

Web-Based Collaboration Technology

Managing the Information Flow on International Mega Projects

Abstract

Emerging economies, in particular those in the Gulf region and Eastern Asia are currently home to some of the largest infrastructure investment projects in the world. These must be managed to tight, and often very public, timescales and can involve complex legal structures between collaborating organizations, often involving specialists in many different countries.

This creates special communication challenges, as participants must efficiently exchange thousands of technical documents and tens-of-thousands of pieces of correspondence every month. Cooperation between participants with different backgrounds and working practices makes it important that good processes and systems are in place. All of these attributes mean that first-class control of project information is a necessity if the project is to be delivered on time, within budget, and with minimum risk.

This paper discusses how these issues can be addressed on international large-scale developments, in particular by using a web-based project collaboration solution.

Aconex is the world's largest provider of web-based collaboration to the construction and engineering industries. The company currently services projects in over 50 countries from its network of 30 offices. This has given us an unparalleled, unique insight into the complexities of information management on large-scale developments and the challenges of streamlining collaboration between geographically dispersed project teams.

Introduction

Globalization has reduced the importance of national boundaries in the architecture, engineering and construction (AEC) industries. As a result, projects are routinely delivered by multi-disciplinary, multi-location, multi-company groups of people [12].

On today's construction project, team members no longer need to be on the same site, or even on the same continent, to work together. A recent survey by the Gartner group found that more than 60% of professional employees work in virtual teams [4]. Furthermore, the ability of leading AEC companies to work across geographic borders, time differences and regulatory regimes has become a distinct competitive advantage [5].

The increasing globalization of the AEC industries has occurred in tandem with a sharp increase in large-scale international projects or 'mega projects', particularly in fast-developing economies in Asia and the Middle East. When embarking on a billion-dollar-plus mega project, with its inherent complexity and risk, clients, developers and head contractors are obliged to work with specialist skilled consultants, regardless of where they are based. This has further driven the trend towards dispersed project teams.

Clients on these prestigious international projects demand transparency, accountability and performance of their lead developers and subcontractors. Some of the greatest challenges in meeting these demands can relate to management of project information, specifically: *How can the flow of information be controlled when project teams are spanning the world?*

Thanks to the internet, there is now no need for participants to relocate to a physical project site, as web-based collaboration tools increasingly link global organizations, allowing team members to collaborate in real time. Essentially, the process of designing and constructing a building or engineered asset has not changed. What has changed are the tools employed, as protocols and systems have been developed to manage the collaboration process effectively.

This paper will examine the growth of large-scale international projects, discuss the barriers to collaboration and illustrate how web-based systems can facilitate good project management on these projects.

The Growth of Mega Projects

More than ever, companies and governments are investing in ambitious and demanding large-scale construction and infrastructure projects [7]. Often dubbed 'mega projects', these developments are typically valued in the hundreds-of-millions of dollars (often in the billions), with 5-10 year project lifecycles, and attract a high level of public or political interest due to their size, visibility and environmental, social or economic impact. Generally, these projects can be split into two types: 1) Commercial or infrastructure developments, designed to service the growing population and economy and 2) Engineering-led developments that capitalize on natural resources, including oil and gas projects. Their sheer scale and complexity can mean that these projects attract the leading contractors and consultants from around the world [11].

One of the most high-profile mega projects undertaken to date has been Europe's Channel Tunnel, a 20km twin tunnel high speed rail link between England and France. The Channel Tunnel was the world's largest private sector infrastructure project with a final cost of about \$15 billion. The prime contractor for the construction was the Anglo-French TransManche Link (TML), a consortium of ten construction companies and five banks. During construction, 150km of tunnels were dug by nearly 13,000 engineers, technicians and construction workers.

But, while they can be found in the established markets of Europe and the US, it is in fast growth economies such as China and the UAE that the international mega project is today most prevalent. Each of these countries has a thriving construction market that is experiencing increased foreign participation.

