Ralph J. Stephenson, P.E.
Consulting Engineer

Version #4

What is Happening to the Use of Technology in Construction Operations? - by Ralph J. Stephenson, P.E.

Some construction professionals sense that their use of conventional operating techniques is out of synch with much of the new construction technology now being produced and marketed by electronic equipment and software suppliers.

At the beginning of the design and construction electronics age in the mid 1950's contractors' technical needs were filled at a pace that allowed even the most cautious professionals to see the resulting benefits and to gradually fold the systems into their daily operations. Examples of this early embracing of technology could be seen in the widespread use of estimating systems using spreadsheets (1960) and critical path planning using early CAD systems and computational systems (1955).

Today, the pace of new entries into the electronic design and construction market make it almost impossible for any but a few users of these systems to keep up with new developments and new products. The result is often chaos in firms, among firms, and in the industry in general. New professional graduates are bringing academically learned, cutting-edge programs to the field where they are promptly put at odds, and often invidiously compared, with other operational systems...both old and new. Let's face it: not every professional can know every program and every platform...nor does he or she want to.

There is even a more fundamental acceptance and learning problem. It deals with our assessment of just what it is that we seem to need to effectively and profitably design, engineer, and construct.

To help bring into focus what this means to the professional constructor let's first examine four factors that determine how well we will be doing business and constructing facilities during the current booming technological expansion.

These four include:

Ralph J. Stephenson, P.E.
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Factor #1. Operational needs of the successful contractor.

Factor #2. Basic technological systems that are used to meet these needs.

Factor #3. Problems resulting from failure to meet these needs.

Factor #4. Solving the problems caused by not meeting operational needs.

Once we have a clear understanding of these four factors, and how they affect our organization we can apply the results to planning how we can best use the evolving technology to achieve success. Let's prepare a check list of the factors in a specific program of improvement...for instance gaining excellence in the preparation of useful project plans and schedules.

Factor #1 - Some of the operational needs of a successful construction contractor

- Knowing how to manually prepare network plans & critical path diagrams.
- Understanding the difference between planning and scheduling.
- Properly using workable expediting systems.
- Knowing the yardsticks by which to measure project success.
- Understanding the concept of program management.
- Understanding and properly using project delivery systems.
- Knowing how to keeping accurate records.
- Preparing and using check lists of design and construction actions to be taken.
- Knowing how to, and, then, properly processing revisions.
- Implementing principles of good field inspection for the project team.
- Knowing how to manage an project or a program.
- Understanding how to evaluate various impacts on project progress.
- Knowing the common causes of contested claims.
- Being able to accurately identify the problem job.
- Understanding how to properly close out the project.

Factor #2 - Some of the basic technological devices currently being used by successful construction contractors

- Office based computers and operating software.
  Lap tops
  Desk-based PC's
  Main frames
  Computer-aided drafting and computational hardware and software

- Hand-held computers and operating software.
- Hand-held cell phones.
- Web devices to link job sites with home office and other project personnel.
  Written
  Verbal
  Pictorial and graphic
  Computational
- Hand-held TV devices.
- Internet and other similar information carriers that import and send data.

Factor #3 - Types of problems often resulting from failure to match the tools available to the needs experienced

- Poor job management.
- Inability to communicate with others.
- Poor staff morale and attitudes.
- Low personnel quality and people difficulties.
- Not being a good on-site neighbor.
- Inability to take timely action.
- Inability to properly plan and schedule the project or program work
- Failure to properly organize, exert authority, and take responsibility.
- Dirty, poorly planned, or dangerous work-site conditions.
- Slow and biased performance in revision processing.
- Poor construction document quality.
- Slow or incompetent submittal processing.
- Inadequate user group interaction to properly build the job.
- Inadequate or inaccurate documents and documentation.
- Slow, improper, and untimely decision making.
- Slow, inadequate, or improper procurement of materials and equipment.
- Sloppy, slow, and untimely closing out of the project.
- Slow or inaccurate payment processing. (Prompt payment is the life blood of a job.)
- Slow, delayed, or biased approval processes.
- Time growth which extends the project without corresponding relief.
- Inadequate staffing and manpower provided on job.
- Disproportionate cost growth of the project that damages expected cash flow.
- Late, excessive, or unfair substitutions and alternates.
- Failure to maintain regular project evaluations.
- Flawed constructibility usually caused by faulty construction documents.
- Legal matters that interfere with job progress and create artificial problems.

- Extreme weather conditions that interrupt job continuity and increase costs.

Factor #4 - Learning systems good contractors can use to effectively meet operational needs

- Mentoring
- Coaching
- Training
- Education
- Orientation
- Cooperation with training institutions
- Cooperation with educational institutions
- Tightening certification requirements

The assignment immediately in front of me as I write this article is to comment on how modern technology is affecting planning and scheduling and the way we deliver successful construction projects today. With the above factor fresh in our minds let us start the critique.

My comments are terse and to the point --

Comment #1 - We are not following evaluation systems that provide rational and objective arguments for adopting, rejecting or revising the bewildering array of systems we are asked to consider in our professional work today.

