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This article presents some helpful "tips and suggestions" regarding building capital projects in China.

"East is East and West is West" – Managing Capital Investment Projects in China

by Jerry Hourihan and Gordon Lawrence

Introduction

"Help one another, for we are all in the same boat."
Chinese Proverb

More and more project management professionals from North America and Europe are finding that their work is taking them eastward to China. The authors of this article are two such professionals. In the spirit of the Chinese proverb quoted above, we offer this article containing some "tips and suggestions" based on our experience of recent capital investment projects in China, in which we have been involved.

The article is intended for those project professionals who may have many years of experience of building in places such as Europe or North America (hereinafter referred to as "the West"), but who have never worked in China before and may be faced with just such a challenge in the near future.

The Basics Still Apply

The first thing to remember is that just because the project will be built in China, it does not mean that the basic rules of successful projects do not apply. These rules are just as important here as anywhere else in the world. They are:

- ensuring clarity of business objectives at the start
- achieving a good level of front-end definition before committing funds for detailed engineering, procurement, and construction
- ensuring clarity of team organization, roles, and responsibilities

These three key areas are still vital and must not be forgotten.

Getting a Bigger Bang for Your Buck

One business reason given for setting up in China is the knowledge that building a facility there is less expensive than building a similar facility in the West. However, the arguments start when one begins to discuss just how much cheaper it may be to build in China.

Location adjustment figures can range from well below 40% up to around 80% of the cost of a similar facility in the USA,[1] depending on facility type and geographical location within China.[2] The "International Construction Cost Index," published by Faithful and Gould[3] currently indicates that a simple "light industrial" facility[4] in Shanghai should cost approximately 59% of the cost of a similar facility in Chicago, Illinois.

In our experience, the more a facility is based on simple building structures and the more that it is possible to source equipment locally, the greater the capital cost saving when compared with a similar facility in the West. However, as the need for complexity in the facility construction increases, through a need for specialized architectural room finishes, complex HVAC systems, or complex, specialized process equipment, the cost increases and the difference between China and the West reduces.

In addition, the other deciding factor in the capital cost is the location. Those facilities built in or near the east coast, developed cities of Beijing, Shanghai, and Guangzhou will likely cost more than a similar facility built further west.

Front-End Design

Home-Based or In-Country?

An early question that will arise for the project team relates to the strategy for designing the project; namely, should the front-end design be done in the owner's home country/region or in China?

Home-Based

The advantages to the owner of doing the front-end design in the home country/region are that one:

- is likely to have a greater knowledge of the strengths and weaknesses of the contractors available to bid for the design
- can potentially keep a closer eye on design quality
- can probably expect transparent, "Western" style project control practices
- can delay the time when one has to relocate team members as (very expensive) expatriates to China

However, there are generally two major potential disadvantages to doing the front-end design at a remote distance from China.

1. Since any facility will need to be compliant with local design laws and operating norms, it is necessary to employ a design contractor that can demonstrate either in-house knowledge of Chinese rules and regulations or can demonstrate that it has a partnership with a Chinese Local Design Institute (LDI)[5] that can provide such knowledge.
2. If the project is a "brownfield" expansion of, addition to, or upgrade of an existing facility, the design team will still need frequent and extended access to the site to survey the existing facility and to discuss and coordinate the design with end users. Hence, the design budget will require considerable funds for accommodation and for travel to and from the proposed construction site.

In-Country

If one opts to do the design in China, one avoids the two disadvantages listed above. However, one immediately has to relocate the owner team members to China with all the expatriate costs that entails. Perhaps more importantly, one also has the decision of whether to employ an international design contractor (e.g., one from Europe, North America, Singapore, Australia, Korea, or New Zealand) who has offices in China or to work directly with a Chinese LDI. The decision to choose an international contractor is usually driven by the desire to retain at least some of the quality control advantages of working in one's home country/region, while avoiding the need to commit a large owner team to supervise and monitor the LDI. (However, there is another issue to consider in using international contractors. The more expats used by the contractor, the more expensive the team, and the less cost advantage gained. We found that those international contractors that had taken the time to train local staff, while imposing international working procedures, held the cost advantage. We also found that while many of these contractors had secondary/pharmaceutical experience, fewer of them had bulk/active pharmaceutical ingredient experience).

