Advance to the front

John Griffith and Drew Dietrich, WorleyParsons Engineering Ltd, UK, and Siva Natarajan and Ron Beck, Aspen Technology Inc, USA, describe advances in front end engineering workflow and integration.

Over the past decade, front end engineering design (FEED), also called front end loading (FEL), has emerged as a crucial phase of engineering and has become critical to the overall economic success of a large capital project. This focus has crystallised as the capabilities of software to manage and integrate the conceptual and basic engineering tasks involved in FEED have rapidly advanced.

At the present time, the process industries in general and EPC services community in particular are facing a worldwide surge in capital investment and facility expansions.[1] This presents engineering services organisations with significant challenges such as designing and delivering projects quickley and finding and deploying the required experienced engineering expertise in an increasingly tight technical labour market[2]. These trends magnify the importance of better execution of the FEED phase of projects.

Using as an example WorleyParsons, the eleventh largest Global EPC organisation (ENR 2006) and the Aspen Zyqad™ collaborative basic engineering software system found in AspenONE™, we examine the broad impact that integrated basic engineering software has on sharing basic engineering work over global teams, working concurrently instead of sequentially, communicating with other engineering groups and communicating with customers.

E&C challeng es in 2007

WorleyParsons is addressing a set of business and operational challenges that they believe are representative of the EPC industry overall.

These challenges include:

- A steady increase in major project business, tied to the upward capital cycle.
- Pressure on the basic engineering community involving size and complexity of projects contrasted with the client's desired timescales. Therefore, there is an increasing emphasis on collaboration between engineering disciplines and cooperation between EPC organisations.
- Resource challenges stressing the ability to add experienced engineers at a fast rate.

In addition to those general challenges, WorleyParsons achieved two major acquisitions in the past four years, integrating Parsons into the Worley organisation in 2004 (a US$ 283 million acquisition) and Colt Engineering in 2007 (a US$ 900 million acquisition). These acquisitions introduced a step wise increase in the scope of

Table 1. Incremental investment and corresponding gain for FEED from Aspen Zyqad at WorleyParsons		
Activity	**Summary**	**Benefits achieved**
Pilot collaborative project (each location) 2002	Match implementation to workflows at each engineering center	Prove the value of the collaborative approach Streamlined and improved workflows
Locally executed production projects 2002 - 2004	Employ Aspen Zyqad on projects executed at one location	Faster project throughput Improved project workflow Enhanced interdisciplinary communication
Repeatable design modeled for proprietary sulfur process 2003	Proprietary sulfur process completed within Zyqad database	Efficient reuse of best practice engineering for proprietary processes Achieve consistent engineering over multiple projects Significant speed and timescale advantages
Global Implementation 2004 – 2007	Employ Aspen Zyqad at multiple WorleyParsons engineering locations	Company standard practices used globally Best practices shared globally Alleviate resource shortage from coordinated sharing of workload at distributed engineering expertise and workshare centers Measured additional timescale advantages
Joint Projects with other E&C organisations 2005	Use of Aspen Zyqad on mega project split between WorleyParsons and other EPC	Split work amongst more than one contractor Share rewards of projects beyond the scope of any one E&C organisation Ensure design consistency, speed up project execution
Collaboration with clients 2007	Use of Aspen Zyqad by both client and WorleyParsons on projects	Improved information flow at FEL and design turnover phases Provide value of design data to client in operations

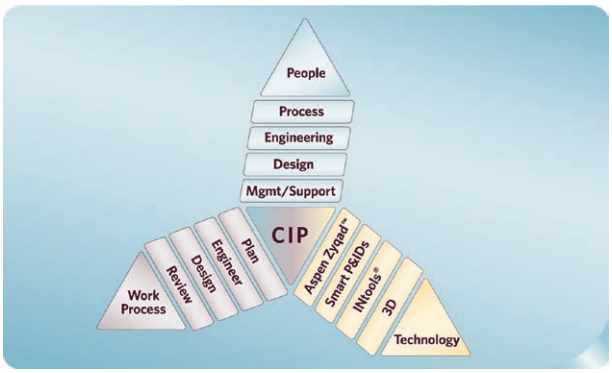

Figure 1. The CIP project strategy.

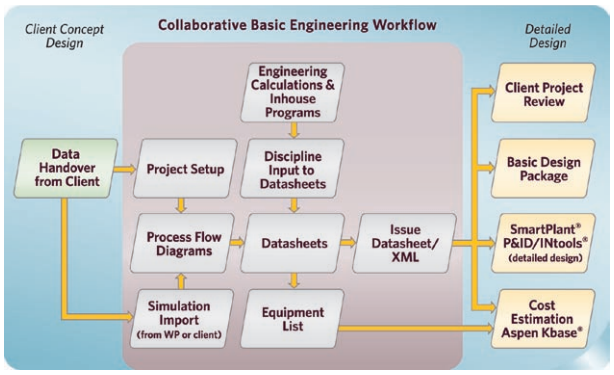

Figure 2. Collaborative basic engineering workflow.

