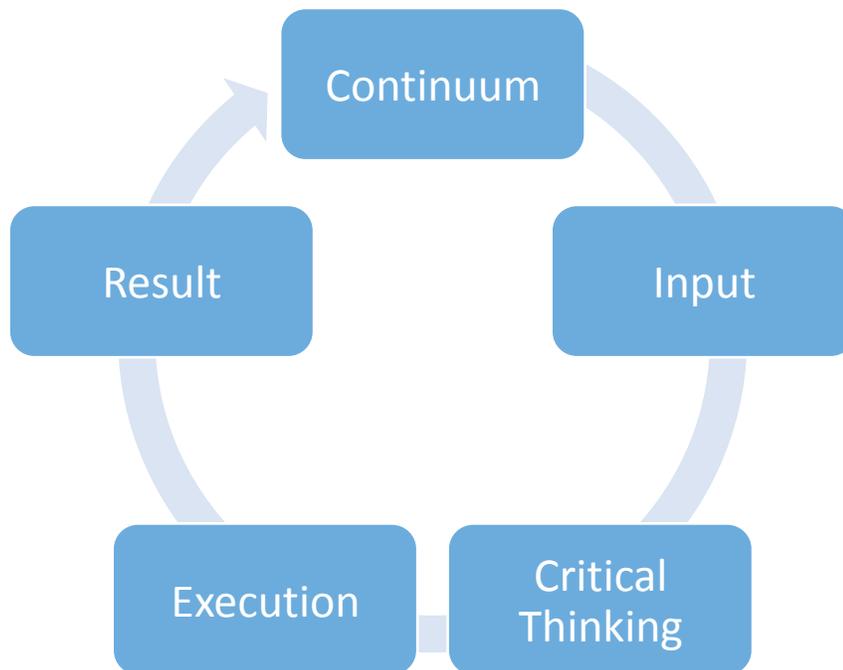


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The Scheduling Process

A. What is the Scheduling Process? It is a *continuum* of factual *input* plus *critical thinking* which is *implemented* to produce a desired *result*.



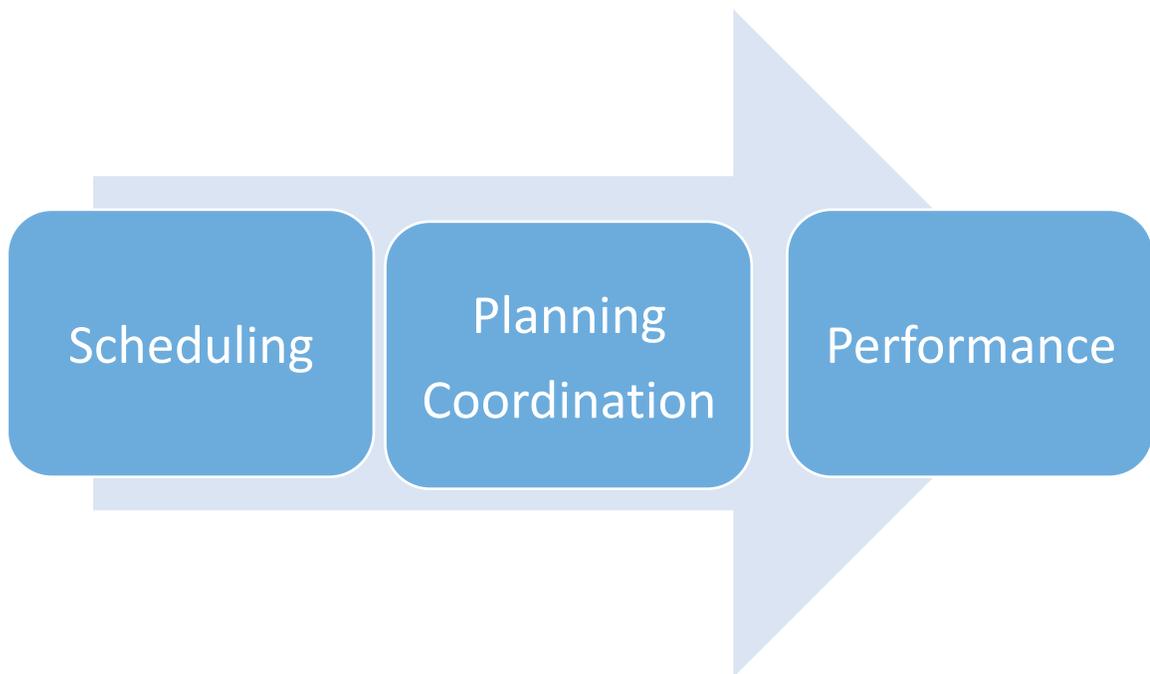
This article does not deal with the mechanical techniques of punching buttons on a computer to produce a document, called a CPM. It does deal with the complete process of developing a roadmap for getting to a desired destination, and then actually getting there in spite of a few bumps in the road or a detour here and there because of highway repairs. It is about *schedule management*, not schedule document preparation; it is about project management, not putting together a billing document called a schedule.