Comment #2 - We are wasting enormous amounts of time that could be best spent in becoming better builders on substitution of eye-catching graphics for understandable explanations of the new technological systems. (If it's pretty it must be right, accurate and sufficient).

Comment #3 - We are not being discerning enough in selecting technological systems that actually contribute to cost effective practices.

Comment #4 - In our rush for volume (too often at a sacrifice of quality and profit) we do not take adequate time to fully understand the actual operational techniques needed to build properly. Many designers, architects, engineers, contractors and facilities managers no longer spend enough time tracking jobs in the field. They don't know how long design and construction operations really take, how much they cost, whether or not they will work properly -- simply because they're not monitoring their projects, and they are not talking and watching the skilled trades and managers who actually build the work at the site.

Comment #5 - We too often substitute electronic processing for mentally derived logic, analysis and decision making by individuals actually responsible for doing and for managing the work.

Comment #6 - We are too complaisant, too accepting, too trusting that technological systems will automatically solve all our problems. We need to challenge doubtful assertions, and to ask again and again...does this technological system--really help us achieve our goals and objectives?

Comment #7 - We must better train and educate technical professionals in the definitions and use of words used to describe construction operations. When we all assume we know what a given word means...and then find out it means different things to different people... we're headed for problems. For instance I hear many professionals use the words "planning" and "scheduling" in the sense that they mean the same thing. Not true!

> Planning is to define project actions and their relations with each other in a sequence that will most effectively achieve goals and objectives.
>
> Scheduling is to show by a graphic or written tabulation of project activities where the planned activities are to start and finish. The schedule is derived from the plan of action by locking the tasks and their resources into specific time positions.

Comment #8 - We don't see what it is that makes problems for others on the project team. We are frequently so concerned with ourselves and our jobs that we exclude any attempt to understand what's going on around us. The result is that we needlessly cause problems for others.

Comment #9 - We fail to understand the ramification of problems created from not knowing how electronic systems differ from human systems. This practice tends to shift the responsibility for designing and using the system from the user to the electrons... all you have to do is type it in and the machine does the rest!

Comment #10 - We often resist learning how to use new systems because they seem to pose a threat to our career by putting us at a disadvantage with the younger, more knowledgeable practitioners. Therefore we fight the new techniques, the new systems and as a result, we fail to be effective construction professionals... and we fail to help others do what we actually believe is needed to improve our industry.

(1466 words - 6/25/2000)

I have watched this trend and have seen many benefits, but am now seeing some serious problems. On the one hand, it is sound management practice that forerunner organizations be the first to adopt new technology and the last to discard the old. I remember the reactions from clients when I urged them in the mid- and late 1970's to acquire and use personal computers instead of investing in updating or expanding their old mainframe systems. Many managers were hesitant when I challenged them to learn how to use their own computers and to bring the best of the technology right to their desks.

Most of my clients eventually DID make use of personal computers. But that has led to something I did not anticipate...a certain stultification in the workplace, even among the newest and the brightest of the practitioners and their organizations. I believe it has something to do with a lack of clear focus on our construction professions.

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Ralph J. Stephenson, P.E.
Consulting Engineer
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III. Major topic outline for article

A. Introduction - What is happening to the use of technology in construction?
   1. There seems to be an increased sensing that operational techniques used by construction contractors to manage their businesses is somehow out of synch with the operational techniques being used and promoted by participants in the facilities planning, design, use and management business.
   2. What are examples of this potential dysfunction?
      a) Use of eye-catching graphics in place of useful technical translations.
         (1) Substitution of bar chart graphics for operational plans and diagrams of work.
         (2) Inadequate understanding of the use of the operational techniques needed to build properly.
      b) Substitution of electronic processing for mentally derived logic, analysis and decision making by individuals responsible for applying the operational plan to management of the work.
      c) Lack of effort to train and educate technical professionals in the meaning of the words used to describe the expectations of a training and educational effort.
      d) Lack of understanding what it is that makes problems for others involved in creating the work product.
      e) Lack of understanding the ramifications of the problems created by not understanding how electronic systems differ from human systems
   3. If these are the happenings in our profession and business what can we do to lessen their negative impact and improve their positive contribution.
   4. Within each system there is a whole series of potential problems that may be susceptible to bugs and glitches that do or will destroy the effectiveness of electronic devices to improve our technical, business and professional practices.
   5. Should narrow the discussion of this phenomena down to specifics and apply a fair and even-handed evaluation to those practices that seem to be out of synch.

