
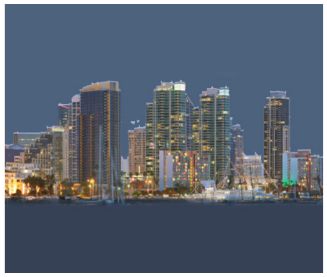

THE BROAD DIMENSION

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Drones

By the time you see this newsletter the FAA should be on the verge of publishing the regulations that will govern the commercial use of drones, or UAVs (Unmanned Aerial Vehicles). Currently, only a limited number of commercial companies have been granted a permit for their use, and then they are officially only allowed to operate under similar rules to those applying to model aircraft. Under those same rules, hobbyists are free to fly them as much as they like, and companies that operate abroad have been able to use them legally outside the US.

Drones have been finding a number of uses in the construction industry. The obvious use is in providing aerial photography of sites and recording construction progress. It is also possible for drones to carry out detailed mapping of sites including 3D imaging. Surveys that might have taken weeks can now be completed in a matter of hours. They can also collect samples, if suitably equipped. Drones are additionally ideal for carrying out visual inspection

and safety checks of roofs and exterior walls of buildings, bridges, or power lines, etc. Regarding the latter, drones have also been fitted with infrared cameras, which can assist in identifying hot spots on the power line that might be nearing failure. Lastly, drones have the potential for lifting materials and equipment to less accessible locations.

The FAA rules currently applying to drones prohibit them from operating above four hundred feet, require that the operator have a direct line of sight to the drone, limit the drone to a weight of no more than 55 lbs, and include other safety restrictions. The companies that operate the drones are hoping for a relaxation of some of these restrictions, but the FAA cannot be faulted too much for playing it safe. There have already been over 200 reports of drones flying uncomfortably close to manned aircraft. Not to mention other interesting accidents such as the drone that was filming a wedding and crashed into the groom.

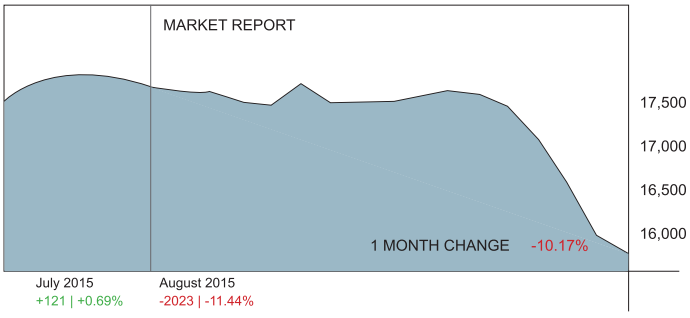
Efforts are being made to lessen the likelihood of drones colliding with aircraft or other objects (such as bridegrooms). Control software is available for manned aircraft to identify potential collisions, but the required computers and other equipment would be too heavy for most drones. Efforts at using neural hardware for object tracking and avoidance are looking promising. Neural hardware works in a similar fashion to the human brain, rather than a traditional PC.

There have also been privacy and security concerns (we have had two drones landing on the White House lawn already, and someone landed a drone on the roof of the Japanese prime minister's office in central Tokyo). These concerns are being addressed. There are already systems available that can locate drones in the area, by listening for the distinctive sound of their motors or tracking the radio signals used to control them. There have also been methods devised to capture a drone that shouldn't be there, using another drone to catch it, of course. One drone manufacturer has started building in software that will stop the drone from encroaching on restricted areas, such as the White House lawn and the controlled airspace around airports. It would not be surprising to find legislation requiring that such controls be built in.

The development of open-source software for the control of drones and the processing of the information that they collect is being furthered by the umbrella organization known as Dronecode (launched by the Linux Foundation). With the price of drones dropping dramatically, we can expect to be seeing a lot more of them buzzing around soon.

