11 On the disruptive and delaying impacts of late payments

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In recent years, more and more construction projects have run into trouble because employers have made late and/or under-certified payments to the contractor – so much so that courts, arbitral tribunals and even governments are taking notice.

Traditionally, contractors have only attempted to recover the additional financing costs imposed on them by late and/or insufficient payments, not realising the significant disruption and delay costs incurred when these payment patterns caused cash shortages severe enough to prevent contractors from properly funding project operations.

Causes for cash deficits on construction projects

There are several reasons why employer payments may be insufficient to timeously fund progress on a construction project:

- Payments by the employer may be late.
- The engineer may delay the issuance of payment certificates.
- The engineer may be under-certifying the works, leading to insufficient progress payments.
- Changes (variations) may have been instructed, formally or informally, and their valuation may be disputed.
- The employer may not be aware about the disruption and/or prolongation costs associated with project changes, and thus may be reluctant to pay for such costs in a timely manner (or at all), even when extensions of time are awarded.
- And, of course, the contractor may have under-bidden the project or be inefficient, and thus may require more resources to complete the project than originally anticipated / planned.

Impact of late and/or insufficient payments on project cash-flow

Before we explore the disruptive and delaying impacts of a cash shortage, let us first describe how easily such an event can actually arise on a construction project.

An as-planned project

In Figure 1 we show an example of the planned cash flow for a $1 bn project: The green and purple lines show cumulative planned cash-in and cash-out curves, and the red curve shows the difference between these two (which is the cash on hand at each point in time.) Bottom line: if both the contractor and the employer strictly followed the plan, the contractor would always be able to finance the works with the payments made by the employer.

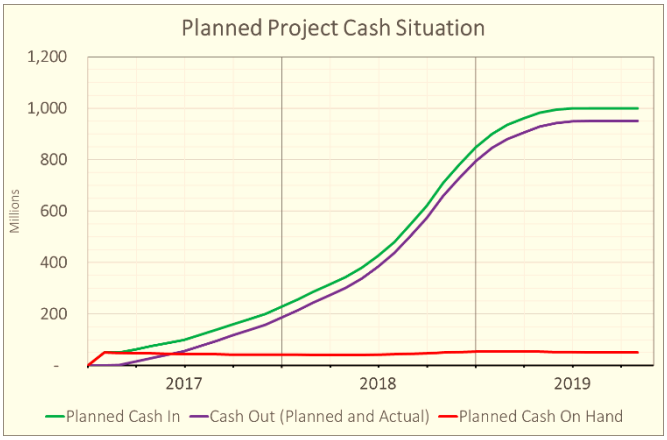

Figure 1: Planned project cash flow.

Of course, no real-world project strictly follows the plan, as it will always face at least some unforeseen events of some kind – thus real project plans include contingencies or some provisions for risk:

- First, the planned cash in hand never reaches zero, so there is always a small amount available for unplanned contingencies.
- Also, contracts often include a small percentage of the contract sum for "additional financing costs", to cover the eventuality that the contractor may need to seek additional funds from other sources (banks, etc.); this is good risk mitigation practice.
- Finally, there are usually contractual provisions that will require the employer to provide additional funds for any changes instructed, and to make on-account payments for any additional costs associated with these variations.

Impact of late payments

Figure 2 shows the impact on the project's cash position when the project proceeds as planned, except that payments are made two months later than what is stipulated in the contract.

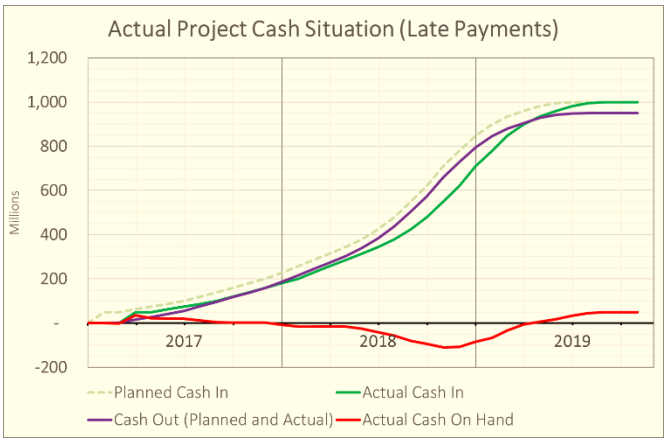

Figure 2: Project cash flow with a 2-month delay in payments.

