IDEAS

Developing Fiscal Measurements to Quantify the Effectiveness of Aging Technology Laboratory Equipment

Jon McDermott

Replacing aging technology education laboratory equipment is often a contentious issue between technology educators and administrators. A possible major reason for this is the high cost of technology laboratory equipment when compared with laboratory-based programs in other disciplines. Administrative reluctance is also reinforced as technology educators accept “hand me downs” from industrial partners to upgrade technology laboratory assets. Too often laboratory educators accept and use “left over” technology laboratory equipment that fails to represent the quality and “leading edge” technology that students deserve. And then maintaining aging laboratory equipment is an expense that administrators resist as they seek to lower capital expenditures. Not only is the cost of maintaining aging laboratory equipment significant, but there is a cost to students of “lost” class time while awaiting equipment repair. Burdened with these challenges, as well as an inability to depreciate technology equipment as commercial users do, publicly funded technology educators who have struggled to justify the purchase of new technology laboratory equipment may benefit from a system of quantifiable measurement strategies that captures the fiscal benefits of new laboratory equipment and the expenses associated with maintaining aging equipment.

I identify several of the hidden costs associated with operating aging, often dysfunctional, equipment in a laboratory-based technology education program. In particular, my examination involves the laboratory equipment in the Aviation Studies Program in the College of Technology at Bowling Green State University (BGSU). Quantifying the effectiveness, or lack thereof, of our student production has been successful in convincing administrators that replacing aging laboratory equipment is in the best fiscal interest of this laboratory-based education program.

Link Measurable Revenue Increases to Production

The aviation laboratory equipment at BGSU was purchased in the 1980s and is still used to train and educate aspiring aviation students. This equipment, meeting minimal industrial standards, fails to represent the improvements in technology that have taken place in aviation equipment over the past 20 years. Initial attempts to replace this aging equipment, based on the notion that new equipment would improve student “quality” for their postgraduate career, failed to gain administrative support. A more business-like approach that measured and quantified the benefits to production, and subsequent accountability of our laboratory education program, was needed. In 1999, I began an effort to measure the impact the age of our laboratory equipment was having on our ability to produce graduates by providing fiscal evidence for university administrators to use in judging the effectiveness of our laboratory-based education program.

Figure 1 represents an analysis of the utilization of BGSU laboratory equipment (aircraft) during the fall of 1999 (McDermott, 2000). Note that this laboratory equipment required maintenance, or had to be “repaired” approximately 12% of the time during that semester. In quantifiable terms, if I needed 2,200 laboratory lessons per semester to meet student production needs, losing 12% to maintenance adds an additional 264 laboratory activities to a 15-week semester, tasking resources beyond limits. Alternatively speaking, decreasing the need to repair laboratory equipment by one half, or reducing this rate to 6%, adds only 132 laboratory activities per semester. This addition, found to be within the scope of current resources, would have produced more graduates and subsequently generated approximately $13,200 in additional revenue for this particular semester (BGSU, 2000).

Figure 1. Utilization of aircraft resource (Fall 1999)

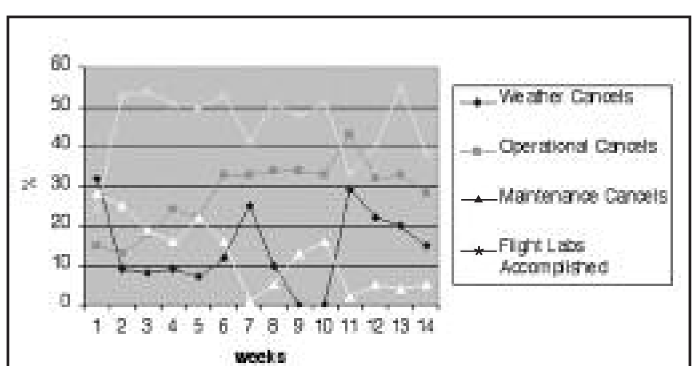


Figure 2. Maintenance costs for A Y00-01.

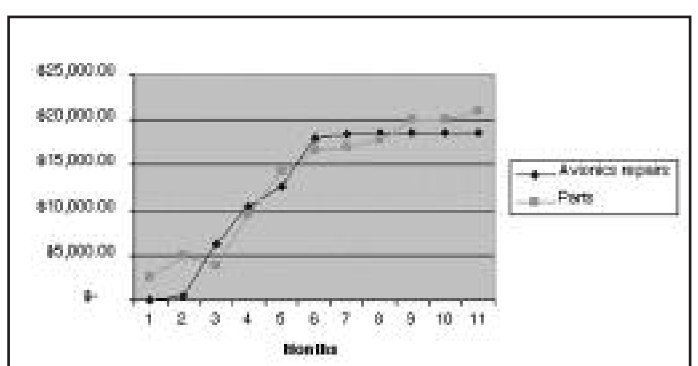


Table 1. Maintenance Activity for Aircraft N5251

Technology Improvement – N345DC	Date	Estimated Cost (then)
Initial aircraft purchase	1980	$80,000
1st Communications and navigation upgrade — basic radios	1982	$7,500
2nd Communications and navigation upgrade — improved radios	1986	$2,500
3rd Communications and navigation upgrade — HIS, basic GPS, DME	1998	$10,000
4th Communications and navigation upgrade — state-of-the-art GPS, NDB	2000	$12,500

