

EVALUATION OF WAYS TO RECOVER LATE CONSTRUCTION PROJECTS

THURPU PRAVEEN REDDY 1 *, MOHD. SAFIUDDIN 2* , SUEBHA KHATOON 3*

1. M.Tech- Student, Dept of Civil, LORDS INSTITUTE OF ENGG & TECHNOLOGY
2. Prof & HOD, Dept of Civil, LORDS INSTITUTE OF ENGG & TECHNOLOGY
3. Asst. Prof, Dept of Civil, LORDS INSTITUTE OF ENGG & TECHNOLOGY

ABSTRACT

Considerable percentages of projects are falling behind schedule and if a project is finished on time it would count as a success. In fact in an on time project nothing is done but what was planned originally and everyone would appreciate a project manager whose project has been finished on time. On the other hand it is common to be late in schedule. This could vary from few days to unacceptable long delays. Delay could be caused by General Contractors, Subcontractors, Suppliers, Owners and Architect Engineers and almost everyone involved in a construction project. Depending on the nature of each late project there could be a different remedy and any of the suggested methods or combination of them may be selected. In small projects the strategy is usually determined by experienced superintendents based on their intuitive ideas. In large construction project the magnitude of financial losses is larger and the project manager should carefully analyze the situation to determine what action should be taken. When a delay occurred unlike working with computer applications, there is no way to rewind the time and go back to the first day and redo the project by the correct strategy, but there are ways to use the remaining time effectively to compensate as much as possible and possibly finish the late project on time. This thesis looks to the problem from different perspectives and suggests effective ways to bring back late projects to the planned schedule.

❖ Critical Factors Affecting Schedule Performance

❖ Schedule based in correction assumptions

A recent study commissioned by the National Society of Professional Engineers (NSPE) concludes that about half of construction projects today are behind schedule. As a result of this study, there is some finger pointing. However, it seems everyone has a piece of the fault. Also, there is little gained from recriminations since, everyone wants the same thing: an on-time and on-budget project with safety and quality excellence. Additionally, each stakeholder in construction wants to do a great job personally and thus, be rewarded accordingly with more work at a higher margin. So, there is a great chance we can get a better result with a little focus. That is, a majority of all projects on schedule. It is important to understand that a CPM schedule is a critical piece of information with which Contractors and Owners manage. However, the Critical Path Method is only as good as the quality of consecutive plans, forecasts and short horizon schedules over the life of the project. So, those use the CPM must proactively plan, forecast and schedule (short horizon) in great detail based on true and accurate information. To seek a greater knowledge into the process of these three processes is the first step of many. Today, it is doubly important to understand planning, forecasting and short term scheduling processes. Again, a major study has concluded that approximately half of today's project schedules are in distress.

❖ Indian construction projects

Based on a study on Indian construction projects it is known that over 40% of Indian construction projects are facing time overrun ranging from 1 to 252 months. Fifty five attributes are known to be responsible for impacting performance of the projects. These attributes were then presented to Indian construction professionals in the form of a questionnaire. Statistical analysis of responses on the attributes segregated them into distinct sets of success and failure attributes. Factor analysis of sets of success attributes and failure attributes separately grouped them

into six critical success factors and seven critical failure factors. In order to understand the extent of contribution of these factors on the outcome of a construction project, a second stage questionnaire survey was also undertaken. The analyses of responses of the second stage questionnaire concluded that there are two success factors and one failure factor.

❖ **Main success factors:**

Followings are two main factors that were concluded to have the most affect on the success of the Indian projects.

❖ **Commitment of project participants:**

As explained later, intrinsic motivation of the project participants has the most affect on project performance. This as will be mentioned later explains the engagement theory and how intrinsic motivation could bring success to the entire project team.

❖ **Owner's competence:**

Although the owner usually is not present in construction field and even in most sophisticated projects handful of owner's personnel are present in jobsite, the project is strongly influenced by owner's competence and cooperation with the General Contractor and Architect/Engineer. Even the design built projects are highly dependent to owner's competence. In another word, a project never begins without an owner and never is completed without owner's presence. The two above mentioned success factors contribute significantly in enhancement of current performance level of the project. The extent of their contribution has, however, been observed to vary for a given level of project performance.

