CITC GLOBAL Construction in the 21st Century

*The Fourteenth International Conference on Construction in the 21st Century (CITC-14)*
Rio de Janeiro, Brazil | **September 2-5, 2024**

# PROJECT LENGTH DETERMINATION: ONE ROOT CAUSE OF CONSTRUCTION'S DYSFUNCTIONS

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## Abstract

Construction Project Schedules are the most significant leverage point for improving social and economic outcomes for the industry. This paper aims to explore the effects of increasing and decreasing timespans. A pressing issue is a lack of a method and mathematical equation for owners to determine a socially and economically sensitive construction timeline. Disturbingly, the current academic research on this topic is sparse. Creating a holistic schedule-setting process and algorithm is more important than ever due to several factors, including worker shortages, women's participation, increased project complexity, mental health, the algorithm are more important than ever due to several factors, including worker shortages, women participation, increased project complexity, mental health and quality problems. Pre-tender project time setting has been an ignored area. This resulting arbitrariness, which relies on experience, input process times and economic motivation, does not serve Australia's social and economic goals. It is one root cause of today's construction dysfunction. Installation time compression with increasingly complex construction installation appears to be a blind spot for project owners since they have to determine an appropriate deadline for all project parties. For-profit organisations and other entities seek to take earlier possession to capture more economic value for themselves; however, these firms must be sensitive to the many adverse effects of pre-tender schedule setting. A structured assessment process should be an additional criterion for project feasibility practices. This paper asserts that a solution may be found if portfolio management scheduling practices can be extended to an entire market where the incident project is planned to be constructed.

**Keywords**: Construction Project Timespan, Baseline Schedule Determination, Schedule Impacts

## 1 Introduction

The current project timeframe determination process is not expressed qualitatively or quantitatively. It appears to be intuitive and consultative with the project owner, creating the project deadline. It is not expressed directly in literature nor in an algorithm. There is scant research on an owner's baseline schedule determination for projects and no apparent formal or structured decision-making process for aligning complexity, size and other factors to a reasonable construction time. This is increasingly problematic due to growing design and installation complexity. This misalignment has many adverse economic and social effects. This is a decades-old error of omission. It is puzzling that construction practitioners and researchers have not identified this as a root cause of many industry problems.

The researchers assert that a shortened project schedule causes poor social and economic outcomes in construction's complicated craft-centric business. Construction's social and economic impact should not be underestimated; it is one of the largest private employers in Australia. McKinsey (2020) refers to the sector as "the world's largest (economic) ecosystem." The current problematic dynamics and suboptimum culture will continue if not addressed across the industry. Economist Howard Bowen coined the phrase "Corporate Social Responsibility" (CSR) in 1954, and he, along with others, has written extensively about its value and utility since that time. CSR's roots emerged in the 18th century when faith-based organisations refused to invest in industries like tobacco and liquor, the slave trade, and war-related activities.

The researcher has observed that construction contractors seek four primary project goals. They are listed in order of criticality: Safety, Quality, Cost and Schedule. Safety is first for obvious reasons, i.e., moral, ethical, legal and financial. The second is quality, which provides elevated utility and low maintenance use. The third is cost, which keeps companies in business with higher-than-average return on investment. The last schedule is an extension of cost management for the owner. For each day the project is completed earlier, its ROI is higher. However, for the contractor (and other stakeholders), shorter schedules cause dysfunctional project portfolio management.

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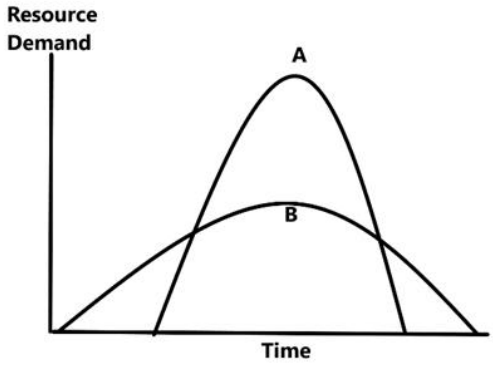


**Figure 1**. Theorised "More Intense" (A) versus "Less Intense" (B) Resource Demand Profile

One challenging problem of construction contracting is the requirement to build more than one project at a time or project portfolio management (PPM). Figure 1 shows a theoretical resource demand curve for each project over time in a construction firm. This is partly from the researcher's experience. As is well known, each is different in turnover size, schedule length, complexity and other important characteristics. Contractors do not determine their mix of work; the market does. Projects overlap imperfectly in timing, and this unevenness causes labour and equipment utilisation to dip below the sustainable return on investment. Other times, demand for these inputs exceeds their capabilities and forces trade-offs, including temporary staff and expensive rental (Not owned) equipment. The industry has the Goldilocks problem, i.e., the business is either "too hot or too cold, but rarely ever just right". See Figure 2.

