

PM.12

PEER REVIEWED PAPER

The Industry's Perspective on Workforce Planning for Major Projects

Mr. Lloyd Kenneth Rankin; Mr. Tim Slotman; and Dr. George F. Jergeas, P. ENG.

In the past decade oil sands upstream and downstream projects in Alberta have experienced cost overruns and to lesser extend schedule delays. These projects are considered by the Construction Owners Association of Alberta (COAA) to be mega-projects, COAA indicates that Albertan oil and gas construction projects of at least \$300 million (Canadian) can be considered as a mega-project, based on a study by the Strategic Services Division of Alberta Human Resources and Employment. Research performed by B. McTague and G. Jergeas, COAA, and the Alberta Economic Development Authority indicated that problems such as cost overruns occur more frequently as the project size and complexity increases [1, 5, 8]. Large projects usually have additional financial risk and complexity that are caused by the large amount of resources, thousands of employees that have to work collaboratively, and the high political involvement [2]. Mismanagement of the extra risk and complexity of the larger construction projects resulted in cost overruns of more than 100 percent.

Although these projects are usually successful from an operational point of view, cost overruns are a cause of concern for many Albertan oil related companies [9]. Research performed by McTague and Jergeas on the causes for the cost overruns on mega-projects identified low labor productivity rates as one of the major causes for low performance [8]. Crews of large projects were observed and the time spent actually building was only 33 percent (table 1). The remaining time was spent waiting for materials and equipment, traveling to the area, taking early breaks, and planning how to do the work. Factors such as a lack of front end planning, poor constructability of design, inefficient procurement, human resource issues, and data that is incomplete or late for project controls are identified as causes for this low productivity.

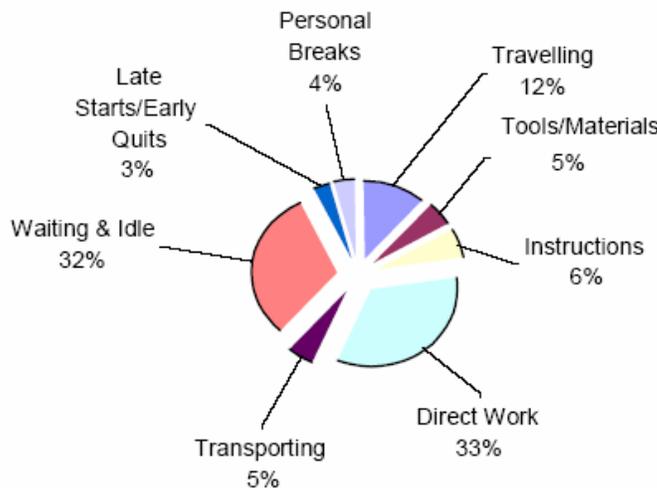


Table 1 – Breakdown of a Typical Crew Day

The COAA Workface Planning Model

The Construction Owners Association of Alberta (COAA) is composed of owner companies in the oil and gas industry, engineering firms, construction firms, labor providers, and other parties with a vested interest in the construction industry in Alberta. Representatives of COAA acknowledge that there is a lack of detailed construction execution planning at the workforce. To address the issue of labor productivity and to develop a workable solution COAA identified implementing a detailed execution planning strategy as an opportunity to solve some of the productivity issues during construction projects in the oil and gas industry this strategy is referred as Workface Planning. This model was based on four years of research into construction planning practice and interviews with contractors, engineers, and owners.

Workface planning is defined as a systems- based approach to provide a quality standard that identifies all elements necessary for the effective implementation of detailed execution planning. Workface planning aligns and integrates all planning related processes within a large project in order to deliver all tools, equipment and required information, prior to the start of execution, to enable craft persons to perform quality work in a safe, effective and efficient manner (COAA 2005).

COAA issued workforce planning as best practice in May 2006, advising its members to adopt workforce planning on future oil and gas construction mega-projects. The rules of the COAA workforce planning model at the time of the survey are provided in table 2 [4].