❖ **Main Failure Factor: Conflict among project participants:**

Conflict can work like both sword and shield. In early stages of project team development, conflict can be a very useful tool to encourage the participant to resolve the issues. Basically not having conflict means that either there is no problem at all or no one cares to resolve the issues. Not having any problem is almost impossible in the construction industry and every project may have its own problems. If conflict doesn't exist because of ignorance of project participants, the project will be in danger. In a project, problems should be resolved as soon as possible; otherwise they will extend to the entire life of the project and become the main failure factor of construction projects.

❖ **Lack of decision making:**

Parties do not know who is responsible and who takes care of what especially the role of the end user is. The reason why a decision cannot be made depends on the process of decision making itself. The difficulty in making decisions is generally attributed to obtaining the information on which the decision is based, being certain that the data used to determine the decision were correct, that it was in the correct order of importance. Not all the needed data were available at the time.

❖ **Lack of time for planning:**

Shortening time to complete tasks or marketing a product has been one of the most critical factors to the success of a business in many industries. As a result, companies have sought methods that can ensure a faster product development. Most industries focus on product cycle time reduction through concurrent development. Construction projects are not an exception. There has been increasing pressure from clients to fast-track construction projects. However, when a project is fast-tracked without proper planning, it can lead to failure or delay of the project. Since construction has a physical manifestation, a construction rework is normally perceived to have a larger impact than change. As a result, construction projects tend to avoid rework on

problematic tasks by changing the scope of the work, especially under time constraints.

❖ **Lack of trust:**

Trust is vital in a construction project, as many people from different organizations work together. The ability to rely on people to do what they say they are going to do impacts everybody and the way they work. Trust is about reducing risks and uncertainty through better communication. There is generally a lack of trust present in construction projects. It is very difficult for members of the project to obtain information from another person. It would appear that no one seems to be willing to share information and pass it on. Some members of the project have actually failed to understand the language used in the construction activities.

❖ **Lack of risk assessment:**

Projects frequently start without proper planning or risk assessment being taken into consideration. It is taken for granted that projects have been well planned and it is known in advance how much the deadline may overrun or cost increase or exceptional events that may occur. Because of the complexities involved in a construction project, there are always risks involved. Construction projects possess more risks than other industries. The risk factors in construction projects include: labour disputes, poor financial controls, bad weather, faulty design, cost overruns, quality problems and even natural disasters.

❖ **Lack of change management:**

Change affects all forms of human activity and construction projects are no exception. Change happens all the time in construction. Many projects are conceived, designed and planned many months or years before they are constructed. No one can predict what would happen in the months and years ahead, no matter how well the project is originally thought out. When change is required in construction projects, it involves many different people: architects, engineers, surveyors, contractors, sub- contractors and suppliers and so on. Changes must be properly managed in construction projects; otherwise, missed dates and claims for damages will inevitably follow. Change is a risk.

❖ **Practical ways of compensating delays:**

The processes involved in the construction industry are complex. For a project to be completed successfully, several different types of skills are needed. Architects, quantity surveyors, designers, contractors, sub-contractors, suppliers and engineers may use different means to convey the same information. However, all these different people must work together to get the work done successfully. Very often, these different people may work together for months or years. For projects to be completed on time and meet budgets, the different people involved in the projects require different knowledge and skills. There is a wealth of knowledge involved in a construction project. The construction industry is facing many of the same problems as the software industry. The problem is that projects often run late and over budget. This often results in failure. Construction projects are among the most complicated of human enterprises. There is a high level of skills and knowledge required to translate a client's version or list of requirements into plans and specifications and then into a real building that functions well for the people who will live or work there. There are different ways to compensate delays. With respect to the project some or all of these methods can be used. Some projects may even require other ways as well. Followings are some of the possible methods:

❖ **Increasing working time:**

The average working time could vary between the cultures. Increasing working time could help to improve the rate of completion in projects which are directly dependent to manpower. For example if the framing of interior walls in a construction project requires to be expedited, increasing the working time from 40-50 can directly increase the rate of progress.