As Greater China's economy flourishes, so does the country's appetite for mega projects. Announcements of massive infrastructure projects, such as the \$60 billion South-to-North Water Diversion Project and the \$24bn Three Gorges Dam, are becoming almost commonplace. China's spending on infrastructure for the 2008 Beijing Olympics is expected to top \$23 billion – which will easily surpass spending for both the Sydney and Athens games combined [11]. Hong Kong is experiencing renewed development, and billions of (primarily American hospitality) dollars are being invested in Macau, as the Special Administrative Region looks to establish itself as the 'Vegas of the East'. The growing number of large Chinese infrastructure projects, combined with China's accession to the WTO, has created a fertile environment for foreign consultants and contractors from the AEC space.

The United Arab Emirates, particularly the city of Dubai, is another home to international projects of the largest scale. The UAE economy has doubled in size over

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the past decade and its population has grown by 75% over that period. As at September 2006, there were an estimated 850 major construction projects underway, worth an estimated \$347 billion. Fifty-four percent of these projects are situated in Dubai. Since the year 2000, Dubai's city government has initiated one major project after the other, and industry experts estimate that 15% to 25% of the world's cranes are currently situated there [1]. There are currently dozens of mega projects under development in Dubai, some of the most famous include: the Palm Islands – the three largest man-made islands in the world; Dubai Sports City – the world's first purpose-built sports city; Dubailand – a \$9.5bn theme park, tourism resort and real estate development; and Dubai Metro – the world's most advanced light rail system.

The current and projected volume of construction work in both the UAE and China certainly presents opportunities, but it also creates challenges. The growth in the number and size of contracts has already seen leading international contractors become more selective about what they bid for – generally high value projects over \$100 million. It has also meant that many companies have joined with others to form consortiums and syndicates; hence spreading their risk and gaining the ability to offer project owners a 'one-stop-shop' approach for the planning, design, construction, landscaping and delivery of projects. If these trends are an indication, then the movement towards multinationally-run mega projects in emerging economies – such as Asian, Latin America, Africa and Eastern Europe – will accelerate.

As well as typical project participants, such as client, project manager, engineer and architect, mega projects often require the involvement of specialist consultants, lawyers, environmental scientists, bankers and government officials.

Consequently, teams on mega projects can be quite unique, with inter-disciplinary participants from many countries, varying roles, responsibilities, goals, work practices and cultures. Collaboration and teamwork are crucial, since sharing up-to-date information between participants leads to minimization of errors, reduction of time delays and breaking the widespread rework cycle [8].

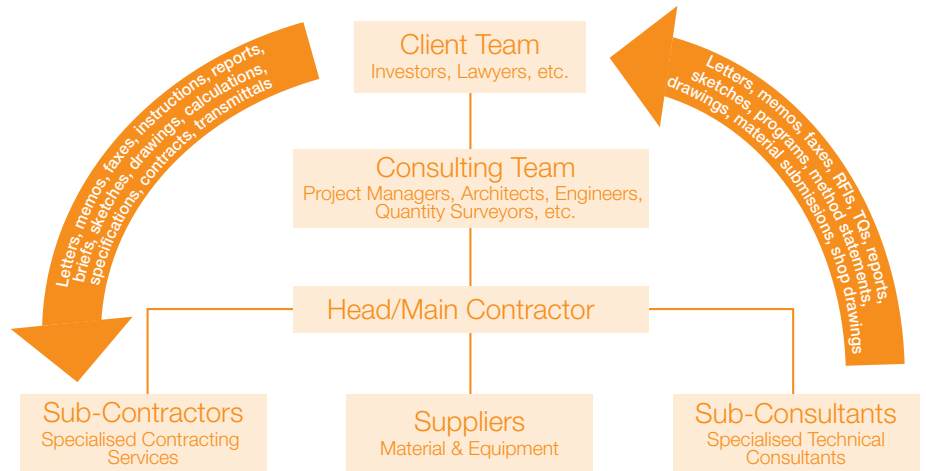


Figure 1: Projects involve a structured exchange of large volumes of detailed, time-critical information

In the past, project team members, even those located internationally, would meet in person at various stages in the project. Although this helps build relationships, it rapidly becomes inefficient in terms of time and money. The result is that global networks face unique communication challenges different from those that are not geographically dispersed.

