

COST ENGINEERING FOR PROJECTS (IN A WORLDWIDE ECONOMY)

by

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INTRODUCTION

Eight years ago I spoke at the 14th International Cost Engineering Congress in Guadalajara on the subject of international project costs and was quite honored when the Congress attendees selected my paper to receive the *Jan Korevaar Outstanding Paper Award*. Two years later in Rotterdam at the 15th International Congress I presented another paper on international projects and once again my paper was chosen to receive the award.

I suspect that much of the reason that my papers were selected to receive these awards was more due to ever growing interest in international economic considerations for projects than to the quality of my writing or to my speaking ability.

We can no longer consider anything we do on projects as a purely national thing which is constrained by the borders of our own country and by a single currency. Everything we do must be considered in light of international economics. Project managers must know cost engineering principles and understand the consequences of bad cost management decisions.

Industrial firms are increasingly multinational, and many companies now build and operate plants in several nations. Economic cooperation agreements between nations, such as the European Economic Community (EEC), the North American Free Trade Agreement (NAFTA), and the General Agreement on Tariffs and Trade (GATT) are encouraging further industrial globalization. In January 2002, twelve European countries encompassing 31 states and territories abandoned their national currencies in favor of a common currency, the euro. The franc, lira, guilder, deutschemark, and several other currencies are no more. Ten more countries are scheduled to adopt the euro by 2006 and seven more may adopt it within the next five years. Twenty-seven other countries

have fixed their currencies to the euro. Denmark, Sweden, and the United Kingdom are the only major holdouts in Europe to adopting the euro but it is probably inevitable that, in time, they will have no choice but to do so. International economic pressures and competitiveness will force them to join the rest of Europe in the conversion.

Pressures such as this and the interrelated nature of world economies are making it increasingly important for project control professionals to be familiar with techniques for estimating costs in other countries and to be able to compare costs in different nations. The questions that are always being asked are: "What will this plant cost in the home country?" "What about Canada, Great Britain, South Africa, and Australia?" and "Which location is the most attractive financially?" In today's world, projects cannot be effectively managed unless such questions can be answered with a reasonable degree of reliability. Companies must know the best location for projects in order to succeed economically. We can no longer assume that our own country is the best location. If we do, a competitor will build elsewhere, produce products and services at lower cost than we can, and import those products and services into our country and price them at less than we can. They will own the market. We will lose it. I could cite many examples where this has happened but that is not necessary. Anyone can readily think of examples where this has happened and where businesses have failed or shut down because they could no longer compete with foreign competitors.

A good estimator or cost engineer can readily develop the estimate for a plant in the home country, but such is not always the case for other nations. While cost engineers, quantity surveyors, and project managers are generally very familiar with major sources of cost data in their own country, they are often unaware of useful sources of cost data and related information in other countries. This problem is exacerbated by lack of time to perform a proper search, publications in various languages, and lack of information about key factors that can impact the estimate for particular geographic locations.

This paper which I presented in Guadalajara provided some insight into the availability of international cost data and location factors. It included:

1. Descriptions of multicountry data sources for preliminary or conceptual cost studies.
2. A list of database sources of unit price/cost data for specific countries, and
3. Some examples of resources available for international project studies.

The complete paper is available on the Internet at <http://www.icoste.org>, the web site of the International Cost Engineering Council. The information sources described in that paper are primarily periodical publications of various types. I do not intend to repeat the content of that paper today. It is easily available to all of you on the Internet. However I do wish to summarize a few of the conclusions made in that paper and the subsequent Rotterdam paper.

LIMITATIONS OF PUBLISHED DATA

Published cost information must always be used with care. Every location factor or commonly available cost index has its own underlying method of construction, with its particular inherent components and weightings. It is vital for the estimator using such quick-estimate data to understand how it was created, and to recognize just what its limitations and applications are. Published data also is often inadequately explained and is frequently improperly dated. Date of publication is meaningless because the data may be months or years old and may require adjustment to current cost levels. Equipment cost data may or may not include ancillaries and/or transportation and installation costs, etc. Too often it seems that in the rush to complete the assignment, people will grasp any number they can find without fully understanding how it was derived, or what it represents.