This article is NOT for the command and control managers. That said, it is not to denigrate such managers for many are very successful with the more dictatorial style. Frankly, when some of the players are weak performers, such a Fayol “do it my way” approach is perhaps the most effective style.

Rather, the thesis of this article is that the *scheduling process* transcends the entire project, that it is an integrated and collaborative planning and execution process which succeeds when ideas and input are sought from all the parties and implemented properly and timely. At the outset, it is emphasized that admittedly the collaborative approach works only when all the parties, *including the owner and design team and the supply chain team*, are committed to participating and supporting the process. It is when all the parties truly accept that the adversarial approach is the bane of the industry and one of the reasons that productivity in the industry remains low and claims remain high, that a more effective approach can be implemented. Again, to be repetitive, our thesis is that scheduling is a term which describes the entire project management process, which is the basis of project success.

And an inherent element of the collaborative approach is the *acceptance of accountability*. It is for this reason that at the outset it must be said that contract clauses which attempt to disclaim responsibility from one's own inadequate performance are inconsistent with both collaboration and peak productivity performance. Someone said that you do not manage risks and challenges through washing your hands in exculpatory and disclaimer contract clauses. You do it through management, through mind sharing, figuring things out, working together. Knowing the right thing to do and then doing it right.

B. The Elements of the Scheduling Process. For purposes of this article, the *scheduling process* will consist of:



In the scheduling process discussed in this article, no function is in a box as an independent activity but rather a part of an integrated system of developing roadmaps and reaching destinations. Of performing and causing others to perform. Of timely decisions and responses. Each function will require input or data which will probably also be dynamic. That is circumstances will change from time to time. (The philosopher Thale stated that you can never put your foot in the same river . . .it keeps moving on. And projects are like that.) And a project is similar to a spider web. Watch when a fly or bee hits one or two strands and the entire web shimmers. Construction is like that. When the building is not dried in on schedule or conditioned air is late, all the follow on crafts are affected (the entire web is shimmering), not just the craft with the responsibility for the delayed activity. There is this goofy little word in construction called *IMPACT*. Labor impact is similar to throwing a rock in a pond and watching the ripples extend all the way across it. When work is thrown out of sequence or compressed, the effect is seldom arithmetic: rather almost always algebraic.

- C. The Schedule Process. The development of the initial schedule involves a review and analysis of numerous components. In the construction industry, each project is unique; therefore each schedule is unique and**

must be tailored to the work to be performed, the environment, challenges and risks inherent in the project, the resources which are available or which are in tight supply. Many, if not most, construction companies now outsource the scheduling function. Our concern is that scheduling consultants build schedules but field personnel build structures. Therefore, it is strongly recommended that the people who are going to actually construct the facility have the opportunity to make input and provide ideas and suggestions for how to handle challenges and risks.