Which to Choose?

As we have shown above, each strategy has advantages and disadvantages. The important thing to consider is how the strategy fits your particular project. We have used both home based and China based strategies. In our view, if the owner has only a small team (which he inevitably does), the better strategy is to do at least conceptual design on a home-based basis and preferably, basic design as well. Then, when you do eventually move to China, work with the LDI through an international contractor that has China experience.

Why Do You Need an LDI?

No matter which strategy is used, before the end of Basic Design, an LDI will need to be involved. This is due to complex system of design authorization and government permits that are required for every project, specifically, the need for an authorized design house to stamp (or "chop" in the local slang) design packages to confirm they have been designed in compliance with regulations. In order to be authorized to "chop" drawings, a design contractor needs to be licensed and registered by the relevant local Chinese authority. In practice, the only companies who currently have such approval are LDIs.[6] Consequently, even if the front-end design is carried out in the home country/region, an LDI will still need to be employed to review and approve the design, submit the permit application to the authorities, and "chop" the approved drawings.

Government Permits

Every country has certain permits and approvals that are required in order to proceed with designing, building, and operating a facility. However, the permit requirements in China are much more complex, and due to the fast pace of development in China, subject to revision/modification at unexpected intervals.

Understanding the Permits and their Sequence

Permit requirements in China occur at every stage in the project process, from the initial decision to invest, through design, engineering, procurement, construction, and commissioning, up to and including start of operations. They also require one to work with numerous government agencies. Hence, it becomes clear that any project team needs an LDI that is experienced in knowing which permits are required and when. Table A shows an early draft of a permit list for one of our smaller projects. We provide it purely as an example to indicate the scale of the issue. (To claim it is a comprehensive list would be foolhardy on our part). This project did not need the full range of permits because it was an expansion of an existing building, not a new site or a new building.

Understanding Regional Interpretations of Permit Regulations

In addition, there can be slight variations in the interpretation of the regulations from region to region. Consequently, it is important to have an LDI that is not only knowledgeable about the Chinese permit system, but also about how that system is enforced in the specific region in which you are building. Space does not permit us to go into details, but we experienced several instances where designs had to be modified because of differences in interpretation of regulations from one region to another.

Managing the Timelines for Permit Applications

It is important that the various permits are correctly represented in the project schedule in order to set a realistic timeline.

What Permit is Needed For	Permit Title
Permits to Proceed with Project	- Project Verification - Business License - Environmental Impact Assessment - Project Permit - Encourage Industry Permit
Permits to Recover VAT and Gain Customs Exemption	- Master Equipment List (MEL) Preparation - MEL Customs Registration – City Authorities - MEL Customs Registration – Regional Authorities - MEL Customs Registration – Provincial Authorities
Permits to Proceed with Engineering	- Preliminary Design Package (PDP) for the Planning Bureau - Registration of LDI with City Authorities
Planning Permit	- Planning Bureau Permit
Approval of Engineering	- Construction Drawing Design Audit - Fire Fighting Design Certificate - Lightning Protection Design Certificate
Permits to Proceed with Construction	- Construction Permit (Construction Bidding Registration, Safety Permit, Quality Permit) - Approval to Break Ground - Registration of Construction Supervision Contractor - Registration of Construction Quality Supervisor - Cement Funds Approval - White Ant Prevention Certificate - Land Planning Permit
Approval of Installation	- Fire Fighting Installation Certificate - Lightning Protection Installation Certificate - Construction Quality Bureau Approval - Construction Planning Re-Measure Certification - Electrical Power Requirement Approval - Special Equipment Final Acceptance Certification - Special Equipment Registration - Construction Safety Record Certification - Construction Environment Certification - Acceptance of Project Archive
Permits to Proceed with Operations	- Project Completion Certification

Table A. An example (for illustrative purposes only) of some of the permits required.

