

## Value-based upgrades

When one upgrades their own aircraft - they usually do it for their own flying interests such as better looking - like paint and interior to more functional by adding an autopilot. However, we all want to keep a focus on what the effect of upgrading your aircraft does to its market value.

As a Certified Senior Appraiser of the National Aircraft Appraisers Association - I can categorically state that older aircraft that haven't had reasonable upgrades applied to them - simply aren't going to fare well at market. I am not saying that these aircraft won't sell at some price (above salvage) - I am saying that they might not sell at all as there is currently low demand for small singles and twins and plenty of aircraft that have been upgraded. Consider trying to sell a 1960's house with original décor and appliances in the current housing market. Without upgrades - the house will simply languish. The same is true for aircraft.

In this article, we examine some aircraft upgrades and consider them in light of their usefulness and the impact on the marketability of your aircraft. To do that - we are going to deconvolve these upgrades into engines, avionics, flight instrumentation, engine instrumentation, paint and interior. As avionics is such a large category - we will further subdivide this area.

### Engines

Engines are the simplest area to address. If you need an engine - you need an engine. If you are keeping an airplane for your own use and can safely run an engine past TBO - that is your decision. However, you will almost never sell an aircraft with engines that are over or even close to TBO. There are many reasons for this - but the major one is simply that no new owner wants the down time and substantial cost to put in new engines.

Factory overhauled engines are overhauls of existing engines to serviceable specification. Factory rebuilt engines are engines rebuilt to new specifications and come with a zero-time log book. Field overhauled engines can be overhauled to manufacturer new or serviceable specifications. However only the factory can start the engine log book over from scratch - so every field overhauled engine continues the time on the engine from where it left off.

Whose engine should you install? Research at this time shows that all reputable shops charge very close (a few charged more) than a factory overhauled engine. Some of those shops overhauled to new specifications and some to serviceable specifications. If you have a shop that you favor or that has a reputation for doing a particularly good or special job - then you might want to consider it. Some of the advantages to field overhauls include being able to pick some of your own parts - such as cylinders. One major disadvantage is that after disassembly - you may find that have to replace parts that you had expected to be serviceable. The extreme example of this would be the crankshaft which might need replacing and would definitely change the price of the overhaul by more than \$5,000.

What effect does the choice of engine overhaul shop have on the resale value? From an appraisal point of view - there are significant differences in value. For this article\* - I am using the Lycoming IO-540-C4B5 engine as an example. To start with - we need the base value of a run out engine. It is \$6,300. The added value to an aircraft for a factory rebuilt engine is \$32,050. That means that a factory rebuilt engine increases the aircraft value by \$25,750. Given that the price of one of these engines is about \$29,000 - most of the value is added to the aircraft. Interesting - a factory overhaul adds the same value.

Field overhauled engines don't add as much value. For example - taking into account the residual value for the existing engine - a field overhauled engine to new specifications adds about \$22,270 while an engine rebuilt to serviceable specification adds about \$18,200. These numbers alone would make one 'favor' engines that are factory overhauled. However, there is still the value intrinsic in the reputation of certain shops - and this should not be overlooked in marketing the aircraft.

If it costs \$3,000 to install a replacement engine - and the cost of a factory overhauled engine is \$29,000 with \$3,000 labor to install and the result increase in aircraft value is \$25,750 - then for every dollar spent - the aircraft increases in value by  $(\$25,750)/(\$29,000 + \$3,000)$  80 cents. The cost of field overhauled engines will vary - but in general the return on investment would probably be less.

Engines add the most value per invested dollar to any aircraft. This is because engines don't change substantially. You generally replace your old engine with the same make/model of engine - hopefully with all ADs and Service Bulletins completed. By contrast avionics does change - and what was valued 10 years ago - may not be valued now.

Finally - one word of caution on older aircraft with older engines. Besides having a recommended Time Between Overhaul (TBO) based upon hours used, engines also have a TBO based upon years. For the most part - this is 12 years. That seems short - and is for most general aviation uses. For commercial usage - 12 years is probably a longer time span than is needed. The caution is that I have come across 30 year old aircraft with as little as one half of their TBO time used. When I appraise these - I set the engine value to core. These are run out engines in years - even if they aren't in hours. [There is another whole question of the reliability of these engines - but that is something that is best left for a mechanic to evaluate].

### **Avionics**

Today's aircraft must have at least one moving map GPS system to be considered marketable. If you have an older aircraft with a dual VOR system, you are going to have to upgrade to newer avionics to put your plane in play in the resale market. However, that may be a secondary consideration - so let's look at some of the choices you might make if you plan to keep the aircraft.