Collaboration through Effective Information Management

As projects grow in complexity and size – particularly when into the realm of mega projects – information coordination becomes a critical success factor. At the same time, the desire to complete projects in an ever-shorter time has decreased the project design and execution stages – exposing projects to even greater risks and delays.

Project managers, particularly in the AEC industry, have always been highly dependent upon information. Getting the right information to the right people at the right time has been the basis of completing on time and on budget. Vastly complicating the process is the fact that mega projects can involve thousands of participants, spread across multiple countries, generating millions of documents and pieces of correspondence.

Traditionally, team members have used a combination of paper documents, email, fax and couriers to communicate. However these methods are unstructured, expensive,

manual-intensive and can lead to each organization becoming an island of information [7].

Inefficient management and storage of information is an extremely high ongoing cost to a project. This cost is not always easily measured, as the ramifications are more extensive than just time and storage space. Difficulties such as poor access or misplaced information can lead to reduced productivity and substandard service by a participating organization [2]. Organizations can also be left open to the risk of disputes and litigation.

To facilitate cross-team collaboration, a key responsibility of the project leader (usually the head contractor) is to ensure that all records created on the project, regardless of whether paper-based or electronically created, are effectively managed from an overall project perspective, rather than left to each participating organization or, worse, each team member to manage.

On mega projects, with potentially hundreds of organizations involved, there can be almost as many filing systems and undocumented procedures. Effective data control using each organization's individual processes, paper documents, spreadsheets, filing systems and email is simply impossible.

Occasionally, Clients are procuring and installing document management software in an effort to improve inefficient information management and exchange. Another approach is accepting the recommendation of the Contractor to use its internal document control system. When used on large-scale developments, particularly those involving international project teams, these methods have potentially detrimental limitations.

When the Client installs an internal document management system, all external participants on the project are placing their intellectual property, files and correspondence behind a firewall controlled by someone they have a contractual relationship with. In addition, external project teams can experience difficulties in obtaining local training and support for the system in their country. Hence, the benefits of using the Client's system are primarily with the Client, not all the participants, often resulting in a reluctance to collaborate via the Client-controlled system.

Similar impediments arise when project collaboration is attempted using a contractor's internal document control system. As with the previous example, the

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challenge for the Client is that its information and letters, responses and approvals are under the control of the very party it has a contractual relationship with. The Client may also have to interface with 5-10 different systems, making it difficult to maintain consistency and control. Again, the challenge for all parties involved in the project is that one single organization controls all the information and can withhold access, or remove and delete data and records. In this instance, the benefits of using the Contractor's system are primarily with the Contractor.

Because of this, on large-scale international developments the need for a third-party information management solution that allows collaboration between multiple, dispersed teams has never been greater. In short, a system is required that:

- Ensures relevant project information is easily accessible to staff, clients and business partners
- Applies systematic access rights to that information
- Controls costs associated with access, management and storage of the information.

Technology has already played a large role in the globalization of architecture, engineering and construction. For example, CADD, GPS, and satellites have helped transform the design process from being labor intensive to capital intensive. This, combined with the advent of internet and the reduced importance of workplace/office location, has helped drive the creation of a global construction market.

Given that the control and management of information is so crucial to the industry, it comes as little surprise that online collaboration systems are increasingly being used to aid international collaboration. These web-based information management solutions store project information online so that documents and correspondence are available in a single, shared environment that is accessible to all authorized team members. This enables participants to view, track, share and archive their information from any location, at any time, using a standard web-browser.