With location factors, one must recognize that they generally reflect only the relative cost to replicate a facility exactly in another location. The factors do not consider cost effects which are introduced by site-unique conditions such as climate, earthquake and geological considerations, etc. If the design is not identical in both locations, location factors alone do not account for all of the cost differences.

BACKGROUND STUDIES

In order for a proper estimate to be made of a particular international project, it is vital to understand the conditions existing in the country or countries where a project is to be located. In a 1978 paper presented at the Fifth International Cost Engineering Congress, Utrecht, Netherlands, C.G. Walker outlined the major economic system parameters to be evaluated as follows:

- Political: stability; attitude towards foreign investment; type of bureaucracy
- Finance: banking system; insurance regulations; tax system; duties
- Legal System: laws governing conduct of business and individual freedom
- Social System: business ethics; education; language and religion
- Geography: infrastructure and communication; climate
- Industry: capacity; diversity; efficiency.

Many other authors have discussed site- or country-specific factors that can impact the cost, schedule, and/or price for an international project. These include: local material quality/availability, labor availability, equipment availability, labor productivity, import duties, import licenses, local taxes, language, length of workweek, holidays, inflation, fluctuating exchange rates, religious customs, buy-local laws, shipping cycles, weather/climatic impacts, workforce level of education, logistics, workforce housing, and many other relevant factors. Regional variations of these factors within a country must also be expected, and remoteness/distance from major cities or supply centers can often aggravate the above problems even further.

INTERNATIONAL LOCATION FACTORS

When little time is available or warranted to perform appropriate background studies, and detailed design and engineering have not been completed, estimators must turn to published indexes, location factors, or other sources of relevant data for help.

A location factor is an instantaneous, overall, total cost factor for converting a base project cost from one geographic location to another. This factor recognizes differences in productivity and costs for labor, engineered equipment, bulk materials, commodities, freight, duty, taxes, indirects and project administration. The cost of land, scope/design differences for local regulations and codes and differences in operating philosophies are not included in the location factor.

With the current rush of industries attempting to globalize, use of location factors has become increasingly important. Location factors should be used to factor a base estimate for comparing costs at differing locations and not for the funding estimate for the selected location. After selection, a higher quality estimate should be developed for project funding.

Many countries do not have the capability to manufacture certain specialized equipment and routinely import this material. So the degree of local vs. import and the relative cost differences need to be part of the location factor calculation. Many companies use U.S. costs and apply percentages for freight, import duties and customs and broker fees. Two other issues that should be considered are:

- a. importing of certain items because of quality or scheduling problems; and
- b. importing and paying the associated costs (if local regulations so allow) of materials from another country because local manufacturing costs are high.

These items can greatly affect the material and equipment costs for an actual project. The location factor needs to reflect the above considerations and expected or known strategies with the factors being adjusted accordingly.

Local monetary rates, productivity differentials and benefits and burdens vary enormously by individual country. Governmental employment regulations, rules for foreign workers, travel and support costs, and religious and cultural differences must be carefully evaluated. All can impact a location cost factor program.

PROJECT ELEMENTS CHECKLIST

The planning and execution of an international project requires many special considerations not usually encountered when planning within your own country. There are the obvious differences such as wage rates, productivity, duties, and taxes, but many more differences may be overlooked. To properly prepare an international estimate and to avoid unpleasant surprises requires that you conduct research on

construction practices in the target country. The following checklist presents many of the differences that need to be considered and recommended actions which should be taken in order to insure development of a reliable and accurate estimate.