Several of the permit applications are almost certainly going to be on the "critical path" of the project schedule. Consequently, it is vital to closely manage the permit application process, including preparation of applications, application submissions, and (hopefully) receipt of approvals. To manage the various permits, the following steps should be taken:

- Set up a "Permits Team" with responsibility for coordinating and progressing permit applications.
- Appoint one person from within that Team with single point responsibility for keeping track of progress of all permits.
- Keep a register of all permits.
- Hold regular meetings of the "Permits Team" to monitor progress, maintain the permit application schedule, and be prepared to take action when obstacles arise.

Preparing the Permit Application

Any application will frequently go through several reviews by the relevant Bureau and it is important to maintain a task-list, identifying all comments received from the Bureau reviews. All of the comments must be reviewed, and where appropriate, dealt with in a timely fashion. Even though it may not be obvious that the Bureau is reviewing these items, at some stage, usually just before final approval, the Bureau will assuredly check that they have been addressed.

Submitting the Permit Application

Even though it is acceptable for the owner firm to have the contractor/LDI prepare the permit application, it is advisable to have someone from the owner organization act as the interface with each Bureau, rather than leave it entirely to the contractor. In this way, the owner demonstrates to the bureau that the owner attaches importance to the application.

Construction Permits and Overlapping of Engineering and Construction

In Europe and North America, it is common practice to overlap detailed engineering and construction work by around 20 to 30%. In China, this is a less accepted practice. The ideal approach from the point of view of the Chinese authorities is that you should finish all your design details and submit them for approval in one package, followed by a single approval for construction. We discovered that any deviation to this approach requires negotiation with the applicable Bureau with no guarantee of success. Since construction cannot start until the permit is received, and the permit cannot be applied for until a considerable quantity of the detailed engineering is complete, this should be accounted for in your timeline.

Working with an LDI

It should now be clear that the project will need to employ an LDI at some stage during design or detailed engineering. So what are some of the issues associated with dealing with a LDI?

Registration of the LDI

China is divided into different provinces, each with its own specific regulations, similar to state versus federal regulations in the USA. Consequently, when choosing an LDI, it is important to ensure that not only is the LDI authorized to "chop" design drawings, but that their authorization is registered with the local regional authority. As an example, drawn from our own experience, an LDI previously registered for work in Shanghai, which was hired to work on a project near Suzhou (80km from Shanghai), had to re-register with the Suzhou authorities. The Shanghai registration was not valid.

Pharmaceutical Experience

A lot of the process engineering work performed by LDIs in the past was in the chemical and petrochemical industries. Consequently, there may be a lot of experience among the LDI staff in civil and structural disciplines, power, mechanical/rotating equipment, and large bore pipework, but less experience in small bore specialized pipework, control and instrumentation, specialist HVAC for clean areas, and specialist architectural finishes for clean areas. It is important to assess the level of experience early on in dealing with the LDI, and where necessary, bring in additional expertise to reinforce the weaker areas.

"Constructability" Experience

In our experience, it is not common for the LDI design staff to visit the site or deal with practical design issues on site. Their normal method of working is to prepare a design remotely from the construction site and "pass it over the fence" to the construction team. This can lead to problems with:

- reluctance to visit the site to survey existing facilities for a revamp project
- poor design "constructability"
- poor estimating of material quantities for cost estimates, and a tendency to focus only on the main items and not on the small details, which are required along with the main items
- lack of efficiency in resolving construction technical queries
- a tendency to repeat design errors in the design office that were previously unearthed at the construction site

Drawing Quality and Document Control

The review and approval of drawings prior to issuing, as well as document numbering and control may not be to the standard you typically expect. You may find you need to spend time ensuring this is of an acceptable standard.