B. What is hindering acceptance and effective use of our various systems?
   1. Resistance to learning how to use new systems.
   2. Not understanding what the various construction operational systems are and how well they are being used in our business.
   3. Lack of a clear understanding of the deficiencies in construction operational systems that cause problems, and hinder improving their use.
   4. Misuse and misconception of some of the basic technological tools most commonly available to the construction professional

Ralph J. Stephenson, P.E.
Consulting Engineer

C. Consider why people resist learning
   1. The improvement curve offers some insights into why people resist learning - Pages 217 to 221 - The Nine Master Keys to Management
      a) Inertia generally blocks the road to improvement.
      b) Initiative is gained by the learner being motivated to gain insights into the need and the mechanisms to overcome inertia.
      c) Insights are needed once inertia is overcome and initiative is gained.
      d) Improvement often comes automatically as inertia is overcome and insights are gained.
      e) Then as the learner improves he or she will usually regress to another plateau of inertia.
   2. Introduction of new ideas into the work place must be accompanied by teaching how to overcome inertia, acquire initiative, gain insights and then improve by proper training in the laws of learning.

D. We might well start the process of improving the use of available technology by selecting three or four systems that seem to be in need of improvement. Ask, what are some of the systems that seem to be in need of improvement in the construction contracting business?
   1. Time management - how to manage time as a resource
   2. Problem solving - the methods by which solutions to problems are approached, analyzed and solutions discovered
   3. Principles of organization for the design and construction professional
   4. Principles of good field inspection for the design team
   5. Planning and scheduling the architectural and engineering production process
   6. Keeping accurate records
   7. Documentation types, processes, & levels
   8. Yardsticks by which to measure project success
   9. Writing good reports
   10. Network planning & critical path method
   11. Project delivery systems
   12. Processing revisions
   13. Principles of effective communication
   14. Preparing and using check lists
   15. Managing by exception
   16. Identifying the problem job
   17. Focusing on vital targets
   18. Evaluating impacts on project progress and design
   19. "Things-that-did-work" files
   20. "Things-that-didn't-work" files
   21. Effective meetings

22. Contract law and its impact & effect on the architect/engineer
23. Estimating systems
24. Expediting systems
25. Common causes of contested claims
26. Closing out the project
27. Alternative dispute resolution
28. Financial systems
29. Decision making
30. Management
31. Design
32. Etc. - add other systems as they come to mind and those listed below

E. What are some of the <u>problems</u> that seem to interfere with the proper operation of construction technology systems that seem to be in need of improvement?

1. .In the following listing the problem material has been arranged in descending order of the number of times the problem was mentioned in response in more than 20 construction job discussions where two questions were asked -
   1, What do others do to us on projects like this that causes us problems.

   2. What do we do to others on projects like this that cause them problems.

   Rankings of 2,855 responses by the number of mentions are shown in the left column, followed by the number of total problem mentions, and the general problem type.
   a) 01. 1146 - Job management.
   b) 02. 0984 - Communicating with others.
   c) 03. 0684 - Staff morale and attitudes.
   d) 04. 0593 - Personnel quality and problems.
   e) 05. 0475 - Being a good on-site neighbor.
   f) 06. 0467 -Timely action.
   g) 07. 0396 - Planning and scheduling.
   h) 08. 0371 - Organization, authority, and responsibility.
   i) 09. 0288 - Work site conditions.
   j) 10. 0268 - Revision processing.
   k) 11. 0267 - Construction document quality.
   l) 12. 0233 - Program conditions.
   m) 13. 0205 - Submittal processing.
   n) 14. 0166 - Issue, conflict, and problem resolution.
   o) 15. 0166 - User group interaction.
   p) 16. 0145 - Equipment and material problems.
   q) 17. 0141 - Documents and documentation.

r) 18. 0133 - Decision making.
s) 19. 0125 - Procurement of materials and equipment.
t) 20. 0116 - Project cost structure.
u) 21. 0112 - Closing out the project.
v) 22. 0097 - Contract interpretation.
w) 23. 0097 - Quality management.
x) 24. 0095 - Payment processing.
y) 25. 0092 - Paper and administrative work.
z) 26. 0090 - Approval processes.
aa) 27. 0088 - Being a good off-site neighbor.
ab) 28. 0073 - Time growth.
ac) 29. 0070 - Policies and procedures.
ad) 30. 0069 - Inspecting and testing.
ae) 31. 0069 - Staffing and manpower.
af) 32. 0064 - Cost growth.
ag) 33. 0058 - Substitutions and alternates.
ah) 34. 0052 - Maintaining regular project evaluations.
ai) 35. 0052 - Safety.
aj) 36. 0049 - Regulatory agency matters.
ak) 37. 0022 - Constructibility.
al) 38. 0022 - Training.
am) 39. 0022 - Value engineering.
an) 40. 0014 - Labor conditions.
ao) 41. 0014 - Legal matters.
ap) 42. 0011 - Backcharges.
aq) 43. 0011 - Financial problems.
ar) 44. 0010 - Weather conditions.
as) 45. 0005 - Warranty conditions