Project Design

1. What local codes and practices apply to the project design? For example, do you construct prefabricated steel buildings or concrete block buildings?
2. What weather and climatic conditions are likely to prevail at the project site? How do these differ from your home country? Is the project location subject to temperature extremes, severe rainfall, flooding, etc.? (eg, Monsoons in Southeast Asia; frost levels in the north: permafrost in the far north)
3. Must consideration be given to any special geological conditions such as earthquake zones, unusual soil conditions, etc?
4. What will be the language of the contract documents - contracts, drawings, etc.?

Bulk Materials

1. What materials are available locally? Is the quality adequate? For example, in some sandy desert areas such as Saudi Arabia local sand may not be suitable for use in cement and concrete. Sand may have to be imported. It may sound like sending coal to Newcastle but it isn't - it can be a major concern.
2. Is it cheaper to buy locally or import? Before the devaluation of the Mexican peso, there were situations when it was actually less expensive to import reinforcing steel into Mexico than to purchase it there. In some situations there may be a VAT on local materials while the project is exempt from duties. This may make it cheaper to import than buy locally. Often owners can take title to goods at the point of import and avoid duties and taxes. Also, owners can sometimes recover the VAT.
3. Should you use different practices? For instance, if construction labor costs are very low, it may be more economical to fabricate rebar at the site rather than at the factory. Similarly, in some areas hand mixing and placing of concrete may be more economical than using ready-mixed concrete.

Engineered (Process) Equipment

1. While equipment pricing tends to be international in nature, there are places in the world that are more competitive than others. Example - for one project a few years ago, a gas turbine generator was priced at US \$14,000,000 if purchased in the US but if

ordered in India it could be bought from the same US company for US \$12,000,000 because of competition.

If possible, obtain quotes for your specific location rather than using recent pricing in other geographic areas. If information from other areas must be used or if importing of equipment is required, be sure to factor in shipping costs and duties from each potential supplier location.

2. Be sure to evaluate the total cost in selecting your equipment supplier. In addition to the base price, you should consider shipping costs, duties and exchange rates.

3. Be sure to evaluate your spare parts requirements. Due to long delivery times for certain components, particularly those which must be imported, you may want to stock more spares. For example, one US-based company maintains a spares inventory of about US \$500,000 for its gas turbine generator projects. For their projects in other countries, they allow US \$2,000,000 for spares.

Construction Labor

1. Is there skilled labor available? Does the labor force have the skills needed for the project? Skilled trades people may be available but technically trained people may not be available.

2. What is the local productivity? While there are several publications that quote average productivity compared to a base location such as the Houston Gulf Coast Area of the United States, wide variances may exist in actual productivity in any given location abroad. For example, in Saudi Arabia, the average labor productivity factor is about 1.6 versus the US Gulf Coast but may vary from being similar to that of the US to over 3.0 depending upon project conditions and the mix of local and expatriate labor. Within the US, productivity also varies widely.

3. Will you be required to provide housing and services, such as medical facilities, as a part of your construction program? In some areas, meals and shower facilities are required. In Brazil, for example, breakfast, luncheon, and transportation to the job site are usually required.

4. How do you obtain local labor? You may be required to pay fees to a labor broker for staffing your project. Subcontracting may be preferable.

5. What are local payroll taxes and benefit costs? They can exceed 100% of payroll in some countries.

6. Should you import construction labor? Is it legal to import labor?

Construction Equipment

1. Is construction equipment available locally? If so, what is the cost? If equipment is in short supply, the costs may be much higher than in your home country.
2. If you need to bring in equipment, will you be required to pay duties? Sometimes duties can be avoided by posting a bond to guarantee that you will export the equipment when the job is complete.
3. What are the rules for removing equipment after the project? Sometimes exporting will be prohibited - this is a big potential risk.
4. Are the local construction forces trained in the use of the equipment? In some areas workers may not know how to use power tools. Hand tools may be required.
5. Supposedly trained local workers may not have adequate skills. On a recent Chinese project, over 70% of people holding Chinese certificates of qualifications were unable to do the work for which they were hired.