### **Requirements**

The first step is to define your flying requirements. Each pilot and each aircraft will generate a different set of requirements based upon how they use their aircraft or if they are fixing it up to sell in the market. What follows are the reasons and 'logic' for my requirements in a recent upgrade to my Aztec.

The first step in any avionics upgrade is to consider what type of flying you do and what type of passengers fly with you. I fly in 'serious' IFR weather. Therefore, I needed to add those components that would make the most safety and add ease to my IFR flying. There was no question that the serious IFR dictated a serious, moving map GPS. The concept of adding a 'dual panel' seemed logical. In my airplane, only the pilot's side had a complete set of instruments.

I often fly with my children. I wanted the ability to communicate quietly and easily with my children and passengers. I make very long flights - often in excess of 5 hours. It can get quite 'boring' for the children - so some means of entertainment is desired if not necessary if I am to expect sane kids at the other end of flight.

I am planning to replace the engines in the next few years with ones that use GAMI injectors. This mandated an engine monitoring system.

Finally, I have very fond memories of a wonderful Aerostar that I used to fly - and the intermittent nature of the transponder in it that caused the controllers and I fits. Combined with the ADIZ in the Washington, DC area that I base under - I decided I would try and keep the existing transponder as secondary while adding a new transponder as primary.

As I said - the requirements are mine. Yours may be different. However, writing them down - is a great first step in planning the upgrade.

#### What Avionics Add Value?

As a Certified Senior Aircraft Appraiser - I know full well what items add value to an airplane and which do not. Let me share some of those insights with you. First, all labor is discarded in an appraisal. Add \$30,000 in an avionics suite -and you can discount the value added to the airplane by 30% (a typical figure for the percentage of labor). Some of the most labor intensive items - don't add any significant value. Consider 6 place headsets. They really are wonderful and satisfy my requirements for communications. However, they are a total value loser. Did I mention that good quality ANR headsets go from \$300 to \$1,000 and are also not even considered in an appraisal? So - strictly from only an appraisal point of view - add large ticket items with small install costs.

#### Primary Nav/Com

I opted for the GNS530 with the GDL-69 for Nexrad. I could have gone with the GNS430 - but the added screen area allowed for much clearer depiction. I also paid for the upgrade rights to the 530W, which adds the GPS approaches with LPV.

#### Transponder

Clearly the transponder was the next decision. I would have liked to have added TCAS but would settle for TIS. TIS requires ground radar

and is going to go away when ADS-B arrives - but since that is a ways off and I fly primarily up and down the east coast where there is significant TIS coverage, TIS is very useful - especially in Virginia and Florida and is included in the Garmin GTX-330.

Another neat feature of the GTX-330 is the altitude alert capability. When you reach cruise - you set the GTX-330 to monitor altitude. It doesn't really care which altitude it is monitoring - it just takes the current value. When you leave that altitude, the unit will talk to you through your audio panel. It's a great warning that the autopilot has failed - you or the electronic one. The shop and I agreed to keep the King KX76A transponder and put a toggle switch to toggle power between the two units. Wonderful - I had a backup transponder. However, I had more. The GTX-330 had altitude readout from my blind encoder. Wala! I had my second altimeter.

Why was this second altitude readout important? The reason is that I had decided that I didn't need a second full instrument panel in the copilot's seat. I never fly with a real co-pilots and wasn't likely to slide over the right seat if my pilot's instruments failed. However, I still wanted the ability to display dual altimeters. The altitude display on the GTX-330 satisfied this requirement (although it is always adjusted to 29.92 so when flying it -I have to make an altitude correction).

#### Keeping the Old

I decided to just keep the Loran M1 in place. Its not IFR certified and while there is a database update available for it that gives it lots more detail, it would still be VFR only. In addition, the update used more memory and since there was only a fixed amount available, you had to choose which half of the US to install. I guess I am not big on discarding working equipment.

I kept the ADF. I am not sure why - except it was working and I can listen to a ball game on it if I am interested. It also has a clock timer built in which might be useful for non-precision approaches. When it dies, it goes.

The radar worked. It worked well - if not a little fuzzy. So it stayed and when it needs replacement, it's a wholesale replacement.

#### Audio

My next decision was to figure out what to do with audio. I wanted music and inputs as well as 6 person communication - so my existing King KMA-34 would have to go. I considered the Garmin GMA340 and the PS Engineering PS8000-SR. I opted for the PS Engineering audio panel for a number of reasons. First, I had used their products before and like them. I found their built-in Sirius radio to be simple and clean - and flying companions and back seat kids think the remote control for the music radio is neat.

Six place wiring is expensive. I originally decided to give the pilot and copilot Bose headsets so the front wiring was to be Bose jacks.