2. Problem types are listed below in alphabetical order. The problem type code follows the name. The total mention (tm) number indicates the total number of problems where this factors appears as an identifiable component in the problem statement. The single mention (sm) number the number of times the problem type can be identified as the dominant or overarching factor in assigning the problem code.
   a) Approval processes - apv tm = 90, sm = 42
      (1) The official acceptance of information or submittals needed on the project from regulatory agencies, governmental bodies, the user, the owner, the design team or any of the members of the construction group is critical to job success. A delay in approval can seriously affect job planning and scheduling

b) Backcharges - bch tm = 11, sm = 11
   (1) These are charges for actions such as clean up, hoisting, equipment use, damage to installed work, or other such items for which the party furnishing the item feels they are entitled to be paid. A backcharge is often deducted from a payment being made by the party providing the item to the party receiving the item. Problem arise when backcharges are deducted without prior negotiation or notification, especially when there appears to be insufficient cause for the charge.

c) Being a good off-site neighbor - ofn tm = 88, sm = 7
   (1) This is project participant behavior that relates well to the people, organizations, or facilities outside the construction site boundaries. When on-site actions cause off-site aggravation...noise or dust from a project; or when off-site actions interfere with off-site neighbors...dirt and other debris left on roadways...it's difficult to be effective builders. Nearly everyone must get to the site by going through the neighborhood--be friendly to the people who live there.

d) Being a good on-site neighbor - onn tm = 475, sm = 87
   (1) On-site behavior of project staff, determines how well they are treated by other on-site people. Poor job behavior almost always damages the informal organizational and social relations so critical to healthy jobs. The best rule is still to treat others the way you want to be treated. It's the quickest way to learn the benefits of being a good on-site partner.

e) Constructibility - cbl tm = 20, sm = 13
   (1) The degree to which the design of the facility is found to be buildable. Often when there's a constructibility problem the project or a component of the project cannot be built as called for by the contract documents. This may lead to serious delays, costs, redesign, and hard feelings on the job.

f) Construction document quality - cdq tm = 267, sm = 196
   (1) Problems caused by poor quality control in the preparation of working drawings and specifications. Difficulties are usually caused by unclear or contradictory notes, drafting errors, poor workmanship, incomplete information, dimensional errors, or other similar detractions.

g) Closing out the project - clo tm = 112, sm = 81
   (1) Closing out means properly finishing the project totally or in part. Factors related to close-out problems affects owners through

delayed occupancy, and contractors and subcontractors by delays to completing their work. Improper close-out also adversely affects payment of retainage and often increases costs difficult to associate with any specific party to the job.

h) Communicating with others - cwo tm = 984, sm = 234
   (1) Information exchanges between or among individuals, groups, or organizations, can be oral or visual, and may express a new thought or a commonly understood policy. Problems caused by the inadequate exchange of thoughts, messages, or information in construction makes communication with others an important factor in design and construction.

i) Contract interpretation - coi tm = 97, sm = 24
   (1) Any contract is open to interpretation. Serious problems may arise from substantial differences in those interpretations especially in the understanding of various parties as to what their work scope is and what they are entitled to claim when they are hurt by a unilateral contract interpretation. Contracts being legally binding, this factor can quickly escalate from a simple problem into a disaster if not resolved promptly.

j) Cost growth - cgr tm = 64, sm = 14
   (1) Changes in project cost, either greater or less than expected often affect the program or project. Growth may be positive for some participants and negative for others. Problems considered here often produce damaging impacts through unfair risk assignment.

k) Decision making - dma tm = 133, sm = 73
   (1) Wise decisions at the proper time are much to be sought after. Inadequate, improper, or untimely decision making on project-related matters by those not competent nor authorized is frequently a cause for much trouble.

l) Documents and documentation - doc tm = 141, sm = 28
   (1) Every construction job requires documentation from conception to occupation. Improper, inadequate, unneeded, or excessive paper work that blocks effective management and implementation is likely to result in long standing and difficult problems.

m) Equipment and materials - emp tm = 145, sm = 23
   (1) You can't build a job without them. Problems with procurement, storage, installation, or functioning of equipment and materials used on the project can create a nightmare.

n) Financial matters - fin tm = 11, sm = 2
   (1) Financing is at the heart of any building project. Problems related to the methods, amount, availability, or reliability of project funding are difficult to discern early and are even more difficult to resolve before they do their damage.

o) Issue, conflict, and problem resolution - ire tm = 166, sm = 29
   (1) Problems are meant to be solved. The best course of action is to agree in advance how the parties will resolve emerging issues fairly and speedily. Prompt settlement of conflicts, contested claims, and other disruptive or destructive action between or among the project participants is essential to conserving profit. Unresolved issues cost dearly and create hard feelings.

p) Inspecting and testing - ite tm = 69, sm = 41
   (1) Safety and quality are the hallmarks of good construction. Inspection and testing are designed to guarantee safety and quality. That means that someone qualified must inspect and test. Problems generated by poor, or untimely inspections and poor testing methods, personnel, management, or interpretation can have a serious impact on the project.

q) Job management - jma tm = 1146, sm = 319
   (1) Good leadership and knowledge-in-depth of the total project or of its components constitute 80 percent of job management. The proper use of skills in planning and scheduling, assigning resources, and assembling and effectively utilizing resources enhance the prospect of job success. Conversely, bad management can doom a design and construction project before it begins.