As can be seen, in this scenario the cash on hand change radically: Simply because of this 2-month delay in payments, the cash on hand would have become negative starting in 2018, and, towards the end of this year the need for additional funds would have reached a peak of $110 million.

Assuming that the contractor had been able to secure a loan to finance all of the shortfall, at 5% interest this would have added over $3.2 million in additional interest costs.

To summarise: the contractor would still have completed the project on time, but he would have ended up making less profit on the project… as long as he had been able to survive the late-2018 cash squeeze, either by arranging for delayed payment agreements with his subcontractors and suppliers, by securing additional short-term funding (such as a bank loan), or both.

Impact of cash shortages on project performance

What the previous example shows is that, in situations where an employer breaches his contractual payment obligations, a contractor may easily run out of money – and will need to quickly find tens (or even hundreds) of millions in additional financing to be able satisfy his own payment commitments to personnel, suppliers, subcontractors, etc.

This problem is felt in many countries int the world, and with ever more frequency, employers, financial institutions and insurers are getting involved in costly disputes and claims over such financing costs.[1]

But… what would have happened on our project if the contractor had not been able to secure sufficient funds in late 2018, to satisfy his need for cash? In other words: What would have happened to the project if there had been what we will call an actual "cash shortage"? In this case, the contractor would no longer have been able to meet his downstream contractual and financial obligations, and both subcontractors and suppliers would not have been paid as agreed. Irrespective of contractual conditions, if this situation had continued for long enough it would eventually have led to unpaid subcontractors refusing to work, and/or to suppliers refusing to deliver without payment – and either of these situations would have caused severe disruption and delay to the project.

Analysing the disruptive and delaying impacts of cash shortages

In recent years, contractors have become more aware of this issue, and late and/or insufficient payments have begun to be recognised as employer-responsible causes in project delay claims.[2,3,4,5] Even so, the difficulties

[1] Peters, E.J., Kern Subar, K., and Martin H. (2019) "Late Payment and Non-payment within the Construction Industry: Causes, Effects, and Solutions, Journal of Legal Affairs and Dispute Resolution in Engineering and Construction, June 2019.

[2] Shahsavand, P., Marefat, A., Parchamijalal, M. (2018), Causes of delays in construction industry and comparative delay analysis techniques with SCL protocol, Engineering, Construction & Architectural Management Vol 25 # 4

[3] Alhajri A. R., and Alshibani, A. (2018) Critical Factors behind Construction Delay in Petrochemical Projects in Saudi Arabia, Energies 2018, 11, 1652; doi:10.3390/en11071652.

[4] Rabbet Partners Procore 2019 Construction Payments Report. The survey of 184 general and subcontractors across the United States showed slow payments had effects on their work and bottom lines.

[5] A spate of cases on this matter have been recently submitted to the Board of Grievances in Saudi Arabia. For example, in Administrative Judiciary Case No. 2553/K for the year 1438 AH, a decision was rendered that the employer's continued delay in effecting approved progress payments applications caused delays to the contractor's execution of

in proving causation and in isolating the damage caused by the cash shortages have limited the number of cases brought forward, especially when claiming for disruption.

But, System Dynamics can help contractors to overcome this difficulty. System Dynamics simulation models are able to capture the two main direct operational impacts that a cash shortage can have on construction projects:

- Reduced manpower levels, caused by layoffs and/or by subcontractors slowing down and refusing to continue to work without payment; and
- Stoppages / interruptions in the supply chain, caused by suppliers refusing to fabricate and/or deliver parts or materials without payment.

To prove this, and to quantify the disruption and the delay that can be caused by these kinds of direct impacts, we used a System Dynamics simulation model that had been previously used to support an actual disruption and delay claim for a project in the MENA region. We decided to use this model because the project had been afflicted by several cash shortages of varying severities and durations, and so we were confident that the model was accurately calibrated to capture the disruptive and delaying impacts of these kinds of events.

