

OFFSHORE OUTSOURCING

NOW BOARDING

A TRIP TO CHINA MAY JUST BE THE TICKET TO TAKE YOUR DESIGN TO REALITY.

OUTSOURCING IS NOT FOR THE FAINT OF HEART. It involves substantial risk and effort. To get the best deals, you need to go directly to China. But getting the best competitive edge comes at a cost not everyone is willing to pay. In China, you probably won't find anyone who will take your credit card; you may be sharing your hotel room with several varieties of crawling and flying creatures; and every restaurant seems to have its own special way of serving chicken feet. You'll also have to face head-on the realities and ethical dilemmas of outsourcing. If having your world turned upside down sounds exciting to you, then you're in for an incredible adventure.

Several years ago, I wrote an article describing a hands-on project in which I moved from being a 32-bit-system programmer working with effectively unlimited memory resources to designing an 8-bit system with less than 2k words (**Reference 1**). The resulting system, christened the Cat0-9 sequencer, has been in production for four years now. During this time, demand for the product hit a ceiling; the high retail price limited potential markets, and the time required to prep each unit for shipping had in turn be-

come unmanageable. Benjamin James, owner of Coolneon.com, which sells the Cat0-9, decided it was time to go to China.

PASS HONG KONG, SAVE \$\$\$

Compressing the events of a several-week-long trip into a few pages is impossible, so I've decided to instead describe a few of the insights I uncovered during the trip. China is filled with many pitfalls, and the most effective course sometimes requires some not-so-common sense.

One discovery that amazed me was the number of layers between the manufacturers and us. This situation occurs because the cost savings of manufacturing in China are so great that they can absorb a significant number of layers without your noticing. In some respects, the situation can be an advantage, letting you choose your level of engagement. You can work with a US rep who will handle all the outsourcing details for you, an approach that avoids many hassles but also results in the least cost savings. You can strip away at least one layer of cost by working directly with a Hong Kong company. However, you'll find yourself wondering



whether the rep you're working with actually works for the factory he represents. Visiting Hong Kong will remove some of this uncertainty.

It's tempting to stop in Hong Kong; the city is amazing, and English is prevalent. However, you may still be working through five layers of reps at this point. To get the best price, you need to go directly into China. (Be sure to get your tourist visa before leaving the United States.)

Shenzhen, which is just across the border, is China's electronics-showroom city. With a cityscape reminiscent of MegaCity One from *Judge Dredd*, it offers everything you might need. In one of the many electronics marts, a towering 15 floors of components and end-

equipment, a casual inquiry got me a first-quote price of 13 RMB (about \$1.63) for a PIC16F84; Arrow's price is \$4.55. Granted, some of the parts may be "refurbished," so buyer beware. (Those 100,000-gate Xilinx FPGAs on sawn-off pc-board squares are perhaps a questionable bargain). And, by the way, *never* accept the first quote. If you are outsourcing an entire board, you needn't worry about securing components; the factory will find equivalent parts at prices you will have to look at several times to believe.

However, even the offices in Shenzhen are primarily for marketing personnel. Also, several manufacturers may use the same factory, which means another middle layer. The only way to ensure that you've peeled back

all the layers is to visit the factory. In all likelihood, this trip will require a several-hour-long bus ride through one of the outlying industrial regions to a tiny “city” comprising two buildings—the factory and the living quarters.

Visiting a factory allows you to evaluate the situation for yourself; a rep’s pictures just don’t seem to inspire as much confidence in the actual existence and use of a piece of equipment as actually seeing it in operation. With even a short tour, you can evaluate the quality of equipment and tools that the engineering and manufacturer teams use. You’ll also be speaking directly to people who understand engineering, as opposed to a rep who may know a resistor only as a term and not comprehend what you mean when you try to describe the tolerances of your design. An in-person visit also allows you to evaluate working conditions and help you decide whether you feel ethically comfortable doing business there.

DO YOU NEED TO OUTSOURCE?

How serious you are about outsourcing should be your first concern. Learning the process is not difficult, but it is time-consuming. The further you go in, the more money you save, but the more time you’ll need to invest. If you can’t afford the time to visit China, you might

COUNTING ON THE LAW TO PROTECT YOUR IP IS FOOLISH.

consider hiring a company to do a site visit for you—once to verify the existence and quality of the factory, and again to resolve final issues before irrevocably giving the go ahead for full production

If you’re going to outsource only one small project, consider working with a professional exporter who knows the ins and outs, because there are many ways for savings to slip through your fingers. For example, shipping piecemeal will quickly erode your savings. Instead, you can rent warehouse space in Hong Kong, where your manufacturer can send products that you are ready to ship. When you have a full cargo container’s worth of goods, the shipper will put the goods on

AT A GLANCE

▷ Any engineer can successfully outsource in China. You just have to decide how much time and effort you want to commit to learning the ropes.