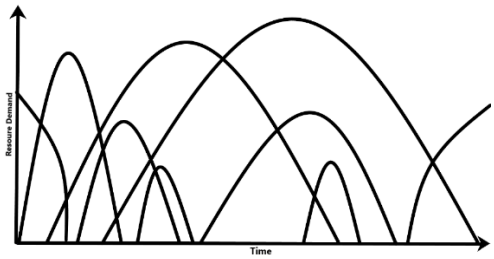


**Figure 2.** Multiple Resource Demand Curves that are Normal For Construction Contractors Make Schedule Intensity Effects More Complex

The United Nations Sustainable Development Goals (SDG) articulate several objectives that are outcomes of socially responsible schedule setting. SDG 8 applies, "Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all", and SDG 12, "Ensure sustainable consumption and production patterns" (UNDESA 2024)

This paper uses the IMRAD framework, a standard format for structuring conference papers and journal articles. The acronym stands for Introduction, Methods, Results, and Discussion.

## 2 Methods and Results

Several reasons exist for external and internal schedule compression, including economic uncertainty, project finance or lost production during construction (Noyce & Hanna, 1998).

To restate, this paper hypothesises that project owners, designers, and contractors – main and sub- want the first three results to be more than a shorter schedule. This allows for outcomes that serve organisations and society's social and economic goals. If prioritised, quick delivery is not the top need since the shelter or infrastructure should have a multi-decade life cycle. In fact, "haste makes waste" behaviours can increase errors and lead to project delays (Jalili & Ford 2016). Specifically, a study focused on the relationship between fast-tracking and predictability It revealed that schedule compression, accelerating or overlapping impacts projects in terms of achieving the original objectives and sometimes may lead to unexpected outcomes (Alhomadi et al. 2011). From the literature, studies show that fast-tracking is risky, and crashing the beginning schedule can harm and increase the probability of cost overrun (Khoramshahi & Ruwanpura 2011, Garrido-Martins et al. 2023). Recent reviews of mega pipeline projects have shown

that fast-tracking of construction doubles the odds of project failure, and concurrent design-construct increases risk four times over a similar but average-paced project (Schoenhardt et al. 2014). Specifically, higher than the average pace of construction manifested in error, design change, crew interference, and poor construction productivity (Garrido-Martins et al. 2023)

McKinsey (2020) asserts that construction projects are becoming increasingly complex. Aslaksen (2008) concludes that construction project complexity has increased due to factors such as material science, equipment utility and value (both installation and facility), design, and increased government regulations. Fast-Berglund et al. (2013) assert that construction complexity positively correlates with installation errors. A high degree of internal and external complexities has caused many difficulties in construction and hindered the successful delivery of mega-construction projects (Kardes et al., 2013). Complex projects, such as power plants and infrastructure projects, have witnessed an exponential increase in completion time and cost (Taylor & Ford, 2008). Project complexity can generate errors, leading to more work on the site (rework) and causing project delays and schedule pressure (Jalili & Ford, 2016). Systematic understanding and effective control for complexity are crucial components of project management (Bosch-Rekveldt et al. 2018). Raworth (2017) asserts that all industries must be "savvy with systems" to succeed in the 21st century. Therefore, the economy's common understanding needs to be updated from its pre-millennium knowledge to one of the complex current systems of many interdependent parts.

There are two kinds of project schedule pressure: a) external - which occurs at the pre-tendering stage with the owner setting a deadline based on factors for timely possession of the project b) internal, which emerges from the post-tendering stage when delays occur; such as in contractor selection, regulatory approval and site access. System engineering and project management strategies set realistic schedules, and acting proactively avoids the full brunt of dynamics from schedule pressure. This improves communication and coordination with suppliers, subcontractors, and designers (Nepal et al., 2006; Jalili & Ford, 2016).