Design Flexibility

It appears that Chinese clients make few changes during execution and in general leave it to the LDI to make design decisions. This can manifest itself in an unwillingness on the part of the LDI to show flexibility in dealing with client requests for changes in project priorities or design.

Project Control Practices

Perhaps because LDIs are used to a more "hands off" approach from clients, there may be a reluctance to demonstrate project schedules and project progress in the form you are used to. However, by judicious questioning, you may find more progress has been made than first appears.

Value for Money

In general, if the above points are evaluated properly, LDIs in China offer good value for money.

Procurement

As on any project, efficient working of the procurement team is a key aspect of project success. Strong procedures and clear workflows are normally necessary to remain compliant with your company finance rules.

Equipment Procurement

Choosing Vendors

There is an obvious cost benefit in sourcing some or all of your process equipment in China. However, as with purchasing anywhere, it is important to specify the design and fabrication quality that you expect to receive. In China, as in other parts of the world, the vendor may well be willing to offer a low price, but it may be because he cannot offer the design complexity or the quality of finish that you require. Therefore, it is important to thoroughly vet potential vendors before including them on any bid lists. The vetting process should include visits to the workshops, not just desk surveys. This all takes time and it needs to be allowed for in the project schedule.

Obtaining Quotes

When preparing a good quality ±10% cost estimate, it is usual to obtain firm quotes for all major and long lead items of equipment and budget quotes for the lesser equipment items. However, in our experience, Chinese vendors are very often reluctant to provide firm, detailed quotes for use in cost estimates on projects that are not yet approved. The issue seems to be that they do not wish to "waste time" providing a detailed quote for a project that may not be approved for several more months (if at all). The attitude seems to be "come back when you're ready to place the order." This can be a serious issue for cost estimate accuracy. Even getting a quote can require the purchasing officer to expend considerable effort with the vendor. To turn that quote into even a good budget standard will take a lot of time and effort from the engineer and the purchasing officer to try and "expedite" the vendor into bringing his quote up to a reasonable standard.

In addition, whereas in the West, a budget quote can generally be relied upon to be at the high end of the likely final cost; in China, there is a tendency to provide low early quotes in the expectation that this will encourage you to continue discussions.

Fabrication Quality

In any location around the world, it is important to inspect equipment during manufacture. China is no exception. You

must be prepared to invest adequate time and resources in an inspection program tailored for your project needs. In addition, it is important to ensure that all inspectors engaged for such a role are reliable. In one example, we received poor quality equipment despite numerous works inspections. The problem was traced to the inspector failing to adequately fulfill his role.

Delivery

There is a saying in English, "The squeaky wheel gets the grease" (i.e., the one that shouts loudest gets what he wants, whether he is the most deserving or not). We have heard of situations where an order which one thought was on time, is suddenly several weeks behind. Upon investigation, one discovers that another customer has come in, paid a premium, and been allocated "your" materials in the workshop, while you are now returned to the back of the workshop queue. In China, you may find that you need to put more effort into expediting than you are used to.

Importation Permits

As with engineering and construction work in China, the importation of equipment requires various permits to be considered, and if required, applied for. As an example, in order to obtain a customs duty waiver on some equipment (and until recently, in order to recover Value Added Tax (VAT) as well), it is necessary to provide lists to the relevant authorities of equipment that is being bought and imported. These lists need to be relatively accurate in terms of supplier and the cost of the item if the full waiver or refund is to be obtained. Ideally, these lists need to be submitted well before expected order placement, in order to receive approval before the order is placed. But this needs to be balanced against the fact that you may not have accurate equipment costs until late in the basic design phase, at which point you wish to place orders immediately. Again, this potential area for delay needs to be planned into the schedule.