For the purposes of simplicity and clarity, for this analysis we removed all other disruptive and delaying events from the simulation model, leaving only a single cash shortage.[6]

The Baseline simulation

First, the simulation model was used to show how the project would have performed in the absence of any external disruptive or delaying events (the 'Baseline' scenario.) Figure 5 shows the baseline performance of four key construction variables: Direct construction manpower, cumulative direct man-hours spent, construction S-curve (cumulative progress achieved), and construction labour productivity.

As shown in Figure 5, in the absence of external disruptive and/or delaying events the project would have achieved essential completion in month 30 (progress exceeding 98% completion), but snagging and punch-listing would have required to maintain manpower on site through month 35 – a common circumstance in many large-scale construction and engineering projects. Also, note how even without the impact of any external events, this particular project would have already suffered from some productivity losses early on[7].

works and, consequently, damages ought not to be imposed on them. "The delay in disbursing the amounts due the contractor leaves the contractor lacking cashflow (short of cash), which negatively impacts his progress based on the need to provide equipment, labour and raw materials on specified dates." The judgement also states that "contractor's delay in execution of the works was due to the delay in [the employer's] not paying the due amounts on time, and this is considered a reason that exonerates the contractor from the application of delay damages and supervision costs."

[6] For more information on how System Dynamics simulation models are generally used to assess disruption and delay, and on how they can produce different scenarios depending on which external events they consider, please refer to our earlier article in this series "05 Applying System Dynamics to assess disruption and delay: The 'D3A' approach". All articles in this series can be found on our website at: www.constructiondynamics.global/on-disruption-and-delay.

[7] For more information on the nature of disruption and on how it can be endogenously generated by a project, please refer to our earlier article in this series "05 Disruption: Such a Tricky, Elusive Animal".

In this case, the earlier losses in productivity were caused by "learning curve" effects (people getting up to speed on the project), while the second dip (starting around month 10) was caused by the tightness of the schedule (which led