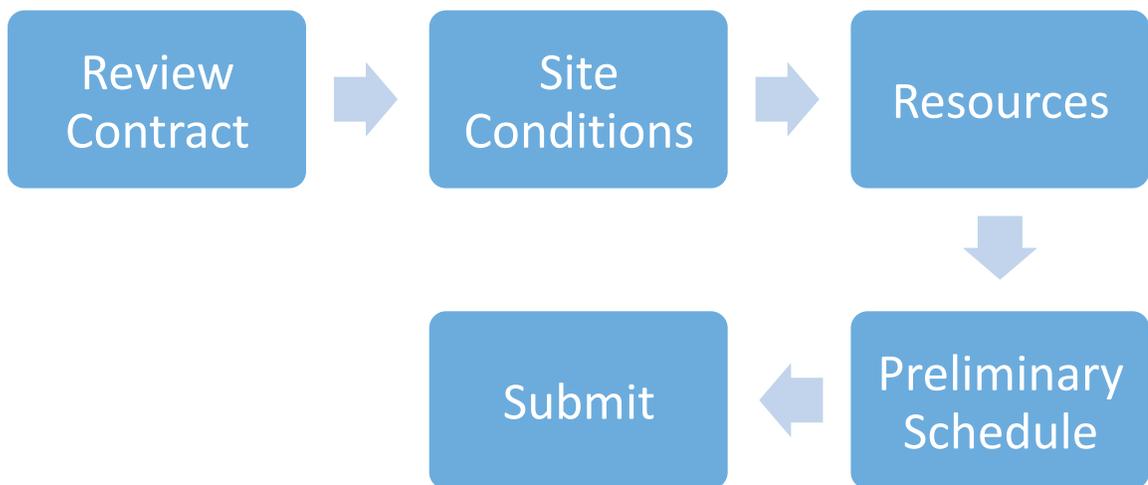
When a scheduling consultant prepares a preliminary schedule and then just passes it around to the various parties for comments, too often the various parties (subcontractors for example) will just check durations and maybe stacking of work activities. They do not really evaluate how best to construct the project, what improvements can be made, how to deal with various risks. Something is lost in that scenario: critical thinking of the parties whose responsibility it is to construct the project. And what else is lost is the sense of ownership: when one is truly a partner in building a scheduling, proprietorship exists and further, since that party helped build the schedule, later on that party must accept accountability for it and do all possible to meet the objectives he established himself.

For example, a general contractor issues a construction schedule and the mechanical subcontractor just checks it over for durations and goes about his business. There is a very large equipment room with a 40 foot elevation and the mechanical subcontractor did not notice that the schedule showed the equipment pads being placed before the overhead installations being started. Thus, when the project got underway and the mechanical contractor started overhead layout, because of the equipment pads being installed, all the overhead installation had to be done off ladders and limited scaffolding and moving equipment around the floor was very restrained because of the interference with the pads. The labor cost impact was a factor of two. Just because the mechanical contractor just scanned the schedule prepared by a consultant, rather than studying it and making input. This is the *critical analysis* component

of scheduling. *Critical analysis by the people who are going to build the project.*

And for there to be critical analysis, there must be a *project culture which solicits that analysis, and project culture for the players to perform that analysis.* From the beginning of the project, throughout to final acceptance. The Empire State Building was constructed in around 12 months because of just that: the parties got together and figured out the best way to build that structure, and incorporated the suppliers of steel and masonry in the process. What the contractor's team did was not a marvel of workmanship but a testimonial to creative planning.

So, let's build the initial schedule. What are the steps that should be taken?



The first step, obviously, is to review the contract. Not by just the scheduling consultant, but by the general contractor project manager and field supervisory personnel; by subcontractors; and to the extent relevant by major suppliers. For example, suppliers may have close out responsibilities relating to start up, commissioning and training.