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Workface Planning Rules	
1	<p>Appoint dedicated field planner(s):</p> <p>Appoint dedicated field planners, assigned specifically to do the FIWP planning, plan the work and pull together the FIWP.</p> <p>To ensure a high quality of the plans it requires that the dedicated field planners are experienced enough to execute the work themselves.</p>
2	<p>Develop a schedule prior to the start of detailed engineering for all Construction Work Packages (CWP):</p> <p>Include issue dates, the scope of the CWP, sequence and timing of the CWP.</p> <p>Supports the planner to efficiently and effectively break down a CWP into FFIWP's that suits the path of construction.</p>
3	<p>The FIWP must be issued ready for release at least 4 weeks before construction on that FIWP starts:</p> <p>FIWP's that are ready to be executed must appear on the three week look-ahead. Everybody will know that this work is ready to proceed.</p>
4	<p>Set-up work processes to ensure that field planners have access to the latest project information:</p> <p>Dedicated field planners must be provided with the latest revisions of documents, even if documents have been issued for construction.</p> <p>There should be meetings scheduled between engineering and dedicated field planners to discuss intent of CWP and any other relevant information.</p>
5	<p>Assign responsibility for integration planning to resolve anticipated conflicts proactively between FIWP:</p> <p>An Integration Planner or a Workface Planner is assigned to direct the timing of FIWP releases to prevent contractors from interference.</p> <p>The Integrated planner understands each FIWP well enough to understand where conflicts may arise or where opportunities exist for better cooperation.</p>
6	<p>Assign responsibility for Material, Scaffolding, Equipment and Tool Coordination to dedicated Coordinator(s):</p> <p>Accountability for ensuring materials, equipment and tools are available before FIWP is released needs to be assigned to a dedicated coordinator.</p>
7	<p>Complete FIWP Checklist before a FIWP is released:</p> <p>Make sure that everything is in place that is required for a construction crew to execute a FIWP, before construction starts.</p>
8	<p>Track progress of each FIWP and provide targets to crew to drive performance via a War Room:</p> <p>Communicate real time progress to crews. This must be located at a "War Room" that houses all information required for completion of FIWP and a wall chart that tracks sign-offs required for each FIWP (e.g. Ready for Hydro, Hydro signoff....).</p>
9	<p>Dedicated field planners develop a backlog of FIWP's:</p> <p>Every FIWP needs a "plan B" that can be issued to the crew by construction supervision if the crew can not complete the first issued FIWP due to unforeseen circumstances.</p>
10	<p>Initiate and coordinate management audit:</p> <p>Ensure that the above rules are being followed by auditing the process.</p>
11	<p>Write the requirement for Workface Planning into all construction contracts:</p> <p>All contracts issued by the owner should include expectations, roles and responsibilities of the Engineers, Contractors, etc. This way the Owner re-emphasizes the importance of workface planning and the Owner's expectations for workface planning across all construction organizations on the project.</p>

Table 2 – Rules for Implementing Workface Planning

Research Rationale

The committee that developed the model had representation from contractors, engineering firms, owners, and labor providers. The model was also presented at the annual COAA conference and feedback was obtained from attendees and used to update the model. Once the model was developed COAA wanted to determine whether face validity existed for their research as well they wanted to determine the level of industry support for the principles included in their model. The validation study consists of a survey on the industry perception of workforce planning, and an ongoing comparison of productivity results for projects that do and do not use the principles as presented in the model. The results of the survey and the productivity comparisons have been used to help guide the development of the COAA Workforce Planning best practice which is now being used by CNRL, Nexen, PetroCanada, Total, Shell, Suncor, Syncrude, and others on projects totaling over \$100 billion. This paper will discuss the results of the survey.