Construction Management Staffing

1. What positions will be filled with expatriates versus local hires? Use of expatriates is expensive. A rule of thumb is double US cost, ie, about US \$25,000 per person per year. Preferably, expats should be bilingual. Seek out bilingual local hires for trial as possible permanent employees.
2. What living arrangements will be provided (camp versus local housing) and what is the cost? Will food be a per diem expense or will workers be fed in a galley? What about security - a gated camp? Alarm? Home systems?
3. What special services, such as housekeepers, drivers, etc, are required?

Schedule

1. How long will project mobilization take? Project mobilization may take longer than normal if you are setting up a base camp, bringing in construction equipment, etc.
2. What is the schedule effect of equipment delivery time? Allow for additional delivery time for imported equipment to cover ocean freight, offloading and customs clearance and possible delivery to the site. A self-unloading ship may be required if port facilities are not adequate.
3. Will weather introduce any special schedule considerations? Be aware of local weather conditions, such as monsoon periods in the tropics, that may delay the

schedule.

4. How will local productivity, work practices (eg, carnival), culture, religion (eg, prayer breaks), and workforce level of education affect schedules?

Local Infrastructure Requirements

1. Are local water, sewer, electricity and other services available? If not, will on-site facilities (eg, generators) be required. In China, for example, local water is generally available but it will contain sediment and will not be potable.
2. Are highways and rail service available? Are they adequate or do they require upgrades? Roads and bridges, for example, may not be able to carry large loads.
3. Are there relocation requirements for people living on the site? What are these relocation requirements? Often people must be relocated and be provided with new housing. Consider the Three Gorges Dam project in China which will displace 1.13 million people.
4. Can the local port handle the cargo? Is the depth adequate? Is the dock adequate? Can the cranes handle your loads? Will self-unloading ships or crane barges be required?

Material & Equipment Delivery (Shipping & Customs)

1. Should shipments be consolidated? Consolidation of shipments can save significant shipping cost but can impact your schedule.
2. What fees are required for customs clearance? They can be significant. In Brazil, for example, nine different types of taxes and fees must be considered. Similar situations are common in other countries.

The costs of importing can be very significant, but exceptions are often available and need to be explored. India, for example, levies duties of 40 to 100 percent or more yet has granted concessional rates as low as 20 percent for recent power projects.

Some items may be restricted for import requiring use of locally manufactured items. For example, in China switchgear and fire protection equipment must be Chinese made.

3. What is the cost of transit insurance to move the equipment to the site?
4. How will you get the equipment from the port to the site (rail, highway, barge)? If you are moving the equipment by highway, can the roads and bridges handle the loads or do they need reinforcement or bypass? Is there special equipment available to

handle the heavy loads (off the ship and on the highway)? It can be necessary to build an airfield and fly the equipment in.

5. Do freighter schedules meet your project schedule? Heavy lift ships have limited availability and, if required, may present schedule problems.
6. What security is required to ensure that your equipment arrives at the site? Is theft a potential problem? Must equipment be guarded?
7. Do you require special shipping due to project financing? For example, US export-import bank financing may require use of US flag ships at approximately a tripled freight cost.

Project Finance

1. Does project financing require that a certain percentage of the project be purchased in certain countries? US export-import financing may impose such requirements.
2. On joint ventures, get a majority interest. Otherwise local codes and standards will apply, and they are not necessarily of the level desired. On one Chinese project I am familiar with, building to Western design standards cost 5000 RMB/m². If built to Chinese standards, it would have been 1500 RMB/m².