Dumond and Mabert (1988) offer an experimental process to help determine the efficient allocation of limited resources for a portfolio of general work managed under one entity. They proposed a Finite Scheduling Procedure. The simulation produced better than the predicted results. They concluded using more information concerning the current work in progress, available resources, and activity precedent relationships provides a better due date estimate for a new project. However, these projects were not contracted at arms-length but internally to an organisation. Dolabi et al. (2014) note that a portfolio management approach to several projects must start with seeking repetitive tasks in each project to allocate resources effectively. However, the main issue for portfolio managers is to create a tailored system that efficaciously coordinates resources required by the activities per the need (or pull). This is the goal of the Resource-Constrained Multi-Project Scheduling Problem (RCMPSP) (Villafáñez et al. 2020). Current practice does not allow construction companies to perform detailed, time-consuming optimisation calculations while formulating their offers (Usmanov and Jarský 2012). This is also true for project portfolio management, as companies don't build one project at a time and have limited resources, forcing trade-offs, uneven weekly work intensity and employee layoffs (Stevens and Smolders, 2023).

The increasing complexity of projects means that the well-documented shortage of experienced personnel (office management, site supervisors, craft workers, and equipment operators) warrants slower installation speeds. Since the complexity of construction projects has risen, the need for system engineering (SE) is increasing (Aslaksen 2008).

In most projects, schedule pressure in a squeezed initial timeframe often encourages field staff to complete their work aggressively. However, they complete the installation inefficiently and dangerously, owing to the inability to determine a suitable trade-off between productivity and safety (Neale and Gurmu 2021). Schedule pressure can be detrimental to project performance. Nepal et al. (2006) found a negative and significant correlation between schedule pressure and work performance measured as productivity, work rate, and quality of work on site. Figure 1 shows the theoretical difference between a more intense and less intense schedule regarding resource demand.

*Labour Shortage* - Oh et al. (2024) assert that the construction industry has faced skilled labour shortages for over a decade. In Australia, the sector employed approximately 28% more people in 2022 than in 2007. The demand trend is expected to grow by 66,400 workers or 5.8% over the five years to Quarter 4, 2026 (ABS2023). Indirectly, if more intense schedules are implemented, the project's surrounding area labour pool may be unable to supply the project's peak worker needs, thus costing travel, lodging and out-of-area premiums.

A recent survey of working-age people looking for full-time employment found that 40% of women and 25% of men want to work set hours on set days. A predictable and longer-term project schedule should reduce an employer's uncertainty about employment numbers and work pace.

*Lost Last Job* – The Australian Construction Industry has the highest lost last job rate of all economic sectors (ABS 2022). Unemployment and underemployment of young people, which construction is disproportionately comprised of versus the general population, are serious and enduring problems in Australia and globally, with

significant economic and social costs for the broader community (OECD, 2022). It is associated with higher rates of depression and anxiety (see Mental Health below), family dislocation, crime, homelessness, drug and alcohol addiction and welfare dependency (Muir et al. 2015).

*Mental Health* - Data from MATES in Construction (2023) has shown that men in the construction industry are 53% more likely to take their own lives than other employed men across the country. Employsure (2023) asserts that the inherent nature of the building and construction industry is complex. Many positions require working 6 or 7 days a week, and working long hours each day produces poor mental health. The environment changes daily, which can cause dysfunction. This insurer has determined that apprentices are two and a half times more likely to kill themselves than comparably aged men.

*Safety*—Rushing is one root cause of safety incidents, accidents, and fatalities. Pre—COVID, the Australian construction industry had the highest work-related injuries or illnesses rate of all sectors, at 59 per 1,000 employees (Safework Australia 2022).

*Cost* – In the study of Noyce and Hanna (1998), schedule compression results in a moderate to high increase in the cost. The findings also indicated a small decrease in schedule duration and a mild decrease in average labour productivity due to schedule compression. Construction bankruptcy is the highest of all 16 Australian industries. Additionally, personal bankruptcy of construction professionals is the highest, and this is a follow-on effect. Missed or delayed client payments disproportionately impact a 5% net profit business. Reduced cash flow is the leading cause of construction organisational bankruptcy (Stevens and Piracha 2022).

*Quality* – the Centre for International Economics estimates the costs of construction errors to be more than AUD 2.4 billion in the country (2021). Due to poor quality, they produced no projection for building and infrastructure facility management expenses. However, it is noteworthy that the average ratio of initial construction costs to total maintenance and building operating costs is 1:9.00. Additionally, they range from approximately 5 to 30 times (Wu and Croome 2007).