The ability to provide administrators with measures of the rate at which aging laboratory equipment was breaking, and thereby failing to produce projected revenue levels, was rewarded in July 2000 with the purchase of two new laboratory aircraft. In retrospect, continuing to measure maintenance reduction provided an additional argument for the continued purchase of new lab equipment. Not only does reducing the amount of time an aircraft is lost to production lead to quantifiable increases in program revenues, the costs of repairing aging laboratory equipment is another measurement that can assist educators in quantifying their production effectiveness. Figure 2 presents the rate at which our program expended resources on aircraft repairs (BGSU, 2000). Note that the rate, or slope, of fiscal resources expended for aircraft repairs decreased from January to June, the time period when we began to utilize our new equipment in student laboratory lessons, saving our program an additional $12,000. Add this decrease in maintenance expenses to the 6% increase in production effectiveness (by having our laboratory equipment break less often), we decreased our operating costs by approximately $25,000 in that academic year.

The purchase of new laboratory equipment had another measurable benefit for our technology education program that was underestimated in initial estimates, and one that may be applicable to other technology disciplines as they pursue new laboratory equipment. Our new laboratory aircraft arrived with a two-year warranty that added an unanticipated economic benefit to our laboratory program—the costs of repair parts and labor is refunded by the manufacturer! This reduction in maintenance expenses netted an additional $2,000 in labor savings and more than $5,000 in savings in the costs of repair parts (BGSU, 2000).

Keeping Aging Laboratory Equipment Current

The challenge of keeping aging laboratory equipment current in an ever-changing technological environment offers another opportunity for educators to quantify the effectiveness of aging laboratory equipment. In this connection, there is discussion whether a particular piece of laboratory equipment is worth “upgrading,” or can be upgraded. In the case of BGSU’s aviation laboratory equipment, Table 1 outlines the costs of technology upgrades that were required to keep this particular “aging” laboratory equipment current in the navigation and communications technologies our students will use in their future professions.

Although the costs of these upgrades relative to inflation have changed, the argument can be made to administrators that the continual requirement to improve the technology of aging laboratory equipment represents a significant burden on limited resources, impacting adversely on year-end fiscal projections (BGSU, 2000). Perhaps a better fiscal strategy would be to avoid the cost of upgrading aging technology altogether by developing a plan to purchase new technology from capital resources.

The Cost of Idle Equipment

Another measurement to consider in examining the costs of maintaining aging laboratory equipment is the impact to laboratory production when aging equipment fails, causing classes to be postponed or experiments to falter. Table 2 presents a review of the time periods a typical aviation laboratory asset was idle awaiting repair during the 2000 school year. Note that in this particular instance, this aircraft was unavailable for use 41 days of that academic year.

To represent the true cost of operating aging laboratory equipment, one must account for the impact that idle laboratory equipment has on production, and subsequent fiscal accountability. In this example, aircraft are typically scheduled for five laboratory periods per day, at $100 per lab. Forty-one days idle could cost $20,500 if utilization were 100%. However, Figure 1 indicates a utilization rate for this particular laboratory educational activity of approximately 50% over the semester; the impact on revenue for those periods of time when laboratory equipment was unavailable for teaching equates to an approximate loss of $10,250. This is a significant impact on year-end fiscal projections, a burden that can never be entirely avoided in any

Table 2. Maintenance Activity for Aircraft N5251

Date	Maintenance Activity – N52514	Days Idle
September 99	Order and replace intercom	9
November 99	Order and install new transponder	3
December 99	Order and repair marker beacon lights	4
January 00	Order and replace navigation radio	4
July 00	Fix interior lighting	3
August 00	Order parts and repair navigation instrument	10
September 00	Exchange glide slope receiver and display	4
September 00	Repair wiring harness for navigation instruments	4

equipment-intensive laboratory program.