Progress Payments (Cash Flow)

1. What up-front payments will be required? Contractors in developing nations may be cash poor and may require a larger than normal up front payment to help with project operating capital. A 15 to 20% advance payment is not unusual. This may be necessary to enable them to buy materials. Funds may not be available locally to them and, if they are, the loan interest rates may be very high.
2. If you are being paid by a foreign government, what kind of processing time can you assume for invoice payments? The bureaucracy can be very slow.
3. What currency will you be paid in? If you are paid in local currency there will be a conversion fee and, on occasion, convertibility may not be available.
4. If payment is in local currency, what risk exists for significant fluctuation in exchange rates or for changes in government policy which might affect exchange rates? Consider the four Asian countries (Thailand, Phillipines, Malaysia, and Indonesia), for example, which have suffered massive losses in the value of their currencies since mid-1997. All four currencies had a long history of stability before this sudden decline.

A good contract clause is one that specifies that bids are to be adjusted for currency

reevaluations, for example the change from pesos to new pesos in Mexico.

5. What is the schedule of payments to local workers: daily, weekly, monthly?

Local Taxes

1. What local business taxes must you pay for working in the country? Some countries levy substantial taxes in order to remove profits from the country.
2. What local sales, property, VAT or other taxes will be assessed against your project? VAT is a tax on a tax. For example, the contractor buys materials and equipment and pays the VAT. The owner is billed and pays the VAT again. Sometimes the VAT can be refunded but it is best to avoid it if possible by the owner buying the materials directly (or by taking title at the time of import).

Insurance

1. Does the local country allow for private insurance? China and India for example do not. If not, you may need to contract with government agencies in the host country for insurance rather than with your regular carrier.
2. What special insurance is required for international freight losses? Marine freight insurance may be included to the site but what about project delays if equipment is lost? Insure for delays plus emergency replacement costs plus interest during construction delays.
3. Is bonding available in the country? If not, a letter of credit may be required.

Legal Recourse

1. What recourse do you have if your customer in the country defaults on the contract through cancellation, non-payment, bankruptcy, etc?
2. What legal recourse do you have for non-performance of local subcontractors? Can they be bonded? What about lawsuits?
3. What about permits? Often permission must be obtained from many government authorities before the project can commence. In Suzhou, China, the Lion Nathan Brewery, which opened in 1998, was required to obtain 41 different government construction permits.

Social System

1. What local holidays are observed?
2. Is family housing required at the job site? Indonesia, for example, is encouraging family status.
3. How do local religious customs impact the work schedule? For example, are prayer breaks customary?
4. What about local work customs such as long mid-day work breaks in some countries (eg, Mexico and Latin America) or exercise periods (eg, 1/2 hour per day in Japan)?

HOW DO YOU BEGIN?

If you have never tackled a multi-national project before, the above list is certainly enough to discourage anyone from attempting it. Fortunately, there is a good support infrastructure to help you get started.

Most major industrial nations have the equivalent of a Department of Commerce. These government agencies have staffs that are well versed in helping you develop a plan and obtain the information you need for a successful project. You should begin your project by contacting one of these agencies and embassies of the countries involved for assistance.

You should consider a local partner or consultant in the host country. This person or company should have the ability to help you with the language, identify local rules and regulations that will apply to the project, and help you through the processes.

You will need help from someone skilled in local construction practices: a design firm, local contractor or just a special consultant. Discuss with this person the project logistics of local contractors vs. self perform, construction equipment, site housing requirements, local versus imported materials and labor, schedule, etc. to develop a project plan. To help locate this person or firm, you may wish to start with the International Cost Engineering Council (ICEC) and the International project management Association (IPMA). ICEC has 44 national member societies doing business in much of the world. Many other national associations have indicated their interest in becoming ICEC members. IPMA has member organizations in 34 countries, 11 IPMA members are also ICEC members. All of these organizations are willing to assist you. You can contact them via the ICEC website at <http://www.icoste.org> or the IPMA website at <http://www.ipma.ch>. The ICEC website provides a complete listing of ICEC members with e-mail links. A link is also provided to the IPMA site and to numerous other organizations which are concerned with project management and control.