**Contract
Review**

- **Delivery System**
 - **Design Bid Build**
 - **Design Build**
 - **BIM**
 - **LEEDs**
 - **Use of Modular**
- **Schedule Specification Requirements**
 - **Float – who owns it**
 - **Number of Activities**
 - **Update requirements**
 - **The duty of discovery (conflicts in drawings or structure)**
- **Mobilization Requirements**
- **Material Handling**
- **Hazardous Material Requirements**
- **Statement of Work**
- **Degree of Difficulty**
 - **Special Issues, such as cold or hot weather concrete, shoring, dewatering, site protection, safety, height, renovation surprises, multiple structures, storage, hazardous material, space limitations**
 - **Special schedule issues (such as LDs being very high, need for overtime, “occupancy dates critical”**
- **Number and Height of Structures (Check NECA on impact on productivity regarding number of floors in a building)**
- **Existing Structures**

- Existing facilities in operational use
- Quality of Documents
- Supply Chain Requirements
- Built in Quality (P-I-F)
- Approval times
- Tests/TAB/Commissioning/Closeout
- How to Handle Weather
- Risk transference clauses, such as no Damages for Delay

The contract review and compliance is of such great importance. It is essential that the contractor get the project started as quickly and effectively as possible, and so often the contractor's schedule is not in compliance with the requirements of the contract. And then there is the continual back and forth between the scheduling consultant and the owner's representative before a schedule is ever accepted. That initial schedule is the BASELINE against which everything is measured: productivity, payment, delays, work flow and variances, perhaps even a default termination. So the baseline needs to be contract compliant . . .the first time it is submitted, not the third or fourth resubmittal. It needs to be submitted within the contract schedule. It is the basis, if well considered and followed, for everyone on the project meeting their goals. And if that is the case, all the affected players should be dedicated to having a timely and effective baseline schedule because they all had the opportunity for input and critical thinking about how best to build this project. And once they have made their input, then there is commitment to meet their goals, and there is actual execution or performance to meet the commitment.

When we say that a schedule is a management process, it means a dynamic game plan of team input and collaboration, not a paper hanging on the wall. It is a process of what to do, when to do it, by whom it is to be done, and the interface between the parties. It is an essential tool of communication.



Site
Conditions

- **Access Issues**
- **Borrow Issues**
- **Material Handling**
- **Environmental Issues**
- **Site Protection**
- **Site Preparation**
 - **Including Power**
 - **Permits**
- **De-watering Issues**
- **Operating Restraints of Existing Facility**
- **Risks and Challenges**

Site conditions often pose the greatest challenges to a project. Certainly if subsurface conditions are different or more difficult than expected, the possibility of an early delay and possibly an acceleration may ensue. Material handling is a very large labor dollar and site conditions affect storage, delivery and installation. Off site traffic, on site congestion and limitations all affect productivity. The scheduling process takes all of these conditions in consideration in developing durations and relationships. Or at least it should. On a postage size site of a very large complex, the ability to bring in materials and equipment as well as other resources is very limited and will affect productivity.

Durations are a function of productivity, so these issues must be considered in the schedule development. Hopefully, the estimator took them into consideration when pricing the project.



- **Quantities**
 - **Quality**
 - **Availability (Market conditions; transportation issues)**
- **Work Force – Remember that the average productive time of work force is less than 30 hours a week due to a variety of factors. That factor becomes more negative when there is inadequate supervision of outsourced employees, incompetent crews, lack of planning, poor workmanship, employee turnover. (Absenteeism and turnover can take a huge slice out of productivity). The scheduling of activities (durations, productivity) should take into consideration the quality and experience of the contractors' work force for there are some contractors who will lose the game even if the other team doesn't show up.**
 - **Availability**
 - **Competence (outsourcing)**
- **Equipment. The condition of equipment is another factor that should be taken into consideration. On heavy equipment projects, like highways and dams, older**

equipment with all its maintenance and operational problems may have a very negative impact on productivity. The improper equipment can also have an adverse effect.

- Equipment cycle time
- Material Handling Resources (cranes, buckhoists, elevators, etc) Remember that material handling is often more than 20% of productive labor yet material handling is often an invisible function, not considered in scheduling, not appearing on labor cost reports or daily records.