r) Labor conditions - lab tm = 14, sm = 3
   (1) Conditions, rules, laws, and obligations exist under which project participants work on any project. The term labor usually refers to tradesmen and women of all skills located at the job site. Problems arise when there are poorly managed union-nonunion disputes, ineffectual communications between management and tradesworkers, financing problems or any of the multitude of conditions that adversely affect the lifeline of the project--financial health for all.

s) Legal matters - leg tm = 14, sm = 4
   (1) The construction practitioner operates under the rule of law, but cannot afford to become preoccupied by it. Adverse legal actions expected or taken on a project can reduce or destroy potential for good project performance.

t) Maintaining project evaluations - mpe tm = 52, sm = 11
   (1) Competent monitoring, analyzing, and acting on information derived from a plan of work is an integral part of managing. In partnering, evaluation is often implemented by regularly measuring actual partnering performance against standards set by the stakeholders in the charter. Problems arise when the process is ignored by the stakeholders or when subjective evaluations replace objective measures.

u) Organization, authority, and responsibility - oar tm = 371, sm = 106
   (1) Organization, authority, and responsibility patterns spring from a functional need for responsible need for competence and leadership. The pattern may be assigned or assumed, and will generally govern project and program actions on the job. Problems follow when the organization, authority and responsibility needs are disregarded or unfilled. The results will often be a disrupted project, uninformed participants, and frayed tempers.

v) Paper and administrative work - paw tm = 92, sm = 26
   (1) Documents, letters, and other communications, whatever the media, must flow quickly and accurately among, between, from, and to project participants. Paperwork frequently creates a love-hate relationship. Imposing too much communication without a corresponding value-added is a distraction and annoyance. Too little communication may produce a value-subtracted situation by encouraging management-by-blindfold where stakeholders run their work by guessing and assuming. There is a right amount of paperwork for each job.

w) Payment processing - ppr tm = 95, sm = 83
   (1) The methods, practices, and timing of payments due to or from project team members are usually spelled out in contract documents. Problems arise when one party disregards that agreement or when practices in billing and paying become sloppy. Prompt payment is a great stimulator of good work.

x) Personnel quality and problems - pqp tm = 593, sm = 34
   (1) The labor pool, wages, and the press of business will determine who works on what job. Variations in personnel abilities, qualifications, desires, skills, attitudes, and honesty of the project staff working in the interests of the project can give rise to any number of conflicts and problems.

y) Planning and scheduling - pas tm = 396, sm = 98
   (1) Competent design, and construction sequencing, resource assignment, scheduling, and procurement planning for project actions are some of the easiest roads to a successful job. Failure to plan and schedule will lead to failing to do the job well. The job of the manager is to plan the work, and then, work the plan.

z) Policies and procedures - pop tm = 70, sm = 5
   (1) These are detailed statements of expected behavior, sequences, courses of action, and principles that help determine decisions, actions, and other matters for the participants on a planning, design, and construction program. Usually, policies and procedures are set both for the firms involved in doing the project work and for the project. Problems arise when those policies and procedures are unrealistic or when involved firms cannot or will not conform to agreed-on policies and procedures.

aa) Procurement of materials and equipment - prc tm = 125, sm = 60
   (1) Procurement is the process of detailing, approving, fabricating, and delivering materials, equipment, and other physical elements to be installed in the facility. Intelligent, experienced management and strong interest in excellent performance is at the core of successful procurement. Procurement problems cause frustration and delays.

ab) Program conditions - prg tm = 233, sm = 100
   (1) The quality of the project program has a sizable effect on the design, construction, turnover, and use of the facility. Good programs help design and build a good facility. Poor programs hinder the work, and often lead to damaging project surprises.

ac) Project cost structure - pco tm = 116, sm = 33
   (1) The characteristics of the project relative to how funding is determined, allocated, and disbursed to the project participants determine the project cost structure. Cost structure is usually established during early programming of the project. It can begin there as a problem or it may rear its ugly head later if there is an unwelcome change.

ad) Quality management - qma tm = 97, sm = 53
   (1) This concerns factors in project success or failure that are related to the quality of people, workmanship, materials, equipment, or organizations being used on the project. Quality, as used here, means of a nature that meets contract requirements and produces

results that satisfy or exceed expectations. Anything less may be a problem.

ae) Regulatory agency matters - reg tm = 49, sm = 23

(1) Rules and guidelines are often are set by regulatory agencies in the public or private sectors. Regulations can be maintained by voluntary compliance or by compliance dictated by law. Intelligent compliance with legitimate, well interpreted regulations helps a job.