WorleyParsons' project activities as well as challenged the organisation to integrate a worldwide and distributed expertise pool. With such large scale acquisitions, merging engineering organisations is expected to be a continuing trend in the industry.

Automation and integration strategies

In the context of these overarching business trends, WorleyParsons designed their corporate strategy and objectives around organisational agility, technology leadership and performance excellence.

To support those objectives, the organisation embarked on a strategic program of automation, computer integrated projects (CIP) designed to be global in scope and span the range of functions performed for clients by the organisation (encompassing the identify, select, define, execute and operate phases of a project). The CIP approach is not only a set of software technologies, but rather, it recognises and incorporates a three pronged focus; namely people, work processes and technology (Figure 1).

A key element of the CIP strategy is the FEED, or basic design area. WorleyParsons initially selected the Aspen Zyqad tool in 2002; a solution that integrates front end engineering work processes, to address FEED. From the beginning of 2002, WorleyParsons has successfully used Aspen Zyqad to streamline their basic engineering workflow, remove barriers and bottlenecks in project engineering, and support global work sharing, thus enabling faster project execution, agility and coordination between engineering disciplines.

Progressive implementation

A collaborative basic engineering solution, such as Aspen Zyqad, comprehensively impacts and improves engineering standards, design workflow and the basic engineering deliverables package. Accordingly, WorleyParsons determined that the best approach for a successful implementation would be to progressively begin with local engineering team pilots, eventually leading to an enterprise-wide implementation. Incremental investment in the collaborative engineering software has resulted in progressive benefits (Table 1).

At first, the Aspen Zyqad software was tested on pilot projects in 2002. London, UK and Houston, TX, offices were involved in this pilot phase. The project size was small and the scope was limited so that a managed range of functionality could be tested. Also achieved in the pilot was

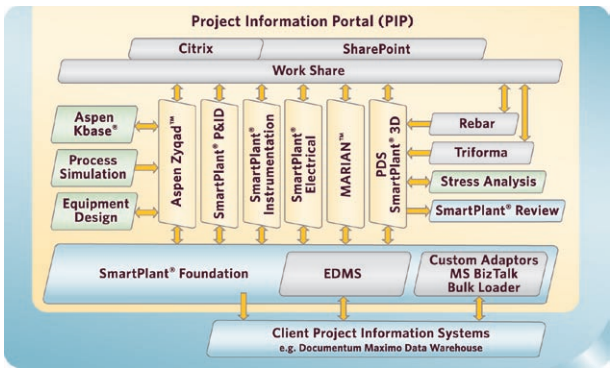

Figure 3. CIP engineering solutions architecture.

capture of those offices' work processes and standard basic engineering deliverables packages.

After successfully executing the pilot projects, the two offices deployed Aspen Zyqad on three new FEED projects. These projects averaged 50 - 75 pieces of equipment in scope. From 2003 - 2004, more and larger projects were executed using Aspen Zyqad in Houston and London. Additionally, the WorleyParsons' sulfur technology was captured as a design package in Zyqad allowing for reuse of the best practice engineering work elaborating proprietary design.

In 2005, an enterprise wide WorleyParsons' Zyqad Community of Practice was established to share best practices and lessons learned from different Aspen Zyqad projects. Company standards were identified and workflow procedures were outlined. Training documents were created to help new offices and teams to make best use of the experiences from earlier Aspen Zyqad projects. With each successful project completed using the collaborative basic engineering software approach, project managers have become more familiar with the work process, clearly understand the quality and time benefits and are committed to the use of the CIP approach on projects.

Currently, more projects are being executed using Aspen Zyqad and these projects continue to increase in scope and size. Aspen Zyqad is currently being used for projects with over 100 equipment tags and one of the largest projects involves close to 500 equipments tags.

Integration with other engineering tools

As Aspen Zyqad expands, different workflow bottlenecks are identified and addressed. For example, WorleyParsons is looking to utilise the costing interface to the Aspen KBase™, also part of the AspenONE solution, streamline the flow of information between process engineering and the cost estimation group. This will streamline the ability to estimate cost of design and design modifications. On one recent project involving approximately 50 major equipment items, it took more than three days to define, format and transfer the basic engineering data into Aspen Kbase. By utilising the Aspen Zyqad costing interface to streamline this data transfer activity, it is estimated that the same activity could be done in less than a day. Additionally, this will eliminate errors associated with manual data reentry.