In practice, this means that feasibility studies, drawings, approvals, schedules, specifications, standards, procedures, etc. can all be viewed online. Team members can add comments, issue notices, instructions and requests for information. Then documents can be published singly or in batches. When documents are superseded, revision numbers are updated, meaning everyone works on the most up-to-date, accurate and relevant information, with older revisions safely archived.

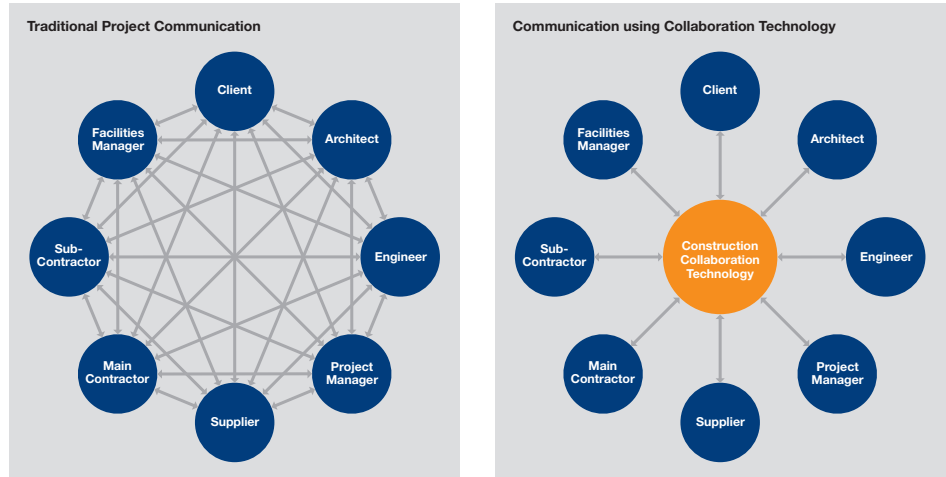
The advantages of using online collaboration can be seen at every stage of the project. During the early stage of development, the developer can communicate in a structured way with key consultants such as the architect, project manager and quantity surveyor. It is easy to move large files between participants and to collaborate on concept drawings in real time, from different locations. Changes and clarification in the scope of work is streamlined as Requests For Information, Architect's Instructions, other Instructions and Change or Variation Requests are automatically registered on the system where they can be viewed, responded to and tracked.

If the initial development work has been carried out using an online collaboration system, the preliminary documents are then available in one place, ready for distribution to the wider consultant team for detailed design. More frequent distribution of larger files can now be expected, and an online collaboration tool excels at this task. Later in the process, collaboration technology facilitates the compilation and management of the head contract tender documentation package and handles the responses. With all documentation already in the system, the successful Head Contractor can then compile and manage sub-contract tender packages in the same way.

As the project moves into the building phase, the same system is used to manage the contractor and vendor submissions, site and works inspections, approval of drawings, processing of claims and payments, defect management, and all other project documentation and correspondence. Rather than geographically dispersed teams being a hindrance to productivity, time zones can be used as an advantage for shifting work when the project schedule becomes tighter.

Throughout the design, tendering and construction phases of the project, collaboration technology can enable the accurate and timely distribution of information to Quantity Surveyors or Cost Engineers through the phases of early outline costing, detailed costing, variation management, reporting and payment control, to ensure that budgetary constraints are not being exceeded.

At the end of the project, the system is used to submit as-built drawings and manuals, and to manage essential services certification. This documentation can then be handed over to the Client and retained for ongoing facility management. The difference between using the technology and not is illustrated in the following diagrams:



As a bare minimum, using an online collaboration system should provide:

- A single point of access to information, for staff, clients and business partners
- An independent solution for all parties on the project, with defined access rights
- Automated control of documents and other information
- Fast creation, distribution and tracking of correspondence
- Security, update and access tracking features for electronic documents and records, with automatic version control
- Protection of the integrity of documents through complete audit trails and the inability to remove documents or information from the system once distributed
- Incorporation of workflow, linking and collaboration in web-based environments
- Prompt and efficient transfer of documents and correspondence to archives