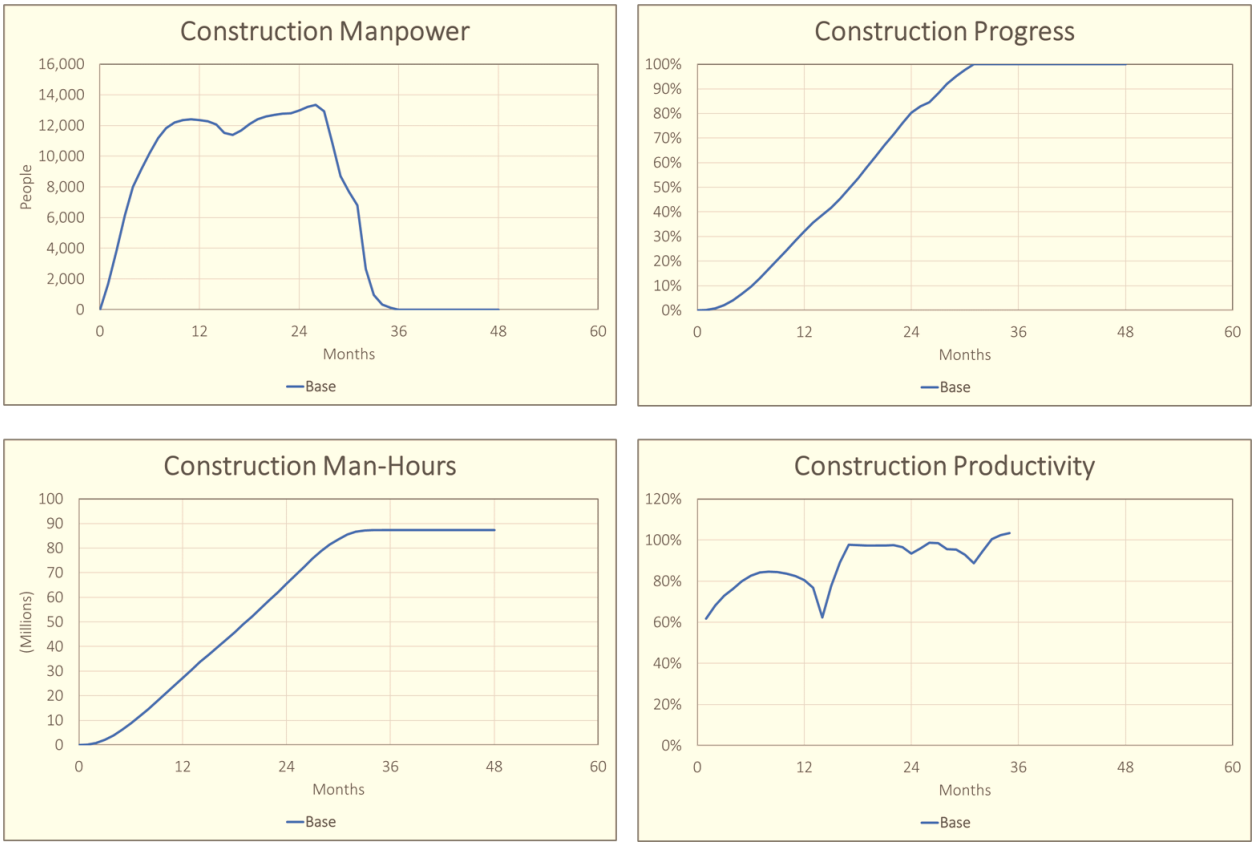

Figure 5: The baseline (undisrupted) scenario.

The impact of a cash shortage

Then, a single cash shortage event was added to the model: It was assumed that the cash shortage would be severe enough to cause 80% of the workforce to eventually leave the site, and 80% of the supply chain to eventually stop their deliveries. The cash shortage started at month 14 and lasted 4 months.

The results of this simulation are shown in Figure 6 (overleaf.) The scenario ("Severe Shortage, red dashed curves) shows that disruption resulting from the shortage caused 10.9% additional direct construction man-hours, and that the project was delayed by 6.4 months.

What produced this disruption? The productivity graph in Figure 6 shows how, while in the "Baseline" scenario project productivity radically improved after month 14 (❶), in the "Shortage" scenario it remained low for the duration of the shortage, and then recovered much more slowly (❷). This happened because, in this latter scenario, more work had to be performed out-of-sequence during the shortage event because of the unplanned partial demobilisation of the workforce. After the event, out-of-sequence work continued to happen because of the haphazard re-mobilisation (not all subcontractors were able to re-mobilise at the same speed, and the whole process was plagued by uncertainty), and because of the imbalances and delays in the procurement process (it took the supply chain the better part of a year to overcome the disruption introduced by the cash shortage event.)

to unplanned overlaps between design and construction.) These disruptive mechanisms occurred on the project for which the simulation model had been originally set up.