Once you have put together your basic project plan, you will need to begin gathering the

specific cost and schedule information required for the project. Here are some suggestions to help you compile the information:

For specific local pricing information, the best approach is to obtain bids from local contractors. Put together a bill of quantities and work through your local construction consultant to obtain the bids.

If you are working on a technology project in a developing country, do not assume that the contractors you are working with understand the project concepts and how they go together. You may get some very strange results if you just supply a list of quantities and ask for unit pricing. Educating your project subcontractors can provide much better results.

Before you visit your subcontractors provide them with the quantity list and give them some time to review it.

When you visit, take photographs of similar work, layouts and elevations of the proposed project, and a simple project schedule. If you have time lapse film of the construction of a similar facility, it will be of great value in educating the subcontractors.

When you visit the subcontractors, take time to sit with them and discuss the quantity list to make sure that they understand your terminology. Remember that an estimator who does not understand a project will be more conservative and will include greater contingencies in the estimate than may be justified.

For equipment pricing, be sure to remember to consider any specific country sourcing due to finance requirements. Look to multiple country sources for bids. Many times the equipment vendors can arrange special financing or in-country manufacturing to avoid duties or can provide other assistance to the project. Be specific that you will be evaluating the bids on a completed project cost basis and not merely on bid price.

Select a freight forwarding company early in the planning stage to help with the schedule logistics, freight costs and duty requirements for the project. These companies generally earn their fees, as travel consultants do, by commissions they receive from the freight lines. You should be able to find a company that will work with you on that basis. You should select a company that has offices in the countries of origin for your equipment and in the country where you will be working. The local agents will be very valuable with helping you through the customs and local transportation requirements.

There are several international consulting companies that provide information about taxes and business requirements around the world. Work through your regular accounting firm to identify a company to work with. You will need to obtain reports on local taxes and business issues for your project.

You will need to obtain an international attorney to help prepare the contracts, business plans and other legal documents for you to do business in your host country. It is important to find an attorney who is experienced in international law and preferably one who has done business in your host country before.

CONCLUSION

The best possible summary for this discussion is from John R. Barry's paper, "Ten Commandments of International Cost Engineering," presented at the 1993 Annual Meeting of AACE International:

The reliability of available data is usually suspect, so test, test, and retest it. Communication problems are difficult across cultures, and sometimes language differences can cause misunderstandings when soliciting data. The use of international factors is a session all its own. A few basic principles for guidance include keeping in mind that a time or place factor means nothing without an exchange rate and date and that a base city must be identifiable, since variation can exist within your home country.

The paper concluded with Barry's "Ten Commandments for Worldwide Cost Engineering," which have appeared in several of his articles over the years. They are a fitting conclusion to this paper as well.

John Barry's Ten Commandments for Worldwide Cost Engineering

- 1. Thou shalt not begin an international cost engineering assignment without preparing for the differences in culture and protocol.*
- 2. Thou shalt not ignore investment objectives of the target country's government.*
- 3. Thou shalt not look at building your own facilities as the only way to enter business in a country.*
- 4. Thou shall not use biased estimated scope that does not reflect technical, cultural, legal, and climate differences.*
- 5. Thou shalt not ignore what equipment must be imported and the impact on cost and schedule.*
- 6. Thou shalt not accept as gospel cost data for other countries without thoroughly checking for understanding and testing for reasonableness.*
- 7. Thou shalt not ignore productivity, weather, religious practices, and construction*

methods when calculating labor cost.

8. Thou shalt not ignore the additional risks associated with cost and schedule on international projects.

9. Thou shalt not forget that ICEC and IPMA members are valuable resources who are capable and willing to help.

10. Thou shalt not ignore the previous nine commandments.

Multi-national projects carry many risks, but as economies become more global, the potential reward from international projects will become greater. This list of activities and recommendations is far from complete, but it does cover most of the more significant items of concern. If you begin working with these recommendations, you will have the tools needed to make you a successful international project manager.