Bulk Materials

When ordering bulk materials in the West, unless schedule is an overriding concern and orders need to be placed early, it is common to ask the construction contractor to supply the material. In theory, this removes the burden of supply from the owner, removes the risk of claims for delay due to non-arrival of material, and opens the potential for obtaining cheaper materials since the contractor can buy "in bulk." However, this strategy is less successful in China for two reasons:

1. The contractors may feel that their cash flow situation will not allow them to buy large quantities of expensive material.

2. Unless the owner puts a lot of effort into quality control, the contractors may provide sub-standard material.

As a consequence, you may be forced into buying bulk material whether you want to or not.

Construction

Construction Management

As with projects anywhere in the world, it is important to try and appoint the construction management team early so that they may be involved in constructability reviews of the design before it reaches site. When getting ready to actually move to site, finding mid-level construction supervisors with the necessary multi-discipline coordination experience is, in our experience, difficult.

Choosing your Contractors

Permits…Again!

When choosing construction contractors, the issue of permits arises again. Ideally, any construction contractor shortlisted should have a good, working relationship with the relevant local government bureau (e.g., The Fire Protection Installation Contractor should have a good relationship with the local branch of the Fire Prevention Bureau). This can help smooth communication when trying to obtain permit approvals. It is then a good idea to listen to the contractor's advice with regard to dealing with that Bureau.

Manage the Relationship

It is very important to develop good relations with the higher management of the individual contracting companies. If difficulties do arise, this can matter more than the precise details of the contract agreement signed by everyone at time of award.

Nomination of the Main Contractor

Chinese regulations require that one construction contractor be nominated as the "main" contractor. This in itself is not a major issue. However, problems arise if one then wants to start a second major project on a site where a "main" contractor is already in place on an earlier project. Trying to nominate a different "main" contractor for the second project may be difficult.

Choice of Quality Control Contractor

Ensuring that construction quality standards are upheld is an important job on any construction site. In China, the appointment of a quality control contractor (a "Jianli" in the local jargon) is mandatory on larger projects. The Jianli's role, although paid by the owner, is to ensure that regulatory codes and government quality standards are adhered to. It is in your interest to choose a good contractor for this role. In one example, testing by our Jianli demonstrated that some pre-formed piles were not to specification, despite having been supplied with certificates showing they were to the correct specification. The contractor replaced the piles at no extra cost.

Working with your Contractors

Progress Measurement

In our experience, there is a tendency by contractors (both LDIs and construction contractors) to avoid giving bad news until the last moment. Consequently, it is necessary to actively seek out the real situation regarding progress and potential

issues if you are to avoid surprises and delays. Bad news will not usually be offered voluntarily. This results in the owner needing to retain active and persistent project engineers and project controllers on the team to constantly seek out the "true" status.

Re-Negotiation of Terms

One big surprise for a Westerner is the discovery that renegotiation of the elements of contractual agreements post-award is regarded as a reasonable practice by contractors, especially if the commercial outcome begins to look less attractive to them than originally envisaged.

Workforce

Skilled Labor

The impression that many Westerners have is that construction workers in China are in plentiful supply. The reality is that unskilled workers are in plentiful supply, but skilled workers, such as welders and pipefitters, may be harder to find.

Construction workforces in China frequently consist of migrant labor, who move to the more prosperous Eastern regions from the less developed regions of the far West. Many of those workers may previously only have had very limited experience of anything other than farm work. Because the workers are usually migrants, they tend to live in a "camp" environment, away from their families and to return home infrequently, sometimes only once a year.

Working Week

Firms will very often prefer a work week of 10 hour days, seven days a week. Consequently, the owner's construction supervision team needs to plan their shifts for regular weekend cover. This can add considerably to the owner team supervision costs.

Public Holidays

Project professionals from Western countries are aware of the need to plan around major holiday periods, such as Christmas, New Years, or Thanksgiving. But when working in China, the most important holiday to remember is Spring Festival, also known as the Lunar New Year (or in the west, Chinese New Year).