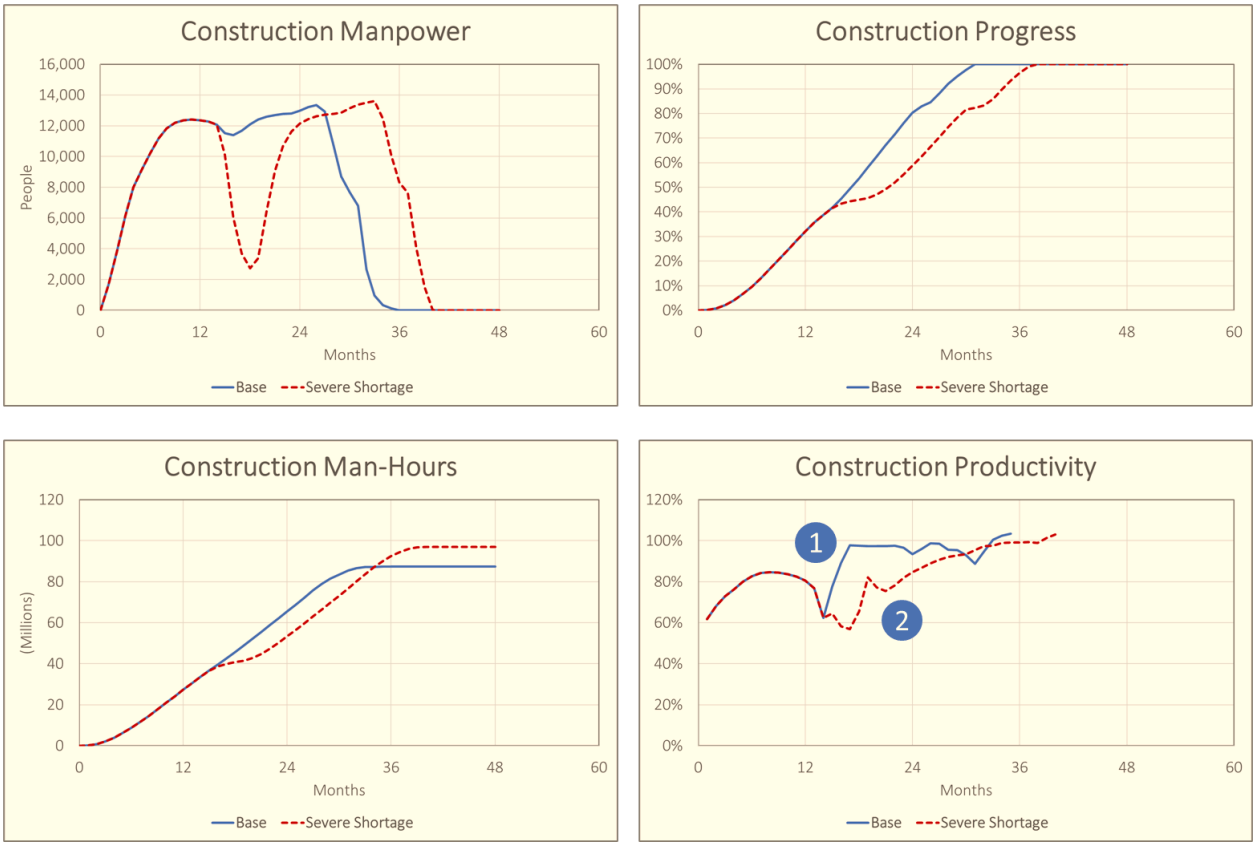

Figure 6: Project simulation without (blue) and with (red, dashed) a severe cash shortage.

The manpower graph in Figure 6 also shows another important characteristic of cash shortages: Their impact is not binary (on/off), but rather gradual. Indeed, the peak in the de-mobilisation process was only reached 4 months after the start of the event, the reason for this being the unplanned and uncertain nature of the cash shortage: Expecting normal payments to resume, subcontractors and suppliers continued to work even as contractual payment obligations by the employer were not met… until such time when they could no longer afford to do so.

Conclusions

Conventionally, the cost of delayed payments and/or under-certified work has been estimated as the cost of financing the resulting cash flow deficit. However, the present analysis shows that, in the event of an actual cash shortage (when the contractor is unable to secure sufficient funds to execute the project as planned), much higher costs can be incurred because of the additional disruption and delay resulting from the shortage.

Historically, this causal connection has often not been recognised, especially on projects that were already severely delayed and disrupted. And, even in those instances when the issue was recognised, available assessment methods were unable to isolate the damages to which the contractor would have been entitled because of the cash shortage.

System Dynamics now changes this picture, allowing contractors to determine the disruptive and delaying impacts of cash shortages, and to estimate resulting cost and time overruns.

A final caveat

The analysis presented in this article shows how delayed payments impact the performance of an otherwise undisrupted project. The analysis used a simulation model calibrated to accurately reproduce the performance of a project, so the results obtained can be considered a close representation of the actual disruptive consequences of these actions by an employer.

However, the analysis did not take into account the cumulative nature of disruption, how the impacts from different events can interact and compound each other, often in counterintuitive ways. Given the almost infinite number of combinations of disruptive events that occur on real projects (types, number, magnitudes, timings etc.), it is impossible to develop any generic rules to foresee the disruptive and delaying impact that cash shortage will have on previously disrupted projects – each one will still need to be analysed on its own merits.

For more information, please contact us at:
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