As I started to shop for used headsets, I continued with that decision and decided upon Lightspeed 3Gs headsets for the rear seats. I was about to put in conventional plugs in the back when I realized that I

could trade the power cords on the Lightspeed headsets for Bose plugs and eliminate the need for any batteries for any of the headsets. For \$50/each - this was a no brain'er as the batteries would eventually drive me crazy and not work when I wanted noise canceling. I particularly chose the Lightspeed headsets as they had audio inputs for each passenger. In today's world of MP3 players and IPODs, CDs and portable DVD players - I could envision each passenger on a different audio source. Over the year, my envisioning has been reality and I am glad I did what I did. I also had conventional plugs put in the back 4 seats as well as Bose jacks so that I can use any headset in any configuration.

Since the capability was there connection from my cell phone to the audio system. This is really great! I can call my pickup parties either prior to taking off from the run up area, or once I stop off the runway after landing. The audio from the Bose headset through the PS Engineering audio panel to the cell phone is crystal clear and quiet. If you need to get a special release to open a flight plan or close a flight plan via phone, this feature is perfect.

Other features of the audio panel include the Sirius radio. Sirius was not designed for travelers who are not terrestrial. Sirius complements their satellite transmissions with ground stations in some high rise populated areas. Therefore, I am experiencing some drop out in the DC, NY and Titusville Florida areas - not due to the quality of the product - but due to the nature of Satellite radio. Of course, I could just plug in a CD player to the audio input jacks and there would be no drop out. Did I mention that there is even a little remote control for the radio - which gives the copilot something to 'play with' without having to reach for the panel? Good safety feature when the copilot isn't always a qualified pilot.- and the avionics shop was going to have to wire the harnesses to the back of the audio panel, I had them bring out both front and rear audio inputs as well as a

One feature that I added to the audio panel is the digital recorder. It's a button that plays back the last number of transmissions on the active communications receiver. It's really useful when you think you got the right frequency - but need to review what was transmitted versus what was received and written by the pilot. Yes - even with Bose headsets - I do miss some of the information - very occasionally.

#### Backup for the primary Nav/Com

I really didn't want the expense of a second new Nav/Com system, so I decided to keep one of the KX175Bs. Actually, I kept both - so I have a spare KX175B that can be easily inserted if the primary one fails. I agonized with the tough decision - and decided that the KX-175B with the Glide Slope receiver, KN550I OMNI with glide slope display and King KN 65A DME were going to be their own complete set of equipment. There was no need to switch the DME as the GPS provided that information. Switching the autopilot between the new Gamin GNS530 and the old KX175B was going to be difficult. So, the old equipment is a full Nav/Com/DME/ILS capable group that has its own indicator.

#### Appraisal Summary

From an appraiser's point of view - the 'new' radios (GNS530, GTX-330, PS-8000SR, blind Altitude Encoder) added their value less the labor to install them. The remaining avionics was already in place. The 6

place headsets and power wiring for them add almost no value. The good thing is that there are almost no parts - so it is just the cost of the hours to disassemble and reassemble the airplane interior.

### **Flight Instrumentation**

A cockpit with dual instruments was really appealing. I don't know why - it just seemed that way. However, in thinking about it, I never or usually don't fly with two pilots. There would be nobody sitting in the right hand seat to fly the airplane - if perhaps - my artificial horizon (AH) went belly up. Okay - so I could switch seats in flight at that moment and now have a working artificial horizon in my view - but everything else would be on the left side. This got me thinking about what backups I really needed and at what level of display and accuracy.

For example, I definitely needed a second artificial horizon. There really are no good substitutes for that display. Fortunately, Sporty's-Castleberry had just released their \$2,000 electric AH with turn coordinator. Given that my primary AH was vacuum driven, this seemed like a good choice as a backup.

Let's consider my altimeter. If I lost my primary altimeter - what accuracy did I want in a backup unit? Would I fly an approach to as low an altitude during an altimeter failure? I don't think so! So, a less accurate and less detailed displaying device might work - such as a read out from my blind encoder or GPS. Accuracy in an emergency to 100 foot increments seemed like a reasonable backup and is displayed at no cost on the GTX-330.

What can I use for backup if my horizontal situation Indicator (HSI/Directional Gyro) fails? There is always the compass. There would most likely be a quality GPS unit in my new avionics suite that can also show heading information.

The other instrument to complete a full dual panel would be an airspeed indicator. Once again - a second airspeed indicator is a very useful thing to have - but not really that necessary in an emergency. For most flight - my attitude plus power pretty much determines my speed. So - I should know my approximate speed from those settings. However, once again - the GPS has that ability (corrected for winds) - so maybe I can live without a backup air speed indicator.

### **Appraisal Summary**

In conclusion - I decided that with a GPS install, that the only instrument I needed would be a second AH that was electric driven. This was inexpensive when contrasted with adding 3 instruments to the right side of the panel which would have caused the shop to have had to remake the entire right hand panel. That would have been expensive and added almost no value to the airplane.