The time chosen by migrant workers for their once yearly visit home is inevitably Spring Festival. The festival is generally sometime around the last week in January or first week in February.

You should expect ALL work in both the design office and on the construction site to halt for at least the first week (think of it as you would the Christmas/New Year period). In addition, since this is very often the only time of the year when the migrant workers get an opportunity to return home, you should anticipate construction work to be impacted for up to three weeks in total.

In addition, there are the following two other issues to be aware of, leading up to the Chinese New Year:

- Contractors may come with demands for additional payment against progress accounts although the progress may not be fully substantiated by measurement. This appears to be driven by cashflow concerns because this seems to be the main payment point to their immigrant workforce.
- The cost of basic commodities, such as steel and concrete tend to rise for about two to three months before the Chinese New Year and go down again afterward. This appears to be driven by higher demand for the materials, driven in turn by the cultural practice within the Chinese construction industry of setting achievement targets to be reached by the Chinese New Year.

Harvest

Finally, it is important to recognize that since the migrant workers come from remote farming villages, they are very often required back in their home villages at harvest time. The loss of up to 25% of your labor force for two to three weeks during harvest time is to be expected (and remember, rice crops can be harvested two or even three times per year).

Construction Safety

The safety of the workforce is of paramount importance to any project manager. We believe and experience shows us that it is possible to run a safe site in China. The important

Figure 1. An illustration of good construction safety in China – note the good use of personal protection equipment.

issue in China, as in other parts of the world, is to show from the start that the owner (not just the managing contractor) is serious about safety. You may hear many stories about poor safety in China, but with vigilance on the part of the owner, you can control the situation. Figure 1 illustrates good use of personal protection equipment on site. We accounted for more than eight million workhours without a lost time accident.

Commissioning and Qualification

We originally hoped that qualified Commissioning and Qualification (C&Q) staff could be recruited locally. There are local firms with experience of more general utility and chemical type commissioning, but we found a severe lack of people with experience of pharmaceutical commissioning and qualification. The explanation given for this was that historically, the foreign operating companies would bring in their own expat team, thus, preventing the local workforce from gaining experience in this field. Consequently, it is necessary to bring more expats in than you might expect to carry out C&Q work. If you want a local team for the future, you should expect to have to spend time training them.

Changes in Government Regulations

China is developing fast. As a consequence, the rules and regulations can change with very little warning. When discussing project risks, make sure you consider the potential effect of regulatory changes. Cost forecasts can be thrown completely by a change in the rules part way through project execution. Here we cite two recent examples that affected projects that we worked on:

- In mid-2008, the regulations surrounding "social burden overheads" (health insurance, pension, sick pay, etc.) for construction workers were changed. The regulations were changed for the very laudable purpose of improving the working conditions under which construction workers worked. However, the effect on construction hourly rates charged to owner firms was that the rates increased by 50% or more within the space of a few weeks (Figure 2 shows how wage rates increased in that period[7]).
- In December 2008, a change in the regulations was announced that would restrict the ability of firms to reclaim VAT paid on process plant items. This effectively added approximately 17% to the cost of all process plant items not yet bought on the project. (We learned about this change purely by chance, reading an article in the local English language newspaper.)

Owner Team Presence

Communication is a major issue for any owner on a project in China; both communicating to the contractors what the owner wants done; and communication in terms of having eyes and ears to understand what the contractors are doing.