▷ It is easy to feel like the entire process is out of your control; that feeling is par for the course when doing business in China.

▷ A factory that can handle small projects best serves a small project.

▷ Being open-minded is essential.

▷ Outsourcing potentially has a lower time-to-cost ratio than most of your other hobbies, with the added benefit of bringing one of your ideas to life.

a boat and handle the appropriate paperwork; misunderstanding import laws can delay or even prevent entry of your goods. Again, you can efficiently execute that process once you understand it, but if you’re interested only in a one-shot deal, consider relying on a professional.

Before you get too involved, consider your break-even point. If you have ambitions of outsourcing other projects, investing in learning this process will again and again pay dividends. If this project



is a one-time deal, think twice about doing it all yourself. Next, consider your potential savings. If you can make the product for \$2 in the states, you don’t have a wide margin of savings; your volumes have to be significantly greater to make the undertaking financially worth it. If you’re thinking of introducing an idea to the market first, sourcing first in the states and selling at less than cost (known as “future pricing”) might be a less expensive way to test the waters; you can always outsource the second round if the market is viable.

Finally, don’t underestimate the impact of how much what you are doing is a hobby. You can live in China for two

weeks for less than it costs to fly there. Consider the cost of some of your other hobbies and how much time and enjoyment they give you. Outsourcing one of your hare-brained ideas might have a significantly lower time-to-cost ratio with the added bonus that, in the end, you’ve brought your idea to life and have a finished product to show for your effort.

PROTECTING YOUR IP

It can be confusing for an engineer to enter the Chinese culture. You might think that most of your difficulties would involve engineering issues, but that’s because you think like an engineer. The underlying truth is that your project is just a board and parts to stuff, and China has for decades been handling this kind of project. In fact, the Chinese government created Shenzhen as a machine for exactly this purpose. It’s worth repeating: Outsourcing is not an engineering venture; it’s a business venture. It is about turning your working design or prototype into a volume-production part.

Doing business in China differs greatly from doing business in the United States. Written contracts aren’t enforceable without a company’s seal. You can have verbal and written contracts, but without that seal, you haven’t locked in any of the details, and, even then, significant changes are likely. Success in a venture revolves a great deal around trust and relationships. In any case, counting on the law to protect your IP (intellectual property) is foolish. Consider whether you want to attempt to bring a lawsuit in China. The RIAA (Recording Industry Association of America) is bigger than you, and look at the lack of success it’s had stopping the flow of audio-CD copying.

One dynamic of outsourcing is that the factory is likely to run off more units than you ask for, so it can sell your product itself. For companies that attack worldwide markets, this situation can create a serious problem. For a small engineer, it is actually a blessing. Consider that you will sell these extra units in markets that you don’t have the resources to approach, anyway. As a consequence, the factory can generate a side income from your product. If the side income is significant, the factory will actually drop the quoted manufacturing price to capture your product, resulting in direct savings at no cost to you.

If you employ a factory that produces

similar products, you'll be able to enjoy lower costs, greater expertise, and engineers more familiar with your product. The primary downside to working with such a factory is that it knows, and perhaps even works with, your competitors, so protection of your IP becomes critical. The factory could share your design with its other customers. The factory also has connections within your industry, so it knows the true potential side income for your product, as well as how and where to sell it.

To facilitate manufacturing, you are going to give up schematics, component lists, and testing schemes—that is, everything you require to build your system. You can try to rely on patent protection, but simply serving notice to, never mind going to court against, the potential multitudes of small-time vendors selling your product may require more funds than you gross. Withholding a few key components for later stuffing in the states (and making more work and cost for yourself) is likely foolish; the factory can easily tear open one of your finished products and re-engineer the missing components. In fact, many factories specialize in using a sample of your competitor's product to create a knockoff for you. Given that they will probably do so anyway, if your product is successful, you might as well accept this practice and leverage your product's success into a subsidy for yourself.

From this perspective, protecting software is your most effective means of securing your IP; without the code, the hardware isn't salable. However, if your product is simple (2k words of code), it is easy to make a knockoff of it. Protecting software also comes at a high cost: You have to program the device or stuff the processor yourself. Creating a device that someone can program after the processor is installed will probably increase overall system cost, both in board size and component cost because of an extra programming connector on the pc board.

However, if you give your source code to the factory, you have nothing left to protect. Alternatively, you can design an activation point on your device that cripples easy-to-fix functions (they run only in test mode), either by shorting two traces or typing in an initialization code. However, your IP is only as safe as your secret is difficult to crack. You can instead ship preprogrammed processors

(and carefully monitor their count), but exporting and importing processors can be complicated and expensive; look into the details before you decide to exercise this option.