(2) If the rules and guidelines are misused or poorly interpreted problems will surface. Regulatory difficulties often occur because regulators are sometimes not considered as a participant in the project. The result of this is an us-them mentality that produces potentially damaging conflicts between the regulators and the stakeholders.

af) Revision processing - rev tm = 268, sm = 118

(1) This factor includes steps taken to properly and effectively produce project revisions from formulation to implementation of the change. As a supportive action, good revision processing is almost invisible. Continued poor performance in this critical part of a design and construction project leads to progressive deterioration of nearly all job management functions.

ag) Safety - saf tm = 52, sm = 42

(1) Provision and maintenance of safe working conditions on the job site is crucial to job success. Safety problems usually result in damage or injury. Both harm job quality and progress.

ah) Staff morale and attitudes - sma tm = 684, sm = 299

(1) Individual and collective morale and attitudes of people can heavily influence and shape working conditions and outcomes on a project. Often morale and attitude problems are matters of perception which may or may not correspond with reality. Good morale and constructive enthusiasm on design and construction projects are always welcome contributions to project health.

ai) Staffing and manpower - stf tm = 69, sm = 47

(1) Defines the number of staff resources on the project and their quality, competence, and abilities. When resources are available the job moves well--when resources are lacking, frustration and confusion result.

aj) Submittal processing - spr tm = 205, sm = 123
   (1) Submittal processing concerns preparing, delivering, reviewing, approving, and returning shop drawings, specifications, designs, samples, cuts, and other documents or objects that must be approved as required by the contract provisions. Done well, submittal processing makes a job support system function well. Lack of competent attention to the procedure causes problems and delays.

ak) Substitutions and alternates - sal tm = 58, sm = 40
   (1) Relates to suggested or actual substitutions or alternative materials, equipment, methods, or systems that are considered for use in place of those already specified or shown on the contract documents. Problems arise when substitutions and alternatives degrade quality, present a false cost saving, or unfairly shift profit or loss among project participants.

al) Time growth - tgr tm = 73, sm = 8
   (1) A change in time either greater or less than expected that produces an impact upon the project or program. This impact, particularly when time is extended, almost always indicates a problem will or has appeared.

am) Timely action - tac tm = 467, sm = 97
   (1) Timely action can mean action taken at the correct or effective time, or action taken for a correct or effective duration. Problems can be related to taking, or failing to take, timely action on any project or program related matter.

an) Training - tng tm = 22, sm = 12
   (1) Adequate training and education of the project team is a management necessity. Problems arise when training and education are inadequate.

ao) User group interaction - ugi tm = 166, sm = 26
   (1) To produce a successful project, project team members and stakeholders must maintain effective informational, technical, business, and professional relationships with the owner and the end user of the facility. When these relations are damaged or ignored problems are almost certain to follow.

ap) Value engineering - ven tm = 22, sm = 19
   (1) Cost and other cost related benefits are often gained on a generic construction project by improving the means, methods, materials, and sequences of architectural and engineering systems used. Without striving to improve value within the target cost restraint a

job remains a static system. Value engineering is best applied before construction contracts are awarded.

aq) Warranty conditions - war tm = 5, sm = 4

(1) Warranty conditions are those construction guarantees placed in effect subsequent to completion of the work and usually upon acceptance by the owner. Warranty problems arise when their starting or expiration dates are unfairly assigned or unilaterally imposed for the benefit of one party, and the detriment of the other.

ar) Weather conditions - wea tm = 10, sm = 8

(1) Weather and construction are either fighting or are friends., but weather will have its way. Bad weather at a poorly managed job can create insurmountable obstacles to good work. Weather is one of the best documented scientific occurrences that exist. The manager is not expected to change the weather. He or she is, however, expected to know the when, how, what, and where of weather in their locality so the people on the job can maintain work continuity and profitability irrespective of poor weather conditions.

as) Work-site conditions - wsc tm = 288, sm = 133

(1) The work site condition almost always affects the project. A poorly-organized and badly-maintained work site prevents people from doing their best work, even when they want to do well. A clean, safe, well-planned work site shows respect for those who earn their salaries by working there. It helps them do a good job. Poor site working conditions demotivate -- good site working conditions motivate. One leads to trouble and danger--the other shows good faith and confidence.

F. What are a few of the <u>technological systems</u> that are currently being offered to solve some the more serious problems the professional constructor faces in his or her daily working life?

1. Use of web connected devices to link job sites with the home office and other stakeholders in the project.
   a) Written
   b) Verbal
   c) Pictorial
   d) Computational
2. Use of easily carried, hand held computers.
3. Use of easily carried, hand held phones.
4. Use of easily carried, hand held TV screens.
5. Use of the Internet and other information carriers.

Ralph J. Stephenson, P.E.
Consulting Engineer

6. Improved use of the mind to reason better
7. Other?

Ralph J. Stephenson, P.E.
Consulting Engineer
June 15, 2000

Michigan AGC Article

I. **Possible Titles**
   A. Modern technology and its effect on the practice of construction.
   B. Concepts of communication and how they affect the practice of construction.
   C. The academician and the construction profession.