Preliminary
Schedule

- Work activities (WBS)
- Durations
- Logic
- Work Flow
- Deliverables and turnaround (supply chain)
- Close out activities
- Three step (P-I-F) activities
- Shutdowns
- Off site work
- Resource Load

Again, this is not the product of punching the key board. It should be discussed with the subcontractors and key suppliers; field supervisory personnel should participate in thinking out the best way to build the project and how to handle the challenges. Attempt to have the most productive and thought out schedule day one, and not wait until you are in a crisis mode to then sit back and try to figure out the best way to build

this project. By this time the players have made input on how to deal with potential restraints and challenges, they have a pretty good handle on potential delivery issues and how best to work around any that may occur. They have reviewed the plans and specifications and site conditions to determine special issues that may be lurking, what productivity they might expect. They are aware of the quality of the drawings and have an idea of the potential for RFIs and change orders. The algorithm for the scheduling process, if we remember, is input plus critical thinking produces a road map which leads to success. So we need to have available the most effective input when this schedule is developed but we need to think about it, be creative about the data which we have, the risks we know exist. And we need to think, collectively, about how best to use the data in building the project the most effectively and productively as possible.

The first 25% of the project is absolutely critical to the probability of success of the overall goals. That means that in this critical thinking period of developing the full duration schedule, the parties can focus on the first 25%, what are the goals that must be achieved, how best to overcome the challenges. So the initial schedule takes on the intensity of planning out and executing, developing the momentum of meeting the early priorities which, when accomplished, become the energy for completing the project successfully.

Submittal
for
Acceptance

- Review Owner Comments
- Review with rest of team
- Incorporate and Finalize
- Update per the contract (to be set forth later)

D. Planning and Coordination. The Concepts. The Baseline Schedule is the initial road map which establishes the overall game plan for getting the job done in a timely manner. It is milestone driven. It is not necessarily the most effective tool for the field to actually build the project from on a short term basis. In the real world of construction, the initial planning as well thought out as it was, may not be consistent with reality in some instances. There are changes sometimes daily as resources may not always be timely or conflicts in the drawings emerge. And there may be space conflicts or congestion of the trades, or conflicts between the trades as to which trade has first priority into an area (priority walls, as an example). The Baseline Schedule is the overall map, but it takes the field supervisory personnel to take that schedule and make it a real tool for building the project TODAY, and this WEEK, and NEXT WEEK. *So the field supervisory planning function has become the critical path of successful projects.*

a. Programs such as Lean Construction are pushing this concept and with excellent results. A separate article on Lean Construction is forthcoming but it is largely repetitious of this article and is actually entitled Old Wine, New Bottle because a lot of the concept is more labeling than really new practices. For example, the idea of Pull Management which is heralded in Lean Construction as a new concept has been around a long time. The term reliable promises is another word for “handshake”. But that does not take away from the fact that Lean Construction practitioners are very successful and

at the outset, below are some of the concepts that are common to the approach set forth in this article and in Lean Construction.

b. The Reliable Promise. Greg Howe of Lean Construction states that a construction project is a *series of promises*. And has written on the Reliable Promise, which simply means that when you make a promise, you keep it. If you say that 15 pipefitters will be on the project, there will be 15 and not 12. When the contract provides that the designer will respond to an RFI in five days he does so in five or less and not six. *So scheduling is a moral and ethical thing. It is keeping one's word. In the old days, we gave a handshake or as some people said a "moral contract".* In our experience, the reliable promise is more than just the handshake, but a part of the algorithm for success. Harvard states that at heart every company, and every project, is a dynamic set of promises made and fulfilled. Our studies show that highly successful projects are a function of the TRUST. And that TRUST has these components:

- i. C for Competence.*** *When a contractor bids a project, he is basically promising that he has the competent and available resources to complete the project successfully. And the owner should be warranting that he has the resources including financial and decision making, to perform its end of the bargain. And then they perform accordingly.*
- ii. C for Character.*** *The parties are inherently promising that they are reliable and will perform in accordance with the contract and not try to take advantage of another. This means the contractor will not try to overinflate the price on changes and the owner will not try to beat down the contractor's price just to save a few dollars. This means the*

parties are reliable, you can count on their representations and their commitments.