Research Methodology

In order to assess the model participants needed to have significant construction experience and representatives from contractors, owners, and engineering firms needed to be represented. The COAA committee identified 716 individuals with the necessary background and experience to respond to the survey. The identified individuals were sent a personal invitation to participate in the survey which was available on the internet. The survey could only be responded to once by each participant. The participants were asked to identify the employer type – Owner, Contractor, EPCM, or other and their current position executive/senior manager, manager, planner/estimator/project controls, frontline supervisor, or field worker.

The questions were based on the principles outlined in the COAA workforce planning model and participants were asked to extent to which they agreed or disagreed with the statements. Participants were given three weeks to complete the survey and regular reminder notices were sent out to help increase the response rate. No monetary inducements were used to encourage participants to respond.

Survey Results

Of the 716 people received an invitation for the survey, 226 responded. Despite pre-selection 14 respondents were identified as not suitable for this research, which left 212 valid survey results, which equates to a 30 percent response rate. Each respondent has at least three year of related work experience, and 88 percent of the respondents have more than ten years related work experience and respondents were mainly supervisors, planners, or (senior) managers. “Average response rates on questionnaires range between 10-25 percent.” [3] Therefore, a response rate of 30 percent to an online survey can be considered as high. Besides the results of the responses, a good response rate itself can have some meaning as well. “The main motivator for people to respond to an online questionnaire is that they see that the results are likely to be useful for them.” [7] A good response rate like this one is an indicator that there is a positive perception to workforce planning in the industry. The raw data is summarized in appendix 1.

SURVEY ANALYSIS

Kruskal Wallis Test

The survey results were first analyzed using a Kruskal Wallis Test using a five percent level of significance. Kruskal Wallis is a non-parametric test used to determine whether response patterns were statistically different for position type or employer type [6]. None of the position types resulted in statistically significant differences, and the employer type resulted in statistically significant differences only for two questions, question six - The owner (oil company) needs to be involved in all stages of planning to ensure the plans will meet the established objectives and question twelve - The foreman must get familiar with the site (where it is, are there other crews, where's a crane, etc.) prior to executing the package.

Question six - The owner (oil company) needs to be involved in all stages of planning to ensure the plans will meet the established objectives. The response pattern for EPCM showed significantly lower levels of agreement with this statement than the owners, contractors, and other group. The interpretation of this response by the COAA committee is that EPCM's believe that once the project is scoped and handed to them the owners do not need to be involved in all stages of planning. This information should be used to assist owners in understanding the resistance they may encounter from EPCM's and in the need to develop a change management strategy to address that resistance.

Question twelve - The foreman must get familiar with the site (where it is, are there other crews, where's a crane, etc.) prior to executing the package. The response pattern for owners and EPCM's were significantly lower than for contractors and others. The interpretation of this response by the COAA committee is that while contractors and others believe more strongly that the foremen must retain this responsibility than owners and EPCM's all parties strongly agree with this statement.

Large Sample Z Proportion Test

Since all other factors were not significantly different the data was collapsed and employee type and employer type were removed. The response patterns were then converted into agrees and disagree responses and analyzed using a large sample Z proportion test (Kvanli, Pavur, et al 2003). Central Limit Theorem allows the assumption of normality to be applied to the sample mean even if the population does not follow a normal distribution (Kvanli, Pavur, et al 2003) because of the large sample involved. Large is defined as $n \times p > 5$ and $n \times (1-p) > 5$. The results of the proportions tests are summarized on appendix 1, note all results were significant at a 5 percent level of significance.

Most questions had support levels of 80 percent or more, there were four questions that did not reach that level:

Question number	Question	Percent Support at a 5% level of significance
1	Packages must be planned by a "dedicated planner" and not by field supervision	66%
3	An "integration planner" must be assigned to identify and resolve anticipated conflicts between packages	78%
6	The owner (oil company) needs to be involved in all stages of planning to ensure the plans will meet the established objectives.	62%
10	An individual CWP must be 100 percent engineered and issued for construction (IFC) before you start the breakdown into work packages	72%

Table 3 – Four Questions below 80 Percent Support Level

Discussion Results

Researchers discussed the results of the survey with the COAA committee. The interpretation of these responses by the COAA committee was that while most of the principles outlined in the COAA model were broadly accepted by the COAA membership they need to work with stakeholder groups to increase support for these for areas. Two major findings based on the survey are:

- The project management team must ensure that planning remains a support function for construction: execution responsibilities must remain with the (general) foremen.
- The roles of the different stakeholders during the project development stages require further clarification.