II. **Notes from panel discussion on Tuesday June 6, 2000**
   A. Location R. E. Olds Museum, Lansing, Michigan
   B. Time 09:00 A.M. to 12:00 noon
   C. Participants
      1. Dick Brunvand - Chairman of meeting - dbr
      2. Ken Krill - CPC, Granger Construction, Lansing - kkr
      3. Lynn R. Swan - Swan Electric Company, Inc., Lansing - lrs
      4. Carl Roehling, FAIA, SmithGroup, Detroit - cro
      5. Judith A. Hayner, Administrative Services, Muskegon Public Schools - jah
      6. James E. Kolp - General Motors WFG, Pontiac - jek
      7. Thomas J. Boensch, Michigan State Building Trades Council, Lansing - tjb
      8. Paul Maxwell, P.E. - Albert Kahn Associates, Detroit - pma
      9. Ed Davenport, Davenport Masonry, Holt - eda
      10. Dave Hamilton - CCA George Auch Company, Pontiac - dha
      11. Dirk Powell - T. H. Eifert, Lansing - dpo
      12. Tim Skubick - Moderator - Political Commentator, Lansing - tsk
   D. General notes from meeting
      1. Meeting started at 08:58 A. M. Dick Brundvand introduced the program , the panelists and Tim Skubick.
      2. Tim started at 09:10 A. M.
      3. cro
         a) mentioned 2 key elements in good construction
         b) decision making and actual labor
         c) decision making is the most difficult.
      4. eda
         a) the caliber of the information (in decision making) is critical.
      5. jek
         a) people are hard to find.
         b) if manpower demands do not match schedule demands, look for trouble.
         c) most managers don't provide the leadership to prepare good schedules.
         d) uses Prima Vera.
      6. dha
         a) biggest problem is selecting an end date for a project
         b) each party's demands may be different

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7. pma
   a) Sometimes unrealistic dates are set - not always
   b) Sometimes dates are difficult to meet.
8. lrs
   a) Good scheduling takes money.
   b) Resources must maintain their integrity (?)
9. pma
   a) changes are destructive to the schedule.
10. jek
    a) mentioned how an aggressive plan of work caused a building to sit empty
11. dha
    a) Costs and on schedule - which can be sacrificed?
12. kkr
    a) Need to pay more attention than we are to details.
    b) Mentioned subtractive analysis.
    c) Team efforts are important.
    d) Mentioned CPM - not a bar chart.
    e) Be up front in planning - be honest
13. jek
    a) Bringing a job back on schedule is a difficult piece of work.
    b) Who provides the leadership in planning and scheduling and managing?
14. kkr
    a) The owner has to be a part of the recovery process.
15. jah
    a) Construction is not a contest.
    b) Communication was the answer on a recent major improvement program for the Muskegon Public School System in Muskegon, Michigan
    c) Everyone on a program has to be heading toward objectives together.
    d) Fostering attitudes is critical to success in program management.
    e) On her major program the CM firm was the hero. They cared as much about the project as the owner.
       (1) Consisted of 19 projects - 4 or 5 were new projects
       (2) Cost - about $250,000,000
    f) In response to question about problems and poor cooperation - said not many, all worked well together.
    g) What did they say that indicated potentially performance?
    h) In cases of poor performance the below expected performers and brought others in. Methodology did work.

16. dpo
    a) Considered alternative to lack of performance.
    b) PM responsible for management of projects
    c) GC didn't prepare plan of work because people didn't listen. (what did this mean?)
17. tjb
    a) Need listening.
18. jek
    a) Give trade unions a chance to provide input as to manning the project.
    b) How do resolve late stacking of trades?
    c) He has found that the project team has often missed getting operator's input.
19. pma
    a) Who sets the ground rules for planning and scheduling?
    b) The A/E or the C/M has to define what is to happen during the course of a job;.
20. lrs
    a) Prime contractor has to drive the process.
    b) Integration from top to bottom is critical part of leadership.
21. cro
    a) Has participated in early buy-in of schedule.
    b) Mentioned the food chain of construction.
    c) Understanding alternate delivery systems is important.
22. dha
    a) Should assemble the project or program team early.
    b) Up-front team must understand the phasing of the program.
    c) Phasing - if you need 7 phases and try to make it in 2 phases the planning won't work properly.
    d) Get all elements of the program on the table up-front.
23. jek
    a) Mentioned e-commerce
    b) Was asked what GM does to keep projects on schedule.
    c) Need to improve paper trail.
    d) GM must be kept informed when one of the parties feels they cannot perform so as to achieve their commitment.
    e) There are more AE's and CM's that understand GM's business - (than what?).
24. eda
    a) How does the contractor handle projects that are not possible to build in conformance with the schedule?

25. jah
    a) Must have flexibility in setting criteria.
    b) How did you know people who wouldn't, or couldn't do the job?
26. kkr
    a) Milestones are important to set and to meet.
    b) Team must have an understanding of what the milestones are and how they are expected to meet them.
27. Coffee break at 10:15 A.M. - back at 10:37 A.M.
28. Dennis - Haussmann
    a) Squeezing lowers the potential for payment.
29. lrs
    a) Feels low bid delivery systems are not the way to go.
30. Dennis
    a) If cash flow is there, the willingness to work is a strong motive.
31. jah
    a) They don't always take the low bid.
32. Question - Where do durations come from?
33. Comment - Get students involved.
34. jek
    a) Mentioned return on net assets.
    b) GM builds incentives into some contracts.
    c) Likes to buy hours.
    d) Know what you have to do to get paid.
    e) Submit invoices!
    f) Mentioned that payments generally run on a 30 to 40 day cycle.
35. Capital Imaging
    a) Relation of Internet and its relation to problems being discussed here.
36. pma
    a) Contractors must come on line to make it work well.
37. cro
    a) Great filekeeper
    b) Contract documents will no longer be produced as they are now.
38. Capital Imaging
    a) Using ? for all data postings.
39. jek
    a) Using in-house resources to communicate.
40. Steel fabrication - lady in audience
    a) Mentioned incomplete contract documents
    b) At what point in a job do changes (most/) impact a job?
        (1) 1st 1/3 of a job.
        (2) 2nd 1/2 of a job.