iii. C for Consistently. This is the “rubber meets the road” test. It is one thing to be accountable when the cost is small (Oh, that is a bad weld, or a bad yard of concrete and I will fix it. But what if there is 200 cubic yards of bad concrete or dozens of bad welds. Are you willing to stand behind your commitment when the price is higher than you would like. When the Owner executes a contract which provides for extending the contract for justifiable delays, he may be willing to grant the short time extension, but he might fight a three month one even if there is complete justification. Rubber meets the road!

c. 20/20 Look Ahead Vision. We believe in the concept of continual improvement. In effect, this is what the idea of Pull Management in Lean Construction is all about. It is about the team getting together and looking the next window of time and figuring out how best to perform within that time frame. In Pull Management, the team works backwards from the end date of that window with all members of the team making input and thinking (critical thinking) about how to prevent waste, how to do something better, may be something that doesn't need to be done, how to improve quality and prevent re-work. And they look at potential problems, like late deliveries and figure out the best way to work around the problem with minimum impact on the project. The hall mark of Pull meetings is participation of the team members and thoughts and ideas put on a wall with sticky notes which are then consolidated and integrated into the next look ahead plan. But sticky notes or not, the idea of regular meetings for this purpose is a key element of successfully run projects.

i. The Football Metaphor. In the 6 week look ahead schedule, the attainment of the six week goal (normally a milestone based on the CPM) is a score, that is six points. But how do you get there? Each week in the look ahead schedule is the progress needed for a first down. And each day is the yardage necessary to make the first down. The idea is to make those first downs and move forward without penalties. If there are penalties, deal with at huddle meetings in real times to see how you can overcome on the next play.

ii. Continuing the football metaphor, look at planning in a new light. Planning is Preparation. You are preparing to pick up the first down. You do that by having the right team, the right play, the right team knowing that the right play is because they helped design it! And because it is a team, committed to unity of purpose.

d. Priority Management. In Lean Management, there are “priority discussions”; such as what are priority walls, and whether equipment pads installed ahead of overhead. The Pareto 80/20 concept, loosely stated, is that 80% of the problems are caused by 20% of the issues. Forget the percentage, but on every project, and in every day, there are priority issues which if unattended, will magnify and the consequences will be not linear but algebraic. Construction is a momentum industry. Isolate that issues which affect movement, which stagnate progress or slows down an activity and attack it. Again, this is a team or collaborative approach. And the owner must be involved, because decision-making by the owner (or dilatory decision) is one of the most important functions on any project. What are the priorities in the first 25% of the project? In the last 10%. Identify them, then nail them!

e. Convert from design to construction as soon as possible. By this is meant that in design bid build projects that the notice to proceed is really a notice to proceed with design and not construction.

There are submittals to be made for designers to play with, drawings that are in complete and filled with conflicts and ambiguities which will be the subject of Requests for Information and Changes for the duration of the project. To the idea is to either have a stand down at the onset of the project or to at least schedule the completion and resolution of these items as early on as possible so that the construction process is not impeded waiting for clarifications or changes. Preconstruction tools such as BIM are very rewarding but where it is not used, a process can be put in place for desk top review of drawings, finding conflicts in the office and not in the field – which will be discussed more fully in another section. But the priority must be to move quickly to a construction project and not just a continuation of the finalization of design.

E. Planning and Coordination. The Components for the First Planning Session(s) or Kickoff Meeting. The following is breakdown of the components of the first planning meetings that should occur after Notice to Proceed. This is a kickoff meeting which could take the form of partnering or simply a preconstruction conference with all the players:(Note that many owners are now requiring a “stand down of sixty days before actual construction begins. There are two NTPs, the first is an administrative NTP which basically gives the team a couple of months to do all of the things listed below, and then there is the construction NTP after all of the planning, deliverables and desk top reviews have taken place. See the attached article entitled “The Clark County Story and the attached copy of slides for a Partnering Session)

➤ ***Team Established***

- ***Kick off meeting***
- ***Commitment to Collaboration***
 - ***If collaboration by all the parties is not truly committed to, then bring in a claims consultant or attorney soon)***
- ***Project Mission Statement***