One effective protective measure is to install the programmed processor after you receive the finished box. Devices without processors are easier to export. However, installing the processor after the fact may be impossible if the pc board is upside down or if you use potting materials. The Cat0-9 design sometimes includes custom programming, so it is essential that its designers have access to the processor. With the first round of manufacturing, we installed the processor

ly hand over all critical details of your design to the manufacturer, you don't want to take this step during bidding. For example, you don't have to give them the real mask on your pc board. However, if you give them too little to work with, you can't get an accurate bid in a reasonable amount of time. Providing a prototype significantly speeds the bidding process but can place you at risk if you lack other IP protection, such as protected code.

If you do supply a prototype, make it as close to what you want manufactured as possible. Having a physical prototype makes explaining your project much easier, especially if language barriers exist. Reps may not be engineers, and they may

YOU CAN CREATE A WACKY TEST MODULE THAT PROVES OUT THE DEVICE FUNCTIONS.



ourselves. Doing so raises the cost of each board through the cost for manual labor, but the protection and flexibility are worth it. Consider how you will handle software before you begin outsourcing.

A final aspect of software to consider is a testbench, so the manufacturer can verify that each product works off the assembly line. In this case, we supplied the factory with a limited number of pre-programmed processors to test each board. The processors do not have production code; they contain dummy code that runs the board through a sequence of actions that the tester can verify. Note that we have to supply preprogrammed devices, because the test code, by necessity, contains all of the I/O drivers, which are the hardest section to reverse-engineer and thus the most important to protect. You can create a wacky test module that proves out the device functions without exposing what you are testing, to further obscure IP, but ask yourself just how much you're protecting. You risk introducing glitches in the test process that will result in an unusable product, because it was unclear that a problem existed. Fortunately, the PIC processor we are using protects code from being read off the chip. Not all devices support code protection, so you'll have to rely on binary files to protect code.

Note that, although you will eventual-

ly not understand what you mean when you say that your board can be longer but not wider. For example, we had a minimum-size requirement based on internal components, such as batteries, but were flexible on size if an off-the-shelf box were available to save us the NRE (non-recurring-engineering) cost of designing our own box. However, any stretching had to occur between components, not between the holes into which, say, the processor goes. The fact that our prototype wasn't exactly what we wanted created significant confusion and would have resulted in unusable products if we had not carefully clarified every detail.

ENGINEERING: THE UNIVERSAL LANGUAGE

Fortunately, when you finally get down to the engineering details, you get to work with the universal language of numbers. We decided to manufacture our own box, but none of us had ever built a mold before, and we were unfamiliar with many of the manufacturing issues related to even simple box building, which is not so simple a process, it turns out. For example, we didn't know that molds must have a slight, or "draft," angle so that the plastic can easily slip out of it; with a perfectly upright edge, the box might stick. In this area, the expertise of our manufacturer saved us. It sent a list of potential problems with our

mold model that would have prevented it from being manufacturable. A less experienced manufacturer may have gone with the model we sent without verifying it, and we would have been out our NRE cost and a few additional weeks. We considered creating a laser-cast prototype through a US company, but, because the prototype is cut rather than molded, doing so wouldn't have exposed such issues. In any case, the factory will silk-screen your packaging as you request: If it's misspelled on your spec sheet, it will be misspelled on your final product.

The spoken word, however, is not so universal. We found English spoken almost nowhere, so we employed the help of an English club to make our first contacts after we failed to find a suitable vendor at the Hong Kong Electronics show. Chinese companies take out memberships in English clubs so their employees have a place to learn and practice English. This group proved invaluable in assisting us with simple travel details, such as finding a reasonable hotel and securing cell phones. It also provided important translation services during our interviews with manufacturers.

At one point, I walked in on two interns cold-calling vendors from the phone book on our behalf. Initially, I was tempted to despair that the success of our venture rested on how well we had managed to convey complex engineering ideas to the interns (both certified in speaking English but far from comprehending technical conversations). Then I realized that I was incapable of even reading the phone book, let alone making calls. It turns out that these initial calls resulted in our meeting one of the vendors we eventually contracted. My reaction was not based on a lack of faith in the process; I hire people from the phone book all the time. It was based on my feeling that the project was out of my control. Such situations are par for the course when doing business in China.

A translator was essential during all negotiations. The side supplying the translator is at an advantage; we could later ask our translator what the other side was saying during side discussions. For example, one component vendor was unwilling to show us part of his factory because he didn't want to risk revealing any of his manufacturing secrets. This practice didn't inspire confidence in the existence of the factory; however, our translator overheard a discussion between the

owner and his secretary that suggested we indeed had nothing to worry about.