The disagreement on the statements that *packages must be planned by a "dedicated planner" and not by field supervision* and an *"integration planner" must be assigned to identify and resolve anticipated conflicts between packages*, lead to a discussion on the responsibilities of the foremen and the planning team. The following clarification is used to reduce the identified resistance: The centralized planning system with a dedicated planning team supports the execution responsibilities of the (general) foremen. This does not imply that field supervision is not involved in the planning process. The planners collect all necessary data, and check the availability of materials. Supervisors are involved with the sequencing of the packages, and check for the completeness of the plans, and they must get familiar with the site. With these new roles all data is centralized and complete. Therefore supervisors shall have more time to be in the field with its workers. Based on this discussion the model has been expanded to include job descriptions for the different members of the dedicated workforce planning team, including the workforce planner, and integration planner (Appendixes 2 & 3) [5].

The second discussion is based on the disagreement on the statements that: *The owner (oil company) needs to be involved in all stages of planning to ensure the plans will meet the established objectives*, and *an individual CWP must be 100 percent engineered and issued for construction (IFC) before you start the breakdown into work packages*. Based on this discussion COAA determined that it is required to expand their investigation on the different roles per stakeholder during the development stages of the project. The issue that needs to be resolved is: How to provide higher owner involvement during design to ensure they have better control of the development process, and constructability input from the contractors during design, without creating an inefficient engineering process.

Since the completion of this survey many owners have made workface planning a contractual requirement that clarifies the roles of the different stakeholders in each stage of the project. Also a flowchart has been produced (Appendix 4) that indicates the information flow during each project stage, and which actor has the main responsibility for that part of the process [5]. One of the recommendations included is that detailed packages are produced from IFC CWP. Contractors should be able to influence the sequencing and constructability of the CWP's, but engineers remain to be the lead actor in that stage of the project. Once the CWP is issued for construction the contractor will be responsible to plan the execution phase.

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Appendix 1

Question number	Question	Percent Support at a 5% level of significance
1	Packages must be planned by a "dedicated planner" and not by field supervision	66%
2	Work is best planned if the scope of work per package requires approximately 1-4 weeks of work for a single crew	80%
3	An "integration planner" must be assigned to identify and resolve anticipated conflicts between packages	78%
4	The responsibility of organizing the flow of materials, equipment and resources must be assigned to dedicated coordinators	83%
5	All stakeholders of the package (superintendent, planner, construction manager, sub contractors, etc.) need to be involved during the production and sequencing of the packages.	93%
6	The owner (oil company) needs to be involved in all stages of planning to ensure the plans will meet the established objectives.	62%
7	Foremen are responsible for the correct execution of the package; therefore they always need to review the contents of the package prior to execution of the package.	95%
8	Planning of individual packages should be completed at least 4 weeks before the construction of that package starts, so the foreman has sufficient time to prepare the work for that shift.	87%
9	There needs to be a continuous comparison of planning and performance of the packages against the overall project plan	96%
10	An individual CWP must be 100 percent engineered and issued for construction before you start the breakdown into work packages	72%
11	Before releasing the package, the planner must confirm that all items are available with the material, equipment and resource coordinators.	90%
12	The foreman must get familiar with the site (where it is, are there other crews, where's a crane, etc.) prior to executing the package.	98%
13	A war room must be established during the execution of the packages to identify the most recent updates in project status, special situations, etc.	83%
14	There need to be formal procedures within the organization to ensure the planners are always provided with the latest data as soon as an update occurs.	82%
15	A package needs to have several what if scenarios to ensure work can proceed if something unexpected happens.	90%
16	Measuring easy to understand targets within a package (e.g. amount of spools installed per day) will motivate crew performance	93%
17	Using workface planning (including the expected format) must be part of the contract between the Owner, EPCM and the Contractor.	97%
18	There needs to be an audit system to assess whether the prescribed procedures were followed during the project.	97%
19	In order to be effective the major stakeholders need to work collaboratively	97%

