliancing in Construction*. Retrieved from CMS: <https://cms.law/en/int/publication/contract-alliancing-in-construction>
- Kenton, W. (2021, February 25). *Critical Pathway Analysis (CPA): Definition, Purpose, and Example*. Retrieved from Investopedia: <https://www.investopedia.com/terms/c/critical-path-analysis.asp>
- Lipman, V. (2017, April 15). *66% Of Employees Would Quit If They Feel Unappreciated*. Retrieved from Forbes: <https://www.forbes.com/sites/victorlipman/2017/04/15/66-of-employees-would-quit-if-they-feel-unappreciated/?sh=3efec8c06897>
- Mignot, A. (2011, March 31). *Alliancing benefits and challenges in infrastructure projects*. Retrieved from projectmanager.com.au: <https://projectmanager.com.au/alliancing-benefits-and-challenges-in-infrastructure-projects/>
- O'Loughlin, E. (2016, May 20). *How Understanding Critical Path Can Drive Project Management Success*. Retrieved from Software Advice: <https://www.softwareadvice.com/resources/what-is-critical-path/>
- Ramos, D. (2022, May 5). *Advantages and Disadvantages of the Critical Path Method*. Retrieved from Smartsheet: <https://www.smartsheet.com/content/critical-path-advantages-disadvantages#:~:text=company%20from%20liability.,Advantages%20of%20Critical%20Path%20Method,easier%20task%20prioritization%2C%20and%20more.>
- Ross, J. (2001). Introduction to Project Alliancing. *Defence Partnering & Alliances Conference* (p. 15). Canberra: Project Control International Pty Ltd.
- Rupp, W. T., & Smith, A. D. (2003). Knowledge workers: exploring the link among performance rating, pay and motivational aspects. *Journal of Knowledge Management*, 112.
- Shaw, E. (2021, March 9). *Alliance contracting in the UK infrastructure industry: An Australian perspective*. Retrieved from DLA Piper: <https://www.dlapiper.com/en/insights/publications/2021/03/alliance-contracting-in-the-uk-infrastructure-industry>

Skaik, D. S. (2017, June 17). *delay and extensions of time in construction contracts*. Retrieved from CMG:
<http://www.cmguide.org/archives/2769>

Suttling, D. (2020, March 20). *What is Culpable Delay?* Retrieved from C-Link: <https://c-link.com/blog/what-is-culpable-delay/>