Prior to Implementing a Project Collaboration System

Documentation and communication between multiple parties are at the core of a construction or engineering project. Good management of written information can determine project cost, completion time, risk profile and financial success. Particularly on an international project, it is important that the lead organizations (Client or Project Manager and Engineer or Architect) agree on basic communication protocols with the other participating companies. These rules are sometimes known as a project hierarchy or communication matrix. Whatever the terminology used, each organization must understand its role and contractual obligations. Processes that parties must also agree on will include:

Collaboration Technology in Practice

- Document and mail types, attributes and disciplines
- Communication flows and matrices for mail and document transmittals
- Document registration meta data required
- Document naming and numbering conventions
- Document version and revision control
- Document formats and statuses
- Control of registration of documents
- Distribution of documents
- Workflows for submission of vendor documentation
- Election of project Administrators
- Other protocols (such as system requirements, training and support plans)

Although some of the decisions made can be quite detailed, agreeing on what constitutes good practice for a particular project is an important step in ensuring consistency in communication and information management.

The following projects – one an infrastructure project in Africa, the other a multi-purpose development on a man-made island in the Gulf – are examples of large-scale international developments likely to become more prevalent in developing economies. These projects have addressed the challenges of scale, complexity and dispersed project teams by using an online collaboration solution called Aconex.

East-West Highway, Algeria

The East-West Highway is being developed by a five-party joint venture named COJAAL comprising five of Japan's largest construction companies including: Kajima and Taisei, Japan's two largest contractors; major general contractors Hazama and Nishimatsu; and trading house Itochu.

COJAAL is responsible for delivering the \$5bn Eastern section of the Highway which will be a 399km, six-lane motorway that includes 190 bridges and viaducts and five tunnels. Expected to be operational by 2010, the entire Highway development will extend 1,216km and ensure the link between Annaba in the north-east and Tlemcen in the north-west – passing directly through 24 provinces and linking Algeria to Tunisia and Morocco.

Construction of the Eastern section of the Highway will involve the flow of a large volume of information between around 2,000 project members, including the client, subcontractors, project managers, engineers, consultants, suppliers, and COJAAL's member-companies' Head Offices, all situated across Africa, Asia, Europe, the Middle East and North America.

The project is using an online collaboration tool in order to facilitate communication and document exchange between these project teams during the design and construction phases. With such an immense project, it was clear from the outset that traditional information management processes would not be adequate.

Mr. Minoru Ishida, Project Director at Kajima Corporation, said: "Using traditional methods of communication, such as paper documents and couriers would have been inefficient and expensive on a project of this scale – particularly when collaborating with international teams. Through managing information electronically, the cost of controlling and distributing documentation will be reduced, and productivity will be increased by team members having instant access to information."

The issue of information control and access can be a difficult issue when operating as a joint venture. Mr. Minoru Ishida continued, "The online collaboration system will maintain a complete, third-party archive of all documentation throughout the project lifecycle, which makes it the ideal solution for this large-scale joint venture development where equal access to information is required. Furthermore, because the system creates an audit trail which tracks all documents and correspondence, it will reduce our exposure to risks such as information loss, disputes over variations, and defects caused by outdated documents."

Lulu Island, The Kingdom of Bahrain

Due for completion in 2009, the \$1.2 billion Lulu Island is a multi-purpose commercial and residential development situated on a 563,000m² man-made island in Manama, Bahrain. The development will include the construction of 39 residential buildings, 1 residential Icon Tower, a 300 room five star hotel with villas, restaurants, shopping arcades, a private marina & yacht club, an aquarium, and an exhibition centre, 65 villas and 49 beach chalets with a 13000m² swimming pool.

The Lulu Tourism Company, which is behind Bahrain's \$1.2 billion Lulu Island development, recently implemented the Aconex document management and control system to allow it to better organize and access project information.