*Cashflow*—Shorter schedules raise expenses per day and thus increase negative cash flow for the contractors—main and sub. Weekly payroll requirements cause any delay in payment to cause rapid negative cash flow. Projects typically start with no prepayment, making them cash flow negative, and retained payments not payable until months after completion exacerbate this situation. Negative cash flow is the leading predictor of bankruptcy.

*Multifactor Productivity* (KLEMS) – Stevens and Smolders (2023) noted that multifactor productivity measures have stagnated since 1997. The 2022 output reported by ABS (2023) is a 0.2% decline. KLEMS (K-capital, L-labor, E-energy, M-materials, and S-purchased services) refers to broad categories of intermediate inputs consumed by industries in producing goods and services. KLEMS has replaced Labour Productivity as more effective technologies, machines and processes are projected to lessen human content on construction projects in the future.

*Stakeholder Relationships*: Quick, thoughtless, and impulsive decisions to meet rapidly approaching deadlines harm relationships and interpersonal trust. Conversely, professionals working in a more predictable environment can be themselves and be more thoughtful in reacting to challenges and engaging in collaboration.

## 2.1 Results

The researcher executed a scoping review to assess the robustness of the literature in studying schedule-setting practices and an industry survey in which important factors and issues were explored and perceptions captured.

### 2.1.1 Scoping Review

Compounding the issue of the blind spot in the projected timespan is the lack of published research. The researchers executed a simple scoping review using the SCOPUS database which “includes access to peer-reviewed titles in health, sciences, engineering, social sciences, psychology, and economics. Includes all Embase content. Coverage dates to 1966”. The search boundaries were limited to the title-abstract-keywords of each paper. See Table 1 for the resulting scoping inputs and results.

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**Table 1**. Systematised Review: Topic Focus, Search Terms and Articles Found

| Topic Focus | Keywords and Search Phrases | Result |
|---|---|---|
| Project Owner's Contract Schedule or Setting of Project Timespan | initial OR beginning AND construction AND project OR contract OR owner AND schedul* | 245 |
| Scheduling Construction Projects – Starting and Ongoing | construction AND project OR builder AND schedul* | 13,683 |
| Construction Project Schedule Setting and Social Responsibility | social* AND responsibl* AND construction AND schedul* | 9 |

The words "delay*," "disrupt*," "accelerat*," or "fast track" were not used due to their applicability to both subject search goals. This broad query of SCOPUS with relatively nonspecific terms was useful in understanding the general difference. Upon inspection, some duplicate articles were found.

The researchers queried one more search string further to understand the paucity of initial schedule settings by procurers. The keywords used were: "social* AND responsibl* AND construction AND schedul*" resulted in 9 journal papers. The first published in 1970.

There is a significant gap in construction knowledge due to the lack of specific research on project owners' schedule setting in a socially responsible way. The research question should be pursued for industry progress. The next section will outline an initial set of questions for industry professionals.

### 2.1.2. Industry Survey

The researchers executed a 20-question survey in June 2024, with WSU Human Ethics approval 15976. The preliminary results are shown below in Figures 1, 2 and 3 (N=32). The survey will be open for four years.