Interesting Times

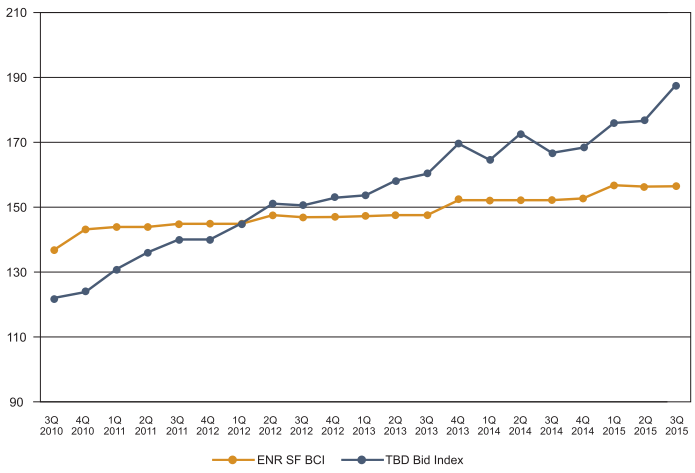
'May you live in interesting times' is said to be an old Chinese curse, although no one has ever proved the saying came from China. But China has been making life interesting in the field of world economics, with its stock market gyrations and its snap currency devaluation, both stemming from the slowing down of its economy. The currency devaluation only amounted to a few percentage points, which was not dramatic as far as currency changes go, but it will make selling goods and services to China a bit more difficult. The question of just how bad China's economy really is finally brought the long awaited correction (or 10% drop the recent high) to the US stock markets, as shown in the following chart from CNN:



Similar falls occurred with stock markets around the globe. It has been suggested that China's real growth rate is down to 2%, rather than the 7% claimed by the Chinese government, but 2% is still not bad compared to many other countries.

Greece got a last-second deal, although they might not have thought it was a great one. They basically conceded to everything that was being demanded of them, and further damaged their economy by holding out for so long. At the time of writing this article (end of August), Prime Minister Alexis Tsipras has resigned and a new general election is expected, probably before this newsletter goes out. And the IMF has been pushing for debt-relief for Greece, which most nations in Europe don't support for political reasons, so the Greek saga will be on-going. Exactly what Europe and the Euro will look like at the end of it all is still open for speculation. But despite all that was going on, the Greek economy actually grew by 0.8% in the second quarter.

Bid Index



Oil prices continue to drop while OPEC, the U.S., and other oil producers keep pumping more and more, waiting to see who blinks first. All sides are suffering of course, with some bankruptcies and mergers expected among US shale oil producers. Even Saudi Arabia is having to borrow money to balance its budget and Russia is wilting under the combination of sanctions and the oil price drop.

It has been said that the main purpose of financial forecasting is to make astrology look good, but since I might have a chance to correct it before the newsletter gets published, I will predict that the above issues will be sufficient to deter the Federal Reserve from touching interest rates in September. But the question of when the Fed is going to start increasing rates is another issue that is creating uncertainty among investors, so it will be good when some clarity is presented as to when the move will occur.

The effects on the market at the end of August have shown that when China catches a cold, the rest of the world, including the US, at least sneezes. That said, the US economy is still progressing nicely, although still not as well as most would like. Wage growth remains below the Fed's target, but moving in the right direction, and consumer spending doesn't appear to have gotten the boost from the drop in gas prices, so inflation remains very low. Unemployment continues to drop and the economy is still moving upwards, despite the head winds.