❖ **Advantages of extra working hours**

One of the major advantages of increasing working hours in a construction site is that it creates a win-win situation. In most of the times construction crews accept to work one or two additional hours and receive overtime and other benefits. Adding extra working hours in short term also reduces some hidden daily costs like start-up costs, indirect costs and overhead cost. Having less safety session will have more productive hours.

❖ **Disadvantages of extra working hours**

Increasing the working hours can reduce the productivity in long term. If working overtime is extended to long term, workers will soon become unproductive. Human's nature demands resting time in order to gain the physical and mental ability. According to the article first published by Army Corps of Engineers the extra working hours can reduce the productivity in long term. The figure in the next page shows how extra working hours can reduce the productivity of worker and employers

❖ **Planning and scheduling for the rest of the project**

In some cases it is possible to redo the scheduling process for the rest of the project. The idea is like looking into the remaining portion of the project as a new project and plan to complete this portion in the remaining time of the original schedule. This method requires a rapidly evaluation of the remainder of the project, developing a new schedule and taking action to work based on the new schedule. In some repetitive project like construction of pipe line this method can easily been used and a

❖ **Advantages of planning for the rest of the project**

As explained earlier in some projects that repetitive work is being performed, the evaluation and planning for the remainder portion of the project can be done easily. This will even be more simplified in a required unit umber of completion per day. In the same example of pipe line project it can be determined to complete certain length of the pipeline per day.

❖ **Disadvantages of planning for the rest of the project**

In complicated projects preparation of a new schedule for the rest of projects is time consuming and costly. In addition if the new schedule is developed within a considerable period of time, the new schedule will be based on data from beginning of this period which might be useless after the development of new schedule. To solve this issue the new plan should be developed for the project condition in future. In another word a short delay should be counted for the planning period of new schedule. For a project with a serious delay this may not be acceptable.

❖ **Adding more working personnel to the existing manpower**

Many construction projects suffer from the lack of personnel. Adding enough manpower to help the current working people will expedite the project and is a useful way to compensate delays. Also depending on the situation this could work like a sword or a shield.

❖ **Advantages of adding manpower to the working personnel**

In majority of construction projects lack of enough personnel is one of the important reasons that the project is not completed as expected. In those projects adding required crew will increase the rate of completion and can be an effective way in order to bring the project back to the schedule.

❖ **Disadvantages of adding manpower**

In some cases the lack of manpower is not the main reason of the slow rate of completion. In those cases adding extra manpower to the working crew will not only leave the problem unsolved, but also may make it

worse. Brooks' law may apply to those situations.

❖ **Brook's law**

Brook's law originally is one of the important agendas in software industry originated by Fred Brooks in *The Mythical Man Month* book. It can be applied in some complicated construction projects which require professional workers who have been trained over the years. Bringing inexperienced workers to such project would have a negative effect on the project which will make the delay worse.

a) The new worker will take the expert's time to teach them how to perform their duty. Possible mistakes committed by those new comers would waste the expert's time and delay the project more than before.

b) The new workers may generate further overhead costs which will increase the overall overhead by square of the ratio. This will waste the company's recourses and make the delay more than before.

❖ **Learning curve effect**

Delay in the beginning of a project could be a result of learning curve effect. Learning curve theory is based on the assumption that repetition of the same operation results in less time or effort expended on that operation. In another way, in the beginning more time is consumed to perform a duty than is spent after repetition.

This situation can happen when a company enters to a new field of practice and bring its worker to the new industry. If the project is complex and requires experience, the learning curve may be extended to considerable time. Learning curve can be modelled with the following formula:

$$Y_x = Kx^{\log_2 b}$$

"Y_x" is the number of direct labour hours to accomplish the x-th activity. "x" is the activity number and "b" is learning percentage.

If the project S-Curve shows such behaviour, it is possible to be in a beginning of learning curve which will be soon on the planed schedule.