### **Engine Instrumentation**

Engine Instrumentation is expensive. The parts are expensive and the labor to install is expensive. To offset some of this cost - I had an

annual done at the same time that this instrumentation was installed - therefore much of the labor to take apart the cowlings was applicable to both. I was determined to eventually go to the GAMI injectors - so I decided to put in the EGT and CHT probes.

The parts for the existing OEM Piper probes was no longer made. They were of resistive technology and today's probes are electro-static. I had previously priced a probe for my old Aztec and realized how expensive these were. So - I went the whole enchilada - Oil, CHT, EGT probes on both sides and an OAT. I should mention at this time the importance of having a good avionics shop. This is tough wiring to do for engines that are out on the wings. I decided on the JPI EDM-760.

In addition, I added the Oil Temperature and CHT probes as primary instruments. This was relatively inexpensive - as the labor intensive part was running the wires that had to be done already for the EDM-760. So - following the rule of appraisals - the increase in aircraft value was significant for the instruments installed as the labor was minimal. Finally, given the long history of Piper fuel gauges - I was very excited to add a fuel flow monitor so that I could track what fuel I had and what was really being used. This is a must for long flights and gives a huge margin of confidence over guessing at the rate and multiplying by the time. The major cost here is a sensor, a price increase in the EDM-760 for the display and totaling and wiring. Again - the labor cost is not very substantial for the increased value.

#### Appraisal Summary

Engine instrument monitoring provides an appraised value increase of usually around 50% of the cost of the job. This is because this is a very labor intensive upgrade - especially in twins.

#### How to Help You Get the Most from your Upgrades

It is not reasonable to solely drive the decision process for aircraft upgrades from an appraised or value point of view. After all you clearly want to enjoy the fruits of your hard spent cash. However, here are a few guidelines:

1. Look for items to install where the labor is as small a percentage of the cost as possible.
2. Combine installation of one instrument with another when they require a lot of the same labor elements
3. Do the upgrade at a single time rather than piecemeal. This will save labor and 'oops' problems with inserting that last instrument you thought would fit - but doesn't and now requires a full panel redesign
4. Choose the shop carefully. Opening up an airplane for any shop is an exploratory adventure. Unless they did the last upgrade - they will have no real idea what to expect and will be surprised with something along the way. Their quote should leave them with enough room to cover some of the unexpected.

Finally - I would suggest you find an appraiser and ask for a 'desktop' appraisal. A desktop appraisal usually runs about half of a full appraisal and doesn't involve actually seeing or examining the airplane. An appraiser can enter your current configuration into the NAAA appraisal database and come up with the current value of the

aircraft. Then the appraiser can enter the value with the 'new/proposed' configuration. Compare the difference in these two numbers to the cost of the upgrades - and you will be able to see how much your new configuration really does increase your aircraft's value. While doing this always remember - in this current limited market - the increase in value may not be as important as putting your airplane in a position where it can be sold rather than languish against other aircraft with a more modern cockpit.

Desktop appraisal can help to guide decisions for which components to add.

**\*All data was taken from the National Aircraft Appraisers Association database for January 2008.**

### **Choosing an Avionics Shop**

This is the step that makes or breaks the deal. I researched and talked with many avionics shops. There is no 'real' way to tell if you are getting the right shop for your plane. Big shops that install on jets can be all wrong as they don't understand the cost tradeoffs in little airplanes. They often times don't deal with 'low end' equipment as would be what are installed in a small twin. Really small shops are fine for a single piece of 'standalone' gear. But let's look at my install. The audio panel is 6 place; integrates to the transponder for TIS and voice altitude alerts. So - 'even' the audio panel is complicated. The JP Instruments EDM-760 also interfaces to the GPS to provide fuel remaining and OAT.

A number of the decisions I made were greatly helped by the guys at Penn Avionics who did my install. I relied heavily upon their knowledge to make many of the decisions including leaving the second nav/com system as stand alone and not integrated to the autopilot. I relied upon them for the choice of audio panel that would control audio from my transponder (yes it talks to me). I relied upon them for some of the switching details of the external audio inputs. Unless you are capable of understanding and reading the schematics for every piece of avionics, you need to supplement your desire with a competent integration. Keep in mind that you are really looking for a 'system integrator' and not a radio shop.

Recommendations and price are clearly among the driving factors. I clearly chose a shop with high marks in the recommendation area and one benefit I received was a fixed priced quote. I was not hit with lots of extra little charges. They knew it was a complete strip of the airplane and reinstall. If one picture is worth a thousand words - take a look at the one that follows and see what a 'massive' job this is.