- ***Procedures/Processes Reviewed***
 - ***Submittal logs in place***
 - ***Procurement logs in place***
- ***Conflict Protocol established***
 - ***The commitment to attack issues and not people***
 - ***Decision Making Tree***
- ***Meetings and decision making process established***
 - ***Agendas for meetings***
 - ***How to have effective “critical thinking “ collaborative sessions***
 - ***Priority Discussions***
 - ***Continued Improvement***
 - ***How to manage timely decision making (See attached protocol for decision making management)***
- ***Commitment to Reliable Promise***
- ***Commitment of Built in Quality***
 - ***The role of manufacturer’s recommendations***
 - ***Supply chain issues, including factory inspections, manufacturer and installation drawings***
- ***Communication Process***
- ***Pricing mechanism for changes to avoid disputes or resolve quickly when they occur***
- ***Variance Management***
- ***Documentation (daily reports, cost reports,). Field reports give us the boots on the ground story of how the project is performing today and what problems, if any exist. Field reports can be real time, eyeball witnesses to variances which may create productivity problems. Labor cost reports can also provide real time monitoring of how well objectives are being met. Reporting is an essential and obligatory part of the scheduling process.***
- ***Back charge procedure***
- ***Waste Management.***
- ***Commitment to maintaining work flow***
- ***Input to schedule updates***

- *Team evaluation process*

- *The Role of the Owner. The Owner is hugely important. Decision making will make or break a project, for example. The Owner's value system, acceptance of responsibility, timeliness of action, collaborative efforts . . .all will set the tone of the project. The Owner which is recalcitrant, unaccountable and mediocre in performing its duties will pay a price and it is often a big price.*

- *Review Initial CPM and Discuss*

- *Key priorities established (Momentum for first 25% of project). Here's the deal. You get behind 4 or 5 % the first part of the project and then you try to make it up later on. Well, later on there are more trades, more crews, more work, more conflicts and in that environment you are going to try to make up 5% or so of the project? All studies show that the closer the project is to the close, the greater the impact to productivity when any additional work is added or variances occur. The reason for profit fade and sometimes profit collapse is that we tend to put two pounds in a one pound bag toward the end of the project.*
 - *Deliverables*
 - *Approvals and Decisions*
 - *Site Restraints*
 - *Work Activities*
 - *Drawing cleanup (desk top reviews)*
 - *The three step (P-I-F) quality program is another place to plan – prepare – for the next activities to be performed, to discover potential problems and resolve before they before field productivity issues, to think about how to perform the activity a little better (See attached specification model)*
 - *Begin coordination drawings*
 - *Goals established and measured*

➤ ***Crews established***

➤ ***Coordination***

- ***Coordination drawings to be completed as quickly as possible to discover potential conflicts and resolve. Commitment of team to continually try to find any drawing problems in the office and not in the field to avoid labor impact issues. Use coordination drawings as a tool for discussion as to how best to work with each other, best practices, how to do better. Coordination drawings are extremely important and not just deliverables.***
- ***Coordination of trades. Meetings to assure that trades understand who has exclusive right to space and when there is concurrent right to space. State of readiness requirements by precedent trades. The concept of reliable promise is emphasized. It is important to keep in front of the team the concept of unity (1 + 1 = 1) and common goals. At any given moment, an individual contractor may feel a sacrifice when agreeing to a process which is in the best interest of the project rather than himself, but on balance if the project gains, then the individual contractors benefit as well.***

➤ ***The Role of Discovery. The contractor has a duty to discover, using reasonable diligence, potential conflicts on a timely basis. These include drawing issues, structural conflicts, and existing site or building interferences. This is a hugely important responsibility and should not be taken lightly. In highly successful projects, the project staff is like the sailor in the bird's nest at the top of the mast, looking ahead for any obstacle and the clearest path to the destination. That is the role of the project and field supervisory staff: to continue to look ahead and plan the best most unobstructed course to the port. The concept of BIM is to build the***

project before you before it. The role of discovery is to find the potential problems in building before you start building.