Take your choice of translator seriously. Don't just accept your first option. Your translator represents you. One of our translators had a rough business style that was an asset during negotiations but troublesome during engineering clarifications. An active translator can drive your interviews and can better protect and represent your interests. There may be uncomfortable moments, such as when your translator is protecting your interests by fighting with a restaurant manager over the quality of a \$2 dish, but the translator can also help with important issues, such as saving face, which may be completely foreign to your understanding.

Chances are, your translator will not be a skilled engineer. Explaining the process of building a pc board to such a translator and then expecting him to be

NRE COSTS IN CHINA ARE ALMOST LAUGHABLE.

able to explain subtle engineering issues to a rep who also has no engineering background requires a sense of humor. Ask a translator to repeat what you have just said, and he will repeat your exact words, leaving you wondering whether he understood their meaning. Remember that, at some point, you'll get to see the blueprints and numbers and clear up any issues at that time. One trick for reducing confusion is to use two translators when you are describing your needs before any meetings take place. Sometimes, one translator understands something the other doesn't and can describe it to the other, increasing the odds that you are accurately conveying your ideas.

MONEY BURNING A HOLE IN YOUR POCKET

Finding a factory to take your job is not as easy as you might expect. Factories have two main resources: engineering and manufacturing capacity. Given small engineering teams, each factory is limited in the number of jobs it can take on. Even though you might be willing to pay what the Chinese consider top dollar, if you need only 1000 units, you can't consume enough of the manufacturing capacity to make taking your job worth it.

NRE costs in China are almost laughable. Several we were quoted were so exceptionally low that we were willing to pay cash out of pocket to get work started immediately. In another case, the vendor quoted a high NRE cost but then volunteered to pay the cost himself if we increased our initial order.

Factories don't make money through NRE costs; volume is king. Most of our discussions revolved around the factories' trying to convince us to increase our initial run. We tried to explain that, this being our first time in China, we wanted to do a small run to mitigate our risk. We had to find a manufacturer willing to accept our claims of future volumes and the promise of new products once we tested out the process.

A key dynamic of your relationship with a factory is that you must be on par with each other. Several vendors turned up their noses and walked away because



the product was too simple. They had equipment on their manufacturing floor that would go unused if they took on our project. A factory that can handle small projects best serves a small project. A large factory may offer you a lower price, but be careful. If another more profitable job comes along, it might bump yours. If you want a long-term relationship with a factory, make sure it is successful and capable of supplying additional capacity as you grow. For example, we decided to learn about outsourcing with the Cat0-9 because it is a high-end product and offers a large savings per product at low volume and low risk. Once we have confidence in our offshore vendors, we can proceed with several higher volume, lower cost projects. If you have only a low-volume project to pitch, you will have trouble finding someone to take your job; direct outsourcing is probably not your best option.

Be sure to check your calendar. Consider the various seasons in manufacturing. For example, if you approach a factory just before it begins production for Christmas, it will quote you a higher rate. As each factory may specialize in a specific industry or product type, these seasons vary.

We attempted to directly handle as many details as we could during our short stay in China. Communication then shifted over to e-mail, which was possible because the factory had English-speaking engineers on staff. The availability of a capable and technical English speaker is critical; we avoided many problems because we could clearly discuss the issues at hand.

Before production, the factory sent us

samples of the actual components they would be using, as well as the actual pc board. We could then build two prototypes and verify that the components they had sourced were within tolerances. As a final precaution, Coolneon.com owner James plans to fly back to China during the scheduled production run. In this way, he can be available to make any last-minute decisions, confirm the quality of the first products off the line, and

verify that our test procedures show us how and why a product has failed, among other considerations. In other words, the second trip will be the final insurance on the production investment.

In some ways, business in China happens at a frustratingly slow crawl. It was not uncommon to have a lunch where the only direct business we discussed was that we would meet for dinner. We were warned that most Americans in China want to start immediately nailing down details, as we did, but the Chinese prefer to work out the broad strokes first, then take time to fill in the details.

Always remember that Chinese and US cultures are different, and so are our various ethical perspectives. Some problems, however, are the same, just in different packaging. For example, during our bids, Chinese vendors often asked whether we would need a receipt. In China, the government issues official receipts that vendors pay for as a form of taxation. If you don't need the receipt, the manufacturer avoids the tax. Often, a bid with a receipt costs 10% more. Opting against the receipt is just another way to obtain a cash or under-the-table discount.

Finally, if you're seriously considering outsourcing, talk to several people who have done it. Our best contacts and advice came from colleagues and strangers we struck up conversations with. If you don't know anyone, you can find people willing to share their stories at almost any trade show; just mention that you're thinking of outsourcing. Many people, especially if they don't think of you as a competitor, are more than willing to share the excitement of their adventure. □

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TALK TO US

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