Appendix 2

Workface Planner – Sample Job Description

Job Title: Workface Planner
Reports to: Construction Superintendent
Prepared by: H.R. Folk
Prepared by date: April 1, 2XXX
Approved by: D. Boss
Approved by date: April 15, 2XXX

Summary

The Workface Planner is responsible for the conversion of construction work packages (CWP) into field installation Work Packages (FIWP). They are also responsible for insuring that all necessary resources are available prior to releasing the FIWP and monitoring and control of FIWP.

Essential Duties and Responsibilities include the following:

The planner ensures that safety, quality and efficiency at the workface are considered in the planning process. In this field position, they would use their hands-on construction expertise to develop field installation work packages (FIWP). The coordinates with and provides workface construction knowledge to project schedulers, engineers, superintendents and managers. They act as liaison between the project controls department and workforce supervision.

Safety:

The workface planner must facilitate a safe work culture and is accountable for identifying and inputting into FIWP all necessary resources and specific safety requirements to provide safe working conditions for all planned activities.

This may include:

- *Knowing, understanding and communicating the safety regulations (Occupational Health and Safety Act) and project specific safety policies and procedures.*
- *Identify specific risks associated with executing the planned activities.*
- *Providing or arranging for inclusion of safety compliance in FIWP to mitigate specific risks. And,*
- *Ensure intended safety requirements are properly conveyed to workforce supervision.*

Project planning:

The planner is accountable for developing FIWP from design documentation and reviewing with foremen to ensure a complete understanding of the daily and weekly activities required to meet production goals.

Responsibilities may include:

- *Developing FIWP templates.*
- *Preparing required project FIWP, which includes determining required activities, resources, special conditions, quality control, risk planning, interdependencies.*
- *Determining and coordinating resource requirements and liaising with resource coordinators.*
- *Reviewing FIWP for completeness and accuracy.*
- *Coordinating FIWP execution with field supervision.*
- *Monitoring and controlling FIWP and advising appropriate parties.*
- *Coordinating activities with field supervision, resource coordinators, project controls, quality assurance other planners, and operations personnel.*
- *Modifying, reviewing or adjusting FIWP as necessary. And*
- *Conducting post-mortem on FIWP.*

Qualifications:

To perform this job successfully an individual must be able to perform each essential duty satisfactorily. The requirements listed below are representative of the knowledge skill and or attitudes required. Reasonable accommodations may be made to enable individuals to perform essential functions.

Education and/ or Experience:

- Completed construction safety training systems.
- Minimum five to seven years experience on industrial construction projects as a journeyman tradesperson or other construction project specialist.
- Minimum three to five years supervisory experience.

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- Completed a formal supervisory training program (e.g., Better Supervision, Merit Supervisory Training Program or equivalent). And,
- Completed Leadership for Safety Excellence.

Knowledge:

The workforce planner should be aware of the following:

- Health, safety and environmental programs.
- Company and project environment.
- At least one specific construction trade discipline or construction specialty at a minimum journeyman level.
- General construction and materials systems and procedures.
- Basic understanding of project scheduling and estimating techniques. And,
- Understand how the FIWP fit into the overall project schedule.

Skills:

The workforce planner should have the following skills:

- problem solving and conflict resolution;
- effective oral and written communication;
- strong organizational and documentation skills; and
- basic computer literacy.