41. When should a schedule be updated?
    a) pma - as little as possible.
    b) cro - when you have to update it becomes chaotic.
    c) lrs - float time important.
    d) dha - domino effect is common in projects that slip early.
    e) cor - contingencies are not always a part of the scheduling.
42. dpo - Reasons why contingencies hurt jobs
    a) Contractors don't want to say no.
    b) Want to be informed and informal?
43. Some discussion here about the need for involvement of the critical trades and disciplines.
44. Discussion began to get less specific and more non-directional about this point.
45. Discussion devolved into comparison of what are the causes of problems on job.
46. kkr
    a) Scheduling is a tool - not more than a tool.
    b) Updating and monitoring a plan and schedule is important.
47. dha
    a) We need to talk about the project successes we have experienced.
    b) Work on incorporating good information into good schedules.
48. cro
    a) Mentioned success of Comerica Park working as a team.
    b) Considered the Comerica Park a success.
    c) Mike Illich was motivator.
    d) Team should have done more to control the owner.
49. U of M representative
    a) Likes to use liquidated damages.
    b) How much good does liquidated damages do for a project?
    c) lrs cringes when he sees liquidated damages on a project.
50. dha
    a) Liquidated damages raises a flag that damages good relations on a job.
51. How effective are bonus/penalty clauses?
52. pma
    a) Doesn't feel incentives/disincentives work in a positive attitude of staff?
53. cro
    a) Against liquidated damages.
    b) Against bonding contractors
    c) If a contractor is bondable he doesn't need a bond.
54. Closing comments - How to be more effective in planning and scheduling?

55. kkr
    a) Milestones are of great help.
56. jha
    a) Owner who clearly understand.
57. dpo
    a) Get involved at the trade level.
    b) Get all team members together for input into schedule. Everybody's schedule.
58. cro - same as above.
59. lrs
    a) Get all people involved and learn the job!
60. pma
    a) Get people together as early as possible & encourage them to work together.
61. eda
    a) Keep the system away from the low bid syndrome.
62. jek
    a) Built team from day one - bring in strategic partners.
    b) Front end work.
63. dha
    a) Use Quality Based Selection Systems (QBS) to select project team.
    b) Know the job! Know the work!

E. **Glossary of terms**

1. Construction
2. Construction
3. Design
4. Front end work
5. Generic Construction
6. Integration
7. Leadership
8. Line of action
9. Maintenance
10. Operation
11. Planning
12. Profit motives and what are they?
13. Program management
14. Project management
15. Strategic
16. Tactical
17. Technology

18. Ultimate decision maker (UDM)
19. Up-front

F. **Abbreviations**
1. UDM

G. **Thoughts and questions**
1. With what impact and to what degree does information quality affect the construction process?
2. How does the UDM select an end date for a project?
3. Where realistic dates are set and achieved, and the project is profitable what went right with the planning and scheduling process?
4. A plan of work and a schedule of work must first and foremost match the needs of the user.
5. Today we are very preoccupied with the electronic systems that store, retrieve and translate information.
6. We are moving rapidly away from understanding and improving the ways we use information. Gathering seems to be the main function of the construction professional and technician
7. Must find better ways of putting our knowledge to work.
8. Need to match systems with actual needs.
9. Must be honest in the use of our planning and scheduling systems.
10. Elements of a successful project
    a) Money
    b) Plan
    c) Resources (time?)
11. In the article concentrate on the need to learn what the needs are and then develop the technology to serve the needs
12. Might focus on the concept of technology and its use in program management
13. What are the technological elements of program management?
    a) Obtaining work - marketing and selling.
    b) Marketing
    c) Selling
    d) Construction.
    e) Design.
    f) Planning.
    g) Proposing on work.
    h) Project delivery systems.
    i) Financing.
    j) Profitability.
    k) Regulatory systems.
    l) Problem analysis.

m) Optimizing performance.
n) Replacing problem performers.

14. Could use the 45 problem set to establish approach methodologies.
15. Listening is a major need for successful project and program management.
16. Consider putting the graphic for program management in the article.
17. How do you utilize input from trade unions to make a project or a program successful?
18. Use the philosophical approach of growing a concept. How do we do this? For civilizations, establish the reason for change or a need for the civilization and then grow the change to encourage the achievement of the civilization.