The Cultural Challenge

Language is obviously the first considerable barrier for a Western expat to overcome. Even though you may have a good

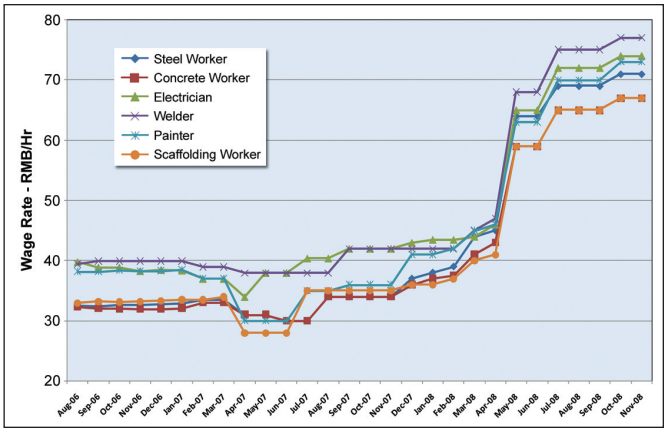

Figure 2. Wage rate data for construction labor in the Shanghai region showing the jump in wage rates in 2008.

interpreter, this does not necessarily mean that your point of view is being relayed word for word. Even after overcoming the language barrier, being heard and being understood are two very different issues. You will need to discuss a topic from several different angles before you can be sure that what you are trying to communicate is understood. Finally, negotiation of everything is a part of everyday life and you must be ready to expend time and effort in this area particularly to ensure that neither side loses face.

"Boots on the Ground"

In our experience, any owner organization needs to recognize that assigning only a small owner team will increase communication difficulties. Assigning more contractor expats is only a partial solution and comes with a similar cost penalty to increasing the owner team. Stringent supervision and time-consuming involvement is required from the owner in order to ensure the required quality and execution in a timely manner. In our experience, empowerment is generally not readily accepted and the most expedient method of management is "command and control."

Conclusions

For a foreigner, working on a construction project in China does present challenges. Many of these challenges are common to working in any foreign country. However, a few are unique to China. For example, a higher level of effort is required to deal with the permit system and a higher effort is required to expedite and deliver equipment and materials than we have encountered in other countries. Nevertheless, China is a fascinating country and with an open-minded attitude and a willingness to learn from new experiences, we believe that working in China can be a rewarding opportunity for any foreigner.

References

1. Remembering that the USA in turn is cheaper than some parts of Europe, such as Switzerland.
2. We cross checked our "gut feel" via a "vox-populi" of the members of the Pharmaceutical Committee of the Construction Industry Institute (www.construction-institute.org).

This Committee comprises heads of cost estimating and control departments from several major pharmaceutical firms. In addition, we are aware of studies carried out by such highly regarded research firms as Independent Project Analysis (www.ipaglobal.com), which have come to similar conclusions.

3. Faithful and Gould, "International Construction Intelligence," Volume 20, Issue 4.
4. The International Construction Cost Index is based upon a nominal 13,900 m^2 (150,000 ft^2) manufacturing building, but it excludes the contents of that building, such as process plant, furnishings, etc. It also excludes design and engineering costs. Hence, it reflects only the on-site construction cost of what we have referred to in this article as a "civil and concrete" based structure.
5. Indigenous local engineering contractors, who are often still state owned.
6. A few western contractors that have been based in China for some time seem to now be beginning to investigate the possibility of becoming directly licensed themselves. However, to the best of our knowledge, this initiative is still in its infancy.
7. These data are supplied by the Shanghai Construction Institute.

About the Authors

Jerry Hourihan recently relocated to Switzerland, after more than three years of living in China. He was the Senior Project Manager of a major new production and development facility on a Greenfield site in Changshu about 70 km outside of Shanghai. This is the largest capital investment by Novartis in China to date. Hourihan has more than 30 years of experience in project work in locations, such as Ireland, the US, Switzerland, and most recently in China. This also includes a period of eight years as Head of Engineering for the Novartis site in Ireland. Since late 2008, he has taken up the role of Head of Project Controlling in Novartis' corporate projects group, dealing with all major capital investments around the globe. Hourihan's original background is mechanical engineering. He can be contacted by telephone: +41-61-69 63725 or by email: jerry.hourihan@novartis.com.

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