DEFINING A RESEARCH AGENDA FOR A/E/C INDUSTRY

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The current project delivery systems whether traditional type, Design then Build, or EPC-type, or Project Management approach failed to build true partnering relationship between the different project parties. Each party still focuses his attention solely on optimising his operations expecting that such approach will maximize his financial returns. For example, the authors experience with EPC-fast-track construction projects of large scale plants is as follows: the engineering team tries as much as possible to cut their cost using methods such as minimizing the number of drawings, or extending the design schedule. The procurement team tries to cut their costs, especially with expensive equipment, by extending the delivery schedule or by minimizing the amount of pre-assembly works at vendor shops. On the other hand, the erection contractor would like to minimize the time spent on preparation of field/shop drawings, minimize the extent of site pre-assembly of equipment, and would like to minimize the idle time for his cranes for heavy lifts. All this coupled with client last minute change requests, have always resulted in adversary relationships between the parties. The same analogies can be drawn under the other types of contractual arrangements.

The authors believe that a measure or matrix should be developed to assess the impact of different work scenarios. We would like to be able to answer questions like is it better, for example, to delay the start of piping erection by one month to give engineering more time to complete the piping design? Is it more cost effective, from the overall project cost view, to use fireproof paint rather than cement lining for steel structures, etc? What is the indirect impact of a design change, or a material delivery delay on construction activities? At present, there are no robust tools, or at least acceptable by our industry, to use to answer such complex questions. In addition, there is no clear incentive, especially financial, for a party to change his work plans to enable another party to be more efficient unless the required action is contractually required or it can be proven that this action will result on cost savings to both parties.

Research effort is also required to increase the value of 3D project models. Currently, the use of such models has become a standard procedure in large mechanical projects. At present, these models can capture the geometrical data as well as <u>some</u> design data about each “object” which is to be built. These models are being used for interference checking, plant navigation, and as a reporting tool, for example, on design and construction progress. To increase the value of these models, they have to capture more information on construction requirements, such as the required temporary works and the required construction workspace to build a given object. We should be able to easily define the construction methods planned, the construction sequences, and the crew movements. Low level construction-related interrelationships between objects should be captured in the 3D model such as objects that share the same scaffolding or the same crane or will be poured at the same time. The time dimension should be captured in the model. The authors believe that 3D models can be a very powerful tool for planning especially the “3-week look ahead” planning. The 3D model technology can help us identify how resources interact and compete on workspaces. Moreover, the 3D technology can be used to automatically highlight areas where the planned construction method or sequence is in conflict with the design specifications such as allowable stresses. In addition, the current 3D commercial systems lack a robust system for management of design changes. For example, if a pipeline is added, re-routed, or deleted, this might have impact on the structure supporting it. At present, engineering companies rely on paper procedures or computerised systems outside the 3D environment for management of changes and revision control.

In the future, the construction crew, on site, can easily query the latest design data, specifications, and construction-planning information displayed on their mobile computer units (e.g. PDA's). Moreover, data required for "NC-like" controlled construction equipment (such as cranes, and excavators) and tools (such as torque wrenches) are extracted from the 3D system and transferred to these equipment. With the use of GPS technology, as the construction crew proceed with their work, whenever they deviate from the design requirements or planned construction method, they will receive different warning levels. As-built information will automatically be updated in the 3D system with date and time stamp.

In the area of testing and inspection, the development of cost-effective tools using scanning technology should be considered. Tools are needed for checking, for example, that the soil has been compacted as per the specifications, a bolt has achieved the required tension, and a paint system meets the required specifications. Ease of use, how the tool will be integrated in the workflow, time required to obtain results and the operating temperature, should be considered in the design of these tools.

Development of more standards is also an area of interest to all project parties. Efforts like CIM steel, Plant Steps should be continued. The development of standard material coding system and standard building components will benefit the construction industry.