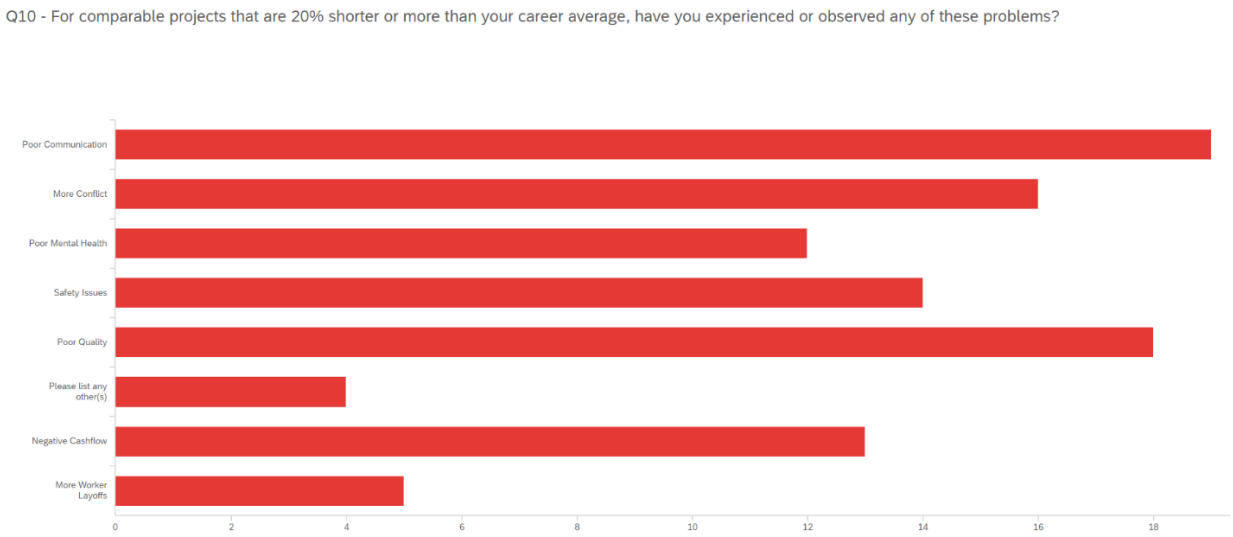


**Figure 1.** Preliminary Results of Theorised Shorter than Average Schedule Effects

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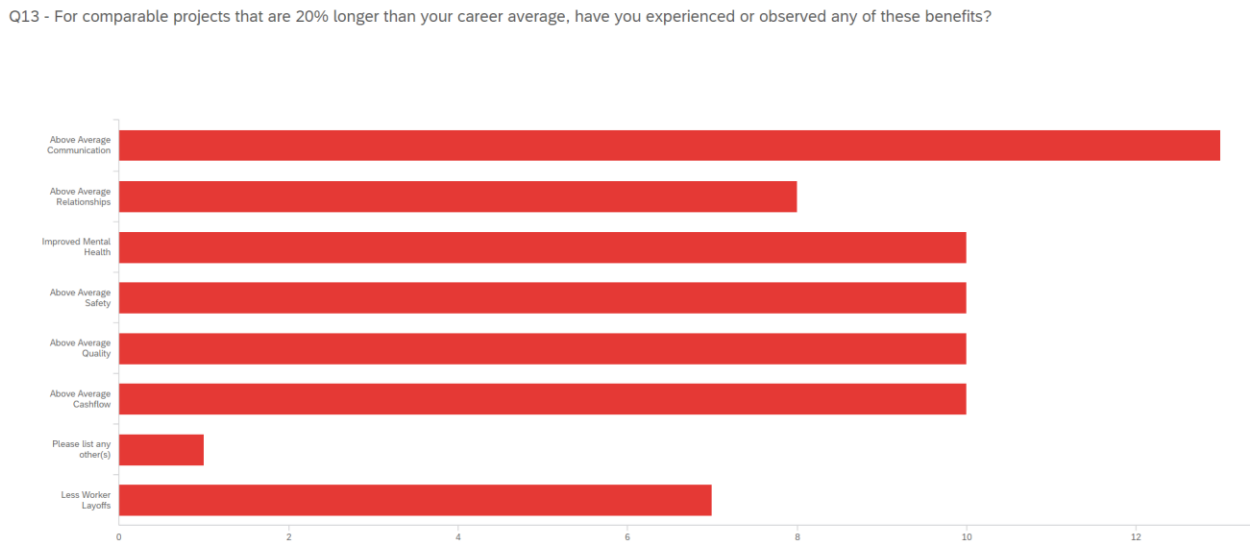


**Figure 2.** Preliminary Results of Theorised Longer than Average Schedule Effects

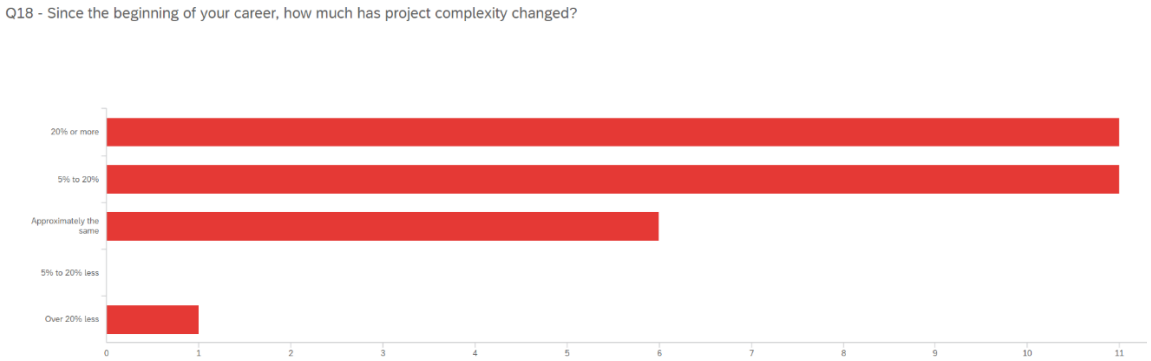


**Figure 3.** Preliminary Survey Results Regarding Project Complexity

The preliminary survey results in Figures 1 and 2 indicate that the researchers' hypotheses are credible. When the project period is lengthened while project complexity has increased, there is a swing from problems to benefits.