Geoff Canham, Editor

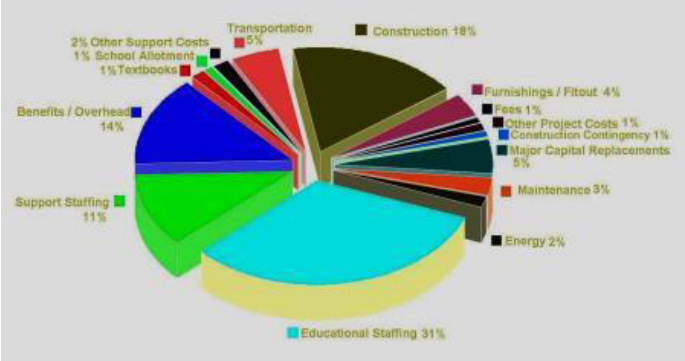
Life Cycle Costing

The initial capital investment in a construction project is substantial, but that investment is only a portion of the total cost of the project over its life. Stanford University estimates that the initial project cost of one of its new buildings comes to only 58% of the costs involved with the building over its anticipated 30-year life. The 58% included the soft costs (design fees, permits and other owner costs) that typically add up to about 30% of the project cost, so the actual construction cost portion becomes about 45%. That life cycle analysis included Utilities, Maintenance, Service, and System Replacement, but excluded the cost involved with the people actually using the building, which can be the largest cost element of them all.

Life cycle cost analysis of a complete building is an interesting exercise, and can provide useful information for making cash flow projections for the maintenance of the building. However, life cycle cost (LCC) studies are more normally carried out to compare alternative designs for elements within a building, to assess which offers the overall best value. Alternative HVAC systems, or alternate

designs for exterior glazing, are the kind of instances where LCC studies are commonly carried out. LCC is often performed in conjunction with Value Engineering, and like Value Engineering it shows more benefit when it is carried out in the earlier stages of design.

LCC needs to be calculated over a specific building lifetime. For new construction, that timeframe is commonly in the region of 20 to 30 years, although some projects, such as those for hi-tech or other rapidly changing industries, might warrant a shorter period. The life-span used for alteration work would also normally be shorter than that for a new-build project.



School Life Cycle Costs

To compare alternate designs, the initial cost is one consideration, but ongoing costs, such as maintenance, fuel and energy requirements, periodic replacement costs, and final disposal cost must also be considered. If one design is expected to lead to the users of the building becoming more efficient (for instance, it has been suggested that enhanced air quality and natural sunlight within a workspace can increase an office worker's efficiency by 10 - 15%) then the cost of staffing the building needs to be included. If a particular design is expected to increase its potential resale value, then that might need to be considered. Costs that remain constant across the alternate designs, such as design fees or permits, would normally not be included in the LCC study. Deciding what scope is to be included in the study is a very important step.

Once you know what items to include, the next step is to arrive at costs for them. The initial construction cost, and any replacement costs for equipment might be fairly straightforward. Assessing the maintenance costs might be a bit more subjective and having historical records can be very handy. Other sources for LCC costs include organizations such as NIST (National Institute of Standards and Technology) which publishes Energy Price Indices and Discount Factors for Life Cycle Cost Analysis.

Once you have compiled the costs, you get to the main problem, which is comparing costs that occur at different points in time and at varying frequencies. Inflation is going to increase those costs over time, and there is an 'opportunity cost' (the benefit that could have accrued from the money if it had been invested). To resolve these issues there are two related techniques that can be used. The first, and most popular, method is to assess how much you have to invest at a set interest rate now, in order to pay for all the costs that occur over the building's lifetime. That method is called Present Value. The other method is called the Annual Equivalent Value, and basically assumes you will be borrowing the money to pay for all the costs, and calculates the amount annually to pay off the capital and interest charges on the loan.

Design alternatives are compared against a baseline option, which would normally be the one with the lowest initial construction costs. The comparison of options can then show either the comparative life cycle costs, or it can show the payback time for the other options (how long it will take before lower maintenance and/or fuel costs, etc., makes the costs of an option comparable to the baseline.)

There are many different software applications available for calculating Life Cycle Costs, such as BLCC (from NIST) and LCCP (from the Water Environment Research Foundation). Microsoft Excel has a PV (Present Value) function that can also be used for amounts that occur every year, which uses the formula:

=PV(InterestRate, NumberOfYears, FixedAmount)