F. The Role of Look Ahead Schedules. People are most motivated through short term goals. Liquidated damages at the end of a three year project does little to motivate a crew to get the work done today. So planning should be bite size. We like “window” scheduling. That is, establish a series of windows and plan to make those goals. A window for coming out of the ground, for topping out, sealing the building, controlled air . . .for example. Each is a crucial step in the process and each can be identified with a definite and measurable milestone. And the field crews can get together and figure out the best way to meet the requirements of each window, be creative, use 20/20 foresight, identify and work around potential problems . . . in that particular window. But a 45 or 60 day look ahead schedule does not replace the daily planning which needs to be done. The crew planning, material handling, safety, required resources, and monitoring to assure that the daily goals are attained. Again, the construction industry is not a “catch up industry”, where you can get behind a couple of days and catch up in a couple of days on some arithmetical basis. You get behind a couple of days and to catch up the cost is in the multiples and you may not catch up even at that. We spend so much time on CPMs and project scheduling and so little on the intense need for daily planning, execution and monitoring.

a. The Role of Earned Value. As major element of scheduling and planning is setting and monitoring goals, or performance. If we simply measure performance on the basis of hours (budgeted 100 hours, spent 50, so we are 50% complete?) we will never really know where we are until we get to the end of the task. If we have some form of performance targets tied together with manhour budgeting, assuming accurate and timely reporting, at any given point in time we know our trends. If we have 100 hours budgeted

for 100 feet of installing widgets, and we have spent 50 hours but installed on 25 widgets, then Houston, we have a problem!)

G. Planning and Execution: Brilliant execution should be the goal. Execution with out planning often equals chaos. Planning without execution does the same. So think in terms of a new word PLEX, or planningexecution. In construction, superintendents have been saying “*work the plan*” for centuries. Many modern contracts (and “with it” contractors) require a three step approach to performance. Though it is termed Built in Quality, the better term is *built in compliance and timely performance*. It has three components, Preparatory, Interim, and Final. It is task oriented, meaning that before each new item of work, the following process is followed (See article on Quality) :

- a. Preparatory.** The field supervisory team which is to perform the team gets together in advance of the scheduled work. Owner’s representative should be present.
 - i. Review the plans**
 - 1. Submit RFI if any conflict or discrepancy**
 - ii. Discuss unusual tolerances**
 - iii. Identify resources required by home office**
 - 1. Workmen**
 - 2. Material and equipment**
 - 3. Tools**
 - 4. Information**
 - iv. Coordination issues with other trades**
 - v. Hazardous and safety issues reviewed**
 - vi. Finalize plan with productivity goals for the task**
 - vii. Home office provides required resources**

- b. Interim.** Field begins execution of the plan. At a point in time there is an inspection to assure that the plan is being executed or that a

revision should be made. Thus any correction is made fairly close to a real time discovery of a discrepancy and before the final.

- c. Final. If the above process is followed, the final inspection will produce no punch lists or only a minor one at best.
- d. Lessons Learned. What better time than when a task has been completed to evaluate how it went, what could have been performed more effectively. Or what was done that was really effective. And to incorporate the lessons learned into future work.

Sequel

In order to properly execute the work, the company must have developed the ability to do so. The first planning exercise should be the plan to acquire and develop the people who are qualified to manage, supervise and perform the tasks involved in a construction project. If there is no union affiliation, then the company must somehow undertake that responsibility on its own. Too often the approach is simply to outsource through a company which specializes in finding both supervisory and field labor. These companies often do not have programs for properly managing the outsourced work force, making them feel a part of the company or having training programs to continue their development.

I do not expect to see such companies change their modus operandi. Nor do I expect to see such companies institute real programs for improved productivity (productivity in our industry remains stagnant).

The trend to perform as much work off site as possible will accelerate the project and often improve quality. The Chinese are building 30 story hotels in a month because of modular and pre-assembly techniques; nanotechnology and sensory technology will diminish our need for service personnel.

There are some companies which truly are emphasizing the development of personnel and they are doing very well. Some companies.