Aconex is being used to manage data – including documents, workflows and correspondence – online through one central site. The result is that everyone working on the project can access documents such as plans, drawings and correspondence by going online and typing key words into a search engine. Over the course of the development, the system is expected to save time spent looking for documents and costs related to printing, and also reduce the risk to the developer arising from information loss and contractual disputes.

Spencer Wylie, Lulu Island project manager for Davis Langdon & Seah International, said, “We have consultants in Bahrain, Dubai, Bangkok, Kuala Lumpur, Melbourne, Spain and the UK. All project teams can access the system and information exchange is in real time.

“Aconex is both a correspondence management system and a document control system. As a mail system, users can issue memos, emails, instructions, meeting notices, etc. It is also a fully recorded mail tracking system. Each organization has maybe 20 users within the organization and you need that one point of contact. Everyone has fast access to all of the information, and data can be made confidential if required.”

The system is also used to store documentation involved with the project and share it with business users. Wylie believes the system has also cut down time spent hunting for documents.

“Users upload drawings, documents, cost plans, etc. onto the system and they’re registered. The first upload is revision zero. Every time you upload again it automatically renumbers and renames the document and tracks the changes as well, so you can look at revision one, two, three, four, five at the click of a button, rather than going to a drawing file and pulling up drawings. It’s all in one place and it’s all linked through the system. It shows you exactly who’s made the change, when the changes were made, who’s looked at it, who’s reviewed it, if it’s been approved or not approved.”

Before moving to the Aconex-hosted system, Davis Langdon used the industry standard system of document transmittals, using hard copies and soft copies, which were very demanding of bandwidth.

“There’s so much information flying about on the system,” says Wylie. “Last month on Aconex we had 6,300 mail transactions. We transmitted nearly 3,000 documents to 14 organizations and we’re storing 18,000 megabytes of information on their system now. We’ve got a total number of 7,300 controlled documents on there, and that was last month alone. So you can imagine trying to upload all that through your email system.”

Conclusion

As developing economies across the world enter a new phase of rapid growth, there will be a considerable volume of large-scale construction projects undertaken – both infrastructure and commercial developments. As currently evident in the Gulf Region and the People's Republic of China, the size and complexity of these developments often lead to Clients and Head Contractors selecting the leading contractors and consultants from around the world. The result is that projects are routinely delivered by multi-disciplinary, multi-location, multi-company groups.

Timely and accurate communication across this network is essential in order to complete a project on time and within budget. For project leaders (Head Contractor, Architect, Engineer or Project Manager) a key challenge in this arena is, not only controlling the millions of pieces of correspondence and documentation that a project generates, but managing this process across different countries, time zones and cultures.

Through using web-based collaboration technology, project leaders can reduce reliance upon paper documents, and instead manage all information online through a central site, which allows team members to view, track, search, distribute and archive information electronically. Information is held securely, independently, and can be accessed remotely using a standard computer and web-browser.

This transparency of information and streamlining of data dissemination can help facilitate collaboration between geographically dispersed project partners. Other benefits include increased productivity through faster information access, reduced administrative costs through storing and distributing information electronically, and reduced exposure to risks such as information loss, disputes, delays and reworks.

For these reasons web-based collaboration technology can provide a comprehensive solution to information management and communication on the large-scale international projects that are set to become commonplace.

About Aconex

Aconex is a document management and collaboration system that uses the internet to manage the storage and flow of information for construction and engineering projects. Aconex improves communication and collaboration by storing all information online in one central site. This enables users to view, track and share their documents at any time, and from any location.

The benefits of implementing Aconex include: saved time through quick and easy information access; reduced costs such as couriers, printing and stationery; and reduced risks such as information loss and disputes.

Aconex now manages more than US\$100 billion worth of projects and has 30 offices worldwide servicing clients in over 50 countries.

For further information about this white paper, collaboration solutions or any of our products and services please visit www.aconex.com.

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