An advantage of this assumption is that no specific action needs to be taken. Things will be back to normal automatically. On the other hand wrong assumption would result more delay on the project which will not be pleasant.

❖ **Experience curve effect**

The experience curve effect is broader in scope than the learning curve effect encompassing far more than just labour time. It states that the more often a task is performed the lower will be the cost of doing it. The task can be the production of any good or service. Each time cumulative volume doubles, value added costs (including administration, marketing, distribution, and manufacturing) fall by a constant and predictable percentage.

❖ **Labour efficiency**

In Time workers become physically faster and also smarter. They become mentally more confident and spend less time hesitating, learning, experimenting, or making mistakes. Over time they learn short-cuts and improvements. This applies to all employees and managers, not just those directly involved in production.

❖ **Standardization, specialization, and methods improvements**

As processes, parts, and products become more standardized, efficiency tends to increase. When employees specialize in a limited set of tasks, they gain more experience with these tasks and operate at a faster rate.

❖ **Technology-Driven Learning**

Automated production technology and information technology can introduce efficiencies as they are implemented and people learn how to use them efficiently and effectively.

❖ **Better use of equipment**

As total production increases, manufacturing equipment will be fully exploited, lowering fully accounted unit costs. In addition, purchase of more productive equipment can be justifiable.

❖ **Changes in the resource mix**

As a company acquires experience, it can alter its mix of inputs and thereby become more efficient.

❖ **Product redesign**

As the manufacturers and consumers have more experience with the product, they can usually find improvements. This filters through to the manufacturing process. A good example of this is Cadillac's testing of various "bells and whistles" specialty accessories. The ones that did not break became mass produced in other General Motors products; the ones that didn't stand the test of user "beatings" were discontinued, saving the car company money. As General Motors produced more cars, they learned how to best produce products that work for the least money.

❖ **Value chain effects**

Experience curve effects are not limited to the company. Suppliers and distributors will also ride down the learning curve, making the whole value chain more efficient.

❖ **Network-building and use-cost reductions**

As a product enters more widespread use, the consumer uses it more efficiently because they're familiar with it. One fax machine in the world can do nothing, but if everyone has one, they build an increasingly efficient network of communications. Another example is email accounts; the more there are, the more efficient the network is, the lower everyone's cost per utility of using it.

❖ **Shared experience effects**

Experience curve effects are reinforced when two or more products share a common activity or resource. Any efficiency learned from one product can be applied to the other products.

❖ **Transfer the experience to next generation**

The more a method is used the better it becomes transferable to the new comers. The new generation will have shorter experience curve than the earlier generation. This is as a result of finding easier ways to become expert in a skill and pass it to the successors.

❖ **Hiring supplemental subcontractors**

In some cases it is possible for the General Contractor to cancel part of an unaccomplished section of a subcontractor contract and award it to another subcontractor in order to speed up the project. This can rarely happen and requires many factors to be considered.

❖ **Advantages of hiring additional subcontractors**

The best advantage of adding new subcontractor is that it speeds up the project rapidly. To prove their productivity, the new contractors often pass the learning curve fast and enter to the productive phase sooner. Also having two or more subcontractor in a same trade will create competition which will benefit the project.

❖ **Disadvantages of hiring additional subcontractors**

One of the major obstacles is that when the subcontract is awarded to the first subcontractor it is usually difficult to separate a portion and cancel that in order to award it to another subcontractor. Experienced subcontractors will never leave any portion of their project untouched and will show activity in every corner.

❖ **Force Majeure**

Force Majeure is a common clause in contracts which essentially frees both parties from liability or obligation when an extraordinary event or circumstance beyond the control of the parties, such as a war, strike, riot, crime, or "act of God" (e.g., flooding, earthquake, volcano), prevents one or both parties from fulfilling their obligations under the contract. The contractor can extend the duration if delays can be classified in force majeure category. Heavy rain and flooding are common reasons to claim for Force Majeure.

❖ **Change orders and additional works**

If there is a change in the plan or specifications or if there is an extra work added to the contract, the contractor can request an extension to the project duration and consequently can lower the delay or even bring the project to the revised schedule.