## 3. Discussion

We assert that a structured schedule review and assessment process should be part of the business case for any proposed project. Private owners may be hesitant to be the first to include a schedule-setting process. However, the most affected by a compressed schedule is the main contractor and sub-contractor that controls or influences 90% of the total construction cost, safety, quality, and cost. We assert that they benefit the most from a slower and not faster construction tempo - portfolio optimisation follows. Dumond and Mabert (1988) started the exploration of resource allocation against a portfolio of work, although internal to an organisation. Their model requires a repetition of the technical installation of work. Villafáñez et al. (2020) suggest that there is a pathway with their framework and model, although they do not suggest it fits competitive parties constructing on their account. Extending these approaches for a geographic area and its activity around a project needs the formalisation of principles. It should include inputs such as the local population of craft workers by skill, current work-in-progress, equipment availability and type of projects constructed. For advising project owners,

Rushing any human-centric craftwork leads to safety, quality, and cost mistakes. Indeed, longer or less input-intense schedules lead to better outcomes. A steady work pace with a daily rhythm and routine for workers, managers, and partners optimises collective outputs.

The researchers suggest poor quality has the most significant negative impact of the four. Project design is not delivered; thus, the construction service does not receive agreed-upon value, but ongoing expenses of a shelter or structure are increased disproportionately. Since the maintenance and building operating cost ratio is 1:9.00 and ranges from approximately 5 to 30 times, construction-design alignment errors.

The lack of a formal schedule determination process by private developers, government procurement officials, and NGOs is telling. Construction's critical role in society should make it the first industry examined by CSR critics. Project timeline determinations and their effects should be re-examined promptly.

Currently, the researchers are working on a solution. Creating a process and algorithm centered on the critical path (CPM) of the schedule that calculates with critical social and economic inputs from the market will set a starting point of establishing a timespan for a specific project. From there adjustments can be made to account for different factors not accounted for in the equation.

Once there is a strong interest in reforming the construction industry, pretender project scheduling will become a primary initiative in improving the most outputs. For a starting place, the literature shows that a project's critical path contains approximately 20% of the total number of tasks. Also, a started reform is to move to a 5-day work week. From these two assumptions, any UN SDG-based guidelines will enable better outcomes.

## 4. Conclusions

Shorter-than-reasonable project schedules negatively impact stakeholders, the economy, and society. Project owners have largely ignored their corporate social responsibility but now can start improving the construction industry. Any schedule bias toward less-than-reasonable completion will continue to cause dysfunction.

The lack of academic research concerning the effects of project schedules is equally troubling. Although social responsibility is well entrenched in the literature, baseline schedule dynamics have not been considered as one possible leverage point for construction transformation.

This paper asserts that four factors (but not limited to) determine the success or failure of a project: Safety, Quality, Cost, and Schedule in that order. Construction's baseline schedules greatly affect the first three project goals and, cumulatively, the industry's economic and societal outputs. The project owner's choice of a shorter rather than longer schedule may be optimal for themselves but economically and socially suboptimal for society.

To formulate, the researchers assert the following beginning ideas to be part of the proposed solution:

a) The focus should be on the time span from the construction mobilisation to practical completion—not letting delays in approval(s), design(s), etc. compress the kinetics of construction.
b) Approximately 20% of project tasks are on the critical path; therefore, an algorithm of successive tasks' overlapping is important to the research
c) A commercially available guide should be used to establish task time
d) Of course, the project schedule should be based on a 5-day workweek
e) Contract language should support the above.

Industry leaders, including government officials, should address the lack of Corporate Social Responsibility concerning arbitrary and economically motivated construction timelines to improve the sector's social and economic performance.

**Further Research**. The researchers have opened a schedule survey for four years and have furthered this enquiry with a baseline schedule process and algorithm collaboration with Western Sydney University School of Computing, Mathematics and Data Science and North Dakota State University Data Science Department. Input from the industry stakeholders and our research partners will be crucial to effectively address social and economic issues emanating from project timelines.

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