Validation—A Case Study

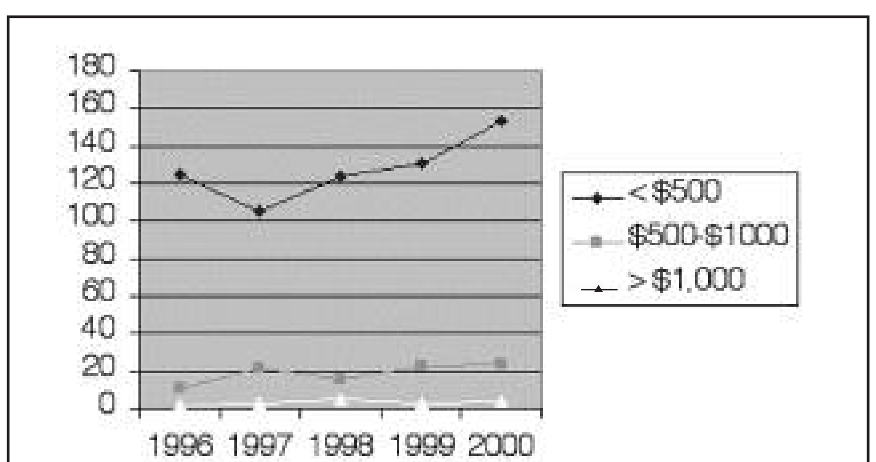
To add further validity to my argument concerning the effectiveness of the timely replacement of aging laboratory equipment, I needed to examine other laboratory-based aviation education programs with similar operations to that of the program at BGSU. After considering several alternatives, I gained access to the laboratory-based aviation education program at Indiana State University (ISU). In July 2001, I examined the maintenance records of the Brown Flying School in Terre Haute, Indiana, one of two commercial contractors for the aviation education program in the School of Technology at ISU. Brown Flying Service laboratory equipment is of the same type and age as that used at BGSU. Brown also maintains its own laboratory equipment (aircraft fleet), as does BGSU, providing similar maintenance database formats. I collected the maintenance data displayed in Figure 3, representing the expenses associated with Brown's requirements to maintain its aging fleet of laboratory equipment and compared it to BGSU data (McDermott, 2001). I contend that this comparison validates my conclusion that the use of laboratory equipment beyond its reliable life span is detrimental to the effectiveness and fiscal accountability of laboratory-based educational programs. First, the loss of production due to broken lab equipment limits a program's ability to be as fiscally accountable as other less-equipment-intensive educational programs. Second, the cost of, and frequency of, equipment repair is incremental and represents a cumulative burden to operating budgets. Third, the cost of upgrading aging lab equipment is an unavoidable expense to operating budgets if we are to offer our students "state-of-the-art" laboratory equipment.

Summary

This article offers technology educators an opportunity to review several measurement devices that I have had success with in quantifying the effectiveness of timely replacement of our laboratory-based technology education program equipment. I have been able to use such measurements to convince administrators that in my particular technology education field, the quality, age, and maintainability of the laboratory equipment is critical to the overall effectiveness and fiscal accountability of the technical educational process. Although I measured the effectiveness of training aircraft in a university aviation education program, I believe colleagues in other technology fields can make similar arguments that will convince administrators that student needs are not met by relying on hand-me-down laboratory equipment. Although any discussion with administrators regarding replacement of aging technology laboratory equipment tends to focus on the initial cost of the new equipment, I believe my measurement devices can assist colleagues in identifying several hidden costs associated with maintaining and operating aging laboratory equipment.

These fiscal measurements and strategies have been successful at BGSU. However, this may be received elsewhere. I contend that it is worthwhile for educators to quantify educational efforts in terms administrators understand and in relation to the effectiveness of the laboratory educational process at producing quality graduates and the accountability of that process for public funds.

Figure 3. Maintenance activity for represenive aircraft at Sky King Aviation.



Jon McDermott, Lt Col, USAF (Retired), is the director of Aviation Studies, College of Technology, Bowling Green State University and is a member of the Alpha Gamma Chapter of Epsilon Pi Tau.

References

Bowling Green State University. (2000). *Aviation studies budget material*. (Available from Jon McDermott, College of Technology, Bowling Green State University, Bowling Green, Ohio 43403)

Indiana State University. (2001). *Analysis of the Brown Flying Service maintenance data.* (Available from Jon McDermott, College of Technology, Bowling Green State University, Bowling Green, Ohio 43403)

McDermott J. T. (2000). University aviation programs: Using business metrics to validate efficiencies. In *NAIT selected papers 2000* (pp. 137-139). Ann Arbor, MI: National Association of Industrial Technology.

McDermott J. T. (2001). A fiscal model to represent the useful life of laboratory equipment in a university aviation education program. In *NAIT selected papers 2001* (pp. 155-157). Ann Arbor, MI: National Association of Industrial Technology.