On the horizon, WorleyParsons has targeted a project in early 2008 to replace cumbersome 'point to point' interfaces and integrate Aspen Zyqad with our preferred design suite via Intergraph's Smart Plant Foundation™ (SPF). This integration combined with change management will assist in meeting WorleyParsons' CIP goals.

SPF acts as a repository for data and a medium through which information is shared among authoring tools. It manages the availability, integrity, and accuracy of engineering information. The built in change management process in SPF combined with our existing toolset:

- Intergraph's Smartplant P&ID™: an intelligent piping and instrumentation diagrams system.
- Intergraph's Smartplant Instrumentation™: an instrumentation database for management of instrument index, loop drawings, wire diagrams, etc.
- Aspen Zyqad: will provide consistency across disciplines and deliverables.

The above mentioned applications represent phase 1 of the integration plan. The overall workflow employed to capitalise on Aspen Zyqad and its interfaces is shown in Figure 2, while Figure 3 depicts the overall integration plan for our core design systems.

Around the clock engineering

One of the advantages gained by WorleyParsons from its global workforce and recent acquisitions is the concentration of highly experienced engineering teams in almost every time zone.

To support and make best use of that competitive advantage, CIP and the associated tools above have been rolled out in all the global engineering offices, enabling global staffing and 'around the clock' execution of projects. As work is passed from London to Houston to Melbourne to Beijing, the CIP approach ensures accuracy and consistency of the design work as it is handed off, and the use of consistent reference libraries provides a framework for ensuring that engineering standards are kept consistent on the project across design centers.

Current projects: design reuse and collaboration with clients

With oil prices high and rising, oil sands, coal to gas and coal to liquid (CTL) projects are on the rise. With compressed schedules and finite engineering resources available for such complex projects, efficiency must be improved. By capturing these technologies in the WorleyParsons CIP tool set this can be achieved. Two current examples demonstrate that benefit.

A major oil sands program

WorleyParsons is currently executing work on the oil sands SAGD (Stream Assisted Gravity Drainage) upgrader project. The scope of the project is to upgrade the bitumen derived from tar sands for processing for a 220 000 bpd production. The distillate will be blended to form a synthetic crude oil product and pipelined to market. This project will utilise WorleyParsons's own sulfur recovery technology as part of converting bitumen into synthetic crude oil (SCO) at an upgrader.

The WorleyParsons sulfur recovery process has already been modeled in Aspen Zyqad, and the reusability of the engineering design is providing a significant resource and schedule benefit.

Natural gas to coal conversion.

A CTL licensor, based in California, is in the design phase for one of the largest CTL facilities in the US.

This facility will be converted from a natural gas fed fertiliser plant into a coal fed poly generation CTL facility producing ultra clean fuels, nitrogen fertilisers and power. After the phase one conversion to Illinois coal, the project is scheduled to produce approximately 920 t of ammonia fertiliser products, 1800 bbls of FT fuels and, 76 megawatts of electric power for the local grid on a daily basis.

Conceptual engineering, performed by the licensor using the AspenTech simulator AspenPlus™, was passed into Aspen Zyqad electronically, speeding up the handover process from the client to WorleyParsons and ensuring design consistency.

Following project completion, the client intends to employ the Aspen Zyqad as a tool to manage equipment and process data for plant operations and support. (A Dow Chemical study[3] has shown that the benefits of modeling PFDs and equipment data sheets in Aspen Zyqad has a factor of 2 - 3 incremental benefit, over the initial benefits in engineering, to the owner operator in operational phases beyond startup.)

Measureable benefits

WorleyParsons has implemented Aspen Zyqad as part of the overall CIP approach to achieve data centric basic engineering for over 11 projects with several large on going projects. As the organisation has gained experience with CIP, which focuses on a data centric approach for all phases of engineering, the following benefits have been realised:

- Global design standards embedded in the collaborative engineering software used at all design centers.
- Knowledge capture and reuse, enabling a cost effective design to be engineered with fewer resources (such as the oil sands project described above).
- Improved quality and consistency of project deliverables and execution.
- Faster project execution (AspenTech reports, for example, a 20% benefit measured by Lurgi in 2003).

Conclusion

WorleyParsons has successfully employed the Aspen Zyqad integrated basic engineering solution on a range of engineering projects, of increasing size, over the past six years. Use of this solution has had enterprise wide benefits in terms of project quality, execution time, global access to available engineering resources for projects. A globally consistent CIP approach to engineering and design has proven invaluable as WorleyParsons are becoming more resources constrained. Thus, WorleyParsons' approach to project execution has positioned the organisation to effectively deploy 'around the clock' engineering using offices around the globe. Finally, the CIP approach will facilitate electronic handoff of design data from WorleyParsons to client owner operators for project life cycle management. As phase 1 of the integration plan is completed, WorleyParsons will continue to expand the scope of CIP to include all phases of the project from conceptual engineering to operations and maintenance.

References

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