❖ **Managerial ways of compensating delays:**

❖ **Lean construction**

It is generally accepted that lean manufacturing had a revolutionary effect on many industries, particularly automotive assembly companies. To improve efficiency and prevent failure of construction projects, a lean construction is needed. A lean construction would involve the followings.

- Reduced defects and waste, helping to improve quality and value, etc.
- Making sure that, workers are responsible for satisfying customer needs.
- Continuing to improve processes for the entire workforce.

Lean construction much like current practice has the goal of better meeting customer needs while using less of everything. But unlike current practice, lean construction rests on production management principles, the "physics" of construction. The result is a new project delivery system that can be applied to any kind of construction but is particularly suited for complex, uncertain, and quick projects.

❖ **Crashing and Activity Overlapping**

❖ **Crashing activities**

Crashing is an action many of contractors take in order to compensate delays. In construction projects when a superintendent decides to ask a subcontractor or the in house personnel to work over the weekend, crashing in small scale has been formed. Regardless of the magnitude, the basics of crashing are always the same and have a single goal to achieve which is compensating the delay. The difference is that the superintendent arranges it intuitively in his or her mind, but for crashing big projects in large scales all factors must be considered. In those cases crashing is often done by sophisticated software considering project critical path and all related factors.

Crashing is spending extra money in order to expedite the completion and shorten the remaining project duration. The additional budget has to be spent only on critical path activities to shorten the duration of the

entire project. Spending money on other non critical activities will only add the float of that activity without affecting the project duration which would be wasteful. It is often possible to find a minimum point showing the optimum point of crashing. This minimum point represents the least expenditure on the project and the duration of that cost.

Conclusion

The topic of this paper has been the evaluation of ways to recover late construction projects from a contractor's perspective.

- Critical factors affecting the performance of construction projects in the United States and India are discussed. In Indian projects “Conflict among project participants” is identified as the main reason for failure, and “Commitment of project participants” and “Owner's competence” are known as the main reasons for success. In USA “Lack of decision-making process”, “Lack of time for planning”, “Difficulty in updating regulations”, “User's need”, “Lack of trust”, “Lack of risk assessment”, “Failure to learn from successful projects”, “Resistance to use of IT” and “Lack of change management” have been counted as the main failure elements.
- Earned Value, Monthly and weekly reports, study cost reports and self performing” are mentioned as tools to evaluate delays.
- Practical ways of compensating delays are introduced and a summary of them with advantages and disadvantage of each is provided at the end of the chapter. “Lean construction”, “Positive working environment”, “Employee Engagement”, “Building trust” and “Knowledge management” and “Fundamental state of Leadership” which are managerial methods have been studied.
- There are different ways to compensate delays in each project. The managerial ways include: “Use of lean construction”, “Create a positive working environment”, “Building trust”, “Knowledge management” and “Fundamental leadership”.
- These methods can be used in all kinds of projects. They are not only related to the managing late project, but also may encompass broader range of programs in the company and can be extended beyond the life of one project. Depending on the type of construction that company is involved, the effect of these methods could vary, but all of them are effective and can expedite the projects.
- The practical ways may vary for each project. Based on what was discussed, best practical ways to recover behind schedule projects are determined by the type of projects.
- In general, construction projects can be divided to four main categories which are: Residential, Commercial, Infrastructures and Heavy industrial. Table 13 shows suggested methods to recover each project category.
- Since each project is unique; the suggested methods can not be counted as definite answer and are only recommended methods. The ultimate decision has to be made by the Project Manager who can distinguish which method works better.

Because of working period restrictions “Increase in working time” is not recommended for industrial projects, but it works well in other types.

In Residential and Commercial projects time consuming methods like “planning and scheduling for the rest of project” may not work.

Industrial projects and Commercial projects require expert crews in the construction team and “Adding more working personnel” is not recommended for these types of projects.

“Hiring supplemental subcontractors” and “extending the project duration” are functions of project duration

and subcontractors behaviour and can be helpful in all types of projects.

All types of projects may experience Learning and Experience curve effect. Since no action should be taken in these projects.

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