Desirable Characteristics:

The workforce planner should exhibit the following:

- accepts challenges;
- willing to learn;
- responsible and accountable;
- good work ethic;
- adaptable;
- leads by example;
- team player; and
- honest and acts with integrity

Appendix 3

Integration Planner/Coordinator – Sample Job Description

Job Title: Integration Planner
Reports to: Construction Manager
Prepared by: H.R. Folk
Prepared by date: April 1, 2XXX
Approved by: D. Boss
Approved by date: April 15, 2XXX

Summary

The Integration Planner is responsible for reviewing work plans from multiple contractors and proactively identifying potential conflicts or integration issues and resolving them. Other responsibilities include providing direction, leadership and coordination to planners while maintaining the critical path.

Essential Duties and Responsibilities include the following:

The integration planner ensures that safety, quality and efficiency are considered in the planning process to ensure results at the workface. In this supervisory position, they would use their hands-on construction expertise to monitor Field Installation Work Package (FIWP) development and coordination of all work plans. The integration planner coordinates with and provides workface construction knowledge to workface planners and acts as liaison between construction contractors and construction managers.

Safety:

The integration planner must facilitate a safe work culture and is accountable for overseeing safety requirement input into FIWPs to provide safe working conditions for all planned activities.

This may include:

- *Knowing, understanding and communicating the safety regulations (Occupational Health and Safety Act) and project specific safety policies and procedure.s*
- *Identify specific risks associated with executing the planned activities.*
- *Providing or arranging for inclusion of safety compliance in FIWP to mitigate specific risks. And,*
- *Ensure intended safety requirements are properly conveyed to workforce supervision.*

Project planning:

The integration planner is accountable for coordinating all FIWPs to a level 4 schedule from design documentation to the field to ensure continuity and integration of plans as part of a level 5 schedule.

Responsibilities may include:

- *Develop, oversee and seek continuous improvement of the Workface Planning program.*
- *Assist in the development of FIWP templates.*
- *Surveillance of contractor FIWP process.*
- *Coordinate FIWPs across all planners.*
- *Review FIWPs and provide constructive feedback to contractors Workface Planning Lead.*
- *Assist contractors with accessing documentation and latest revisions necessary for building FIWPs.*
- *Facilitate regular meetings to proactively resolve planning conflicts across contractors.*
- *Participate in Workface Planning audits. And,*
- *Keep up to date on Workface Planning developments in industry.*

Qualifications:

To perform this job successfully an individual must be able to perform each essential duty satisfactorily. The requirements listed below are representative of the knowledge skill and or attitudes required. Reasonable accommodations may be made to enable individuals to perform essential functions.

Education and/ or Experience:

- *Completed Construction Safety Training Systems.*
- *Minimum 7 to 10 years experience on industrial construction projects as a journeyman tradesperson or other construction project specialist such as a field engineer or technologist with hands on construction experience.*
- *Minimum 5 to 10 years supervisory experience.*

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- *Completed a formal supervisory training program (e.g., Better Supervision, Merit Supervisory Training Program or equivalent). And*
- *Completed Leadership for Safety Excellence*

Knowledge:

The integration planner should be aware of the following:

- health, safety and environmental programs;
- company and project environment;
- at least one specific construction trade discipline or construction specialty at a minimum journeyman level;
- general construction and materials systems and procedures;
- basic understanding of project scheduling and estimating techniques; and
- understand how the FIWP fits into the overall project schedule.

Skills:

The integration planner should have the following skills:

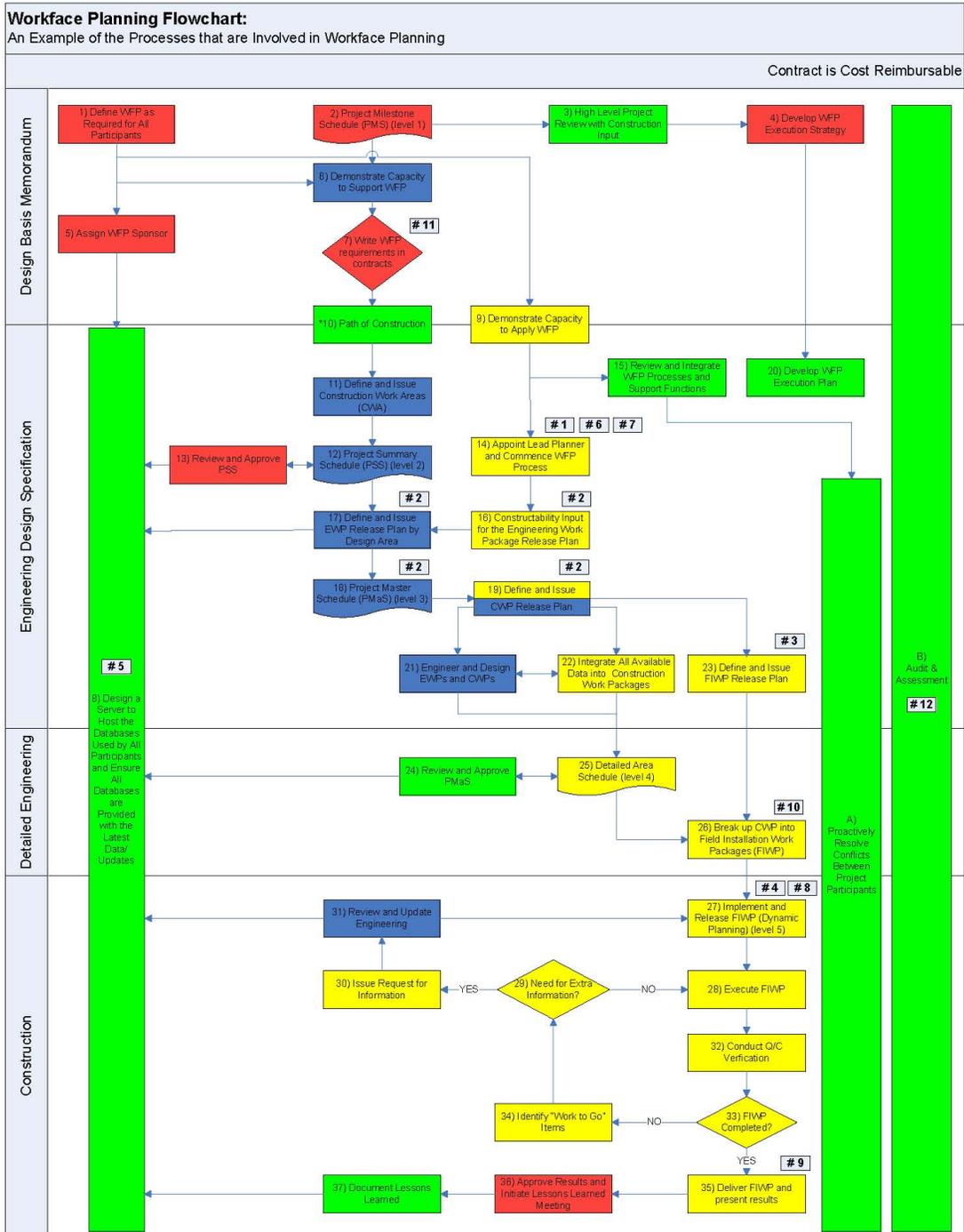
- problem solving;
- conflict resolution;
- effective at promoting collaborative decision making;
- leadership;
- effective oral and written communication;
- strong organizational skills;
- basic computer literacy;
- time management; and
- good understanding of scheduling.

Desirable Characteristics:

The integration planner should exhibit the following:

- team leader;
- leader by example;
- team player;
- organized;
- good communicator;
- accepts challenges;
- willing to learn;
- responsible and accountable;
- good work ethic;
- adaptable; and
- honest and acts with integrity.

Appendix 4



*10) Path of Construction
Ideally this involves the Construction Contractor, Construction Management Team, Engineering and the Owner. This means the Construction Contractor is engaged in late DGM/Early EDS. In the absence of the Construction Contractor the Construction Management Team will fulfill this role.

