II) WHATEVER PRODUCT ROLLS OUT, BETTER HAVE SIGNIFICANT VALUE TO THE POTENTIAL CUSTOMER

The personal transportation airplanes envisioned in the SATS program must represent clear value to the customer to be marketable. I suggest that some type of value analysis like the one shown next be included in any design definition studies.

For small, GA airplanes the following value-added parameter (VAP) is suggested as a yardstick:

$$VAP = \{(DDS)x(RFPL)x(Cabinvolume)\} \quad \text{in} \quad (nm/hr)x(nm)x(ft^3) \qquad (10)$$

where: DDS is the door-to-destination-speed in kts

RFPL is the range at economical cruising speed with full payload and NBAA reserves in nm

Figure 6 shows an example plot of this VAP parameter for a range of business airplanes plotted versus their market price. The data were modified from Ref. 3. It is clear that some airplanes offer more value for the money than others. In turn it may be rational to use such a plot to determine desirable (i.e. marketable) design characteristics for the new family of airplanes.

To that end the lower part of Figure 6 has been replotted in Figure 7 and the trend line has been linearized in two segments. Data for single engine and twin engine turboprop airplanes have also been added. It is clear that when designing a small business jet airplane the competition from single engine turboprop airplanes must be carefully considered. Note that the twin-engine turboprops compare rather poorly with their single engine counterparts when using this VAP parameter.

From a value-to-the-customer viewpoint, Figure 7 shows that the airplanes to beat are the Pilatus PC-12 and the Aerospatiale TBM 700. For a six-passenger personal transportation jet to be effective in the market place requires a value of $VAP \approx 50$. Assuming a minimum required DDS of 200 kts and a ratio of $\Delta R_{ground}/R_{block} = 0.10$ results in a design cruise speed of about 300 kts. In an airplane without sanitary facilities a design range with full payload of 900 miles is probably about right in view of the "bladder-time" phenomenon. With a VAP of 50 this results in a required cabin volume of about 185 cu.ft. It is noted that this is about the cabin volume of a Cessna Citationjet. This airplane has a RPFL of 769 nm and a cruise speed of 311 kts.

The challenge therefore is to design such a small twinjet for a price of 1.5 to 2 million dollars. In addition to having an acceptable VAP value, a general aviation airplane has real value to a non-pilot customer if the airplane provides reliable and affordable transportation while at the same time providing a convenient place to work when airborne. If the airplane is to be a convenient place to work then it must be equipped with appropriate communications and lap-top plug-in facilities. All this implies that the airplane itself must be easy to operate, in other words: user-friendly. **That aspect of airplane design is being addressed as part of the AGATE program.**

Table 3 presents a mission specification for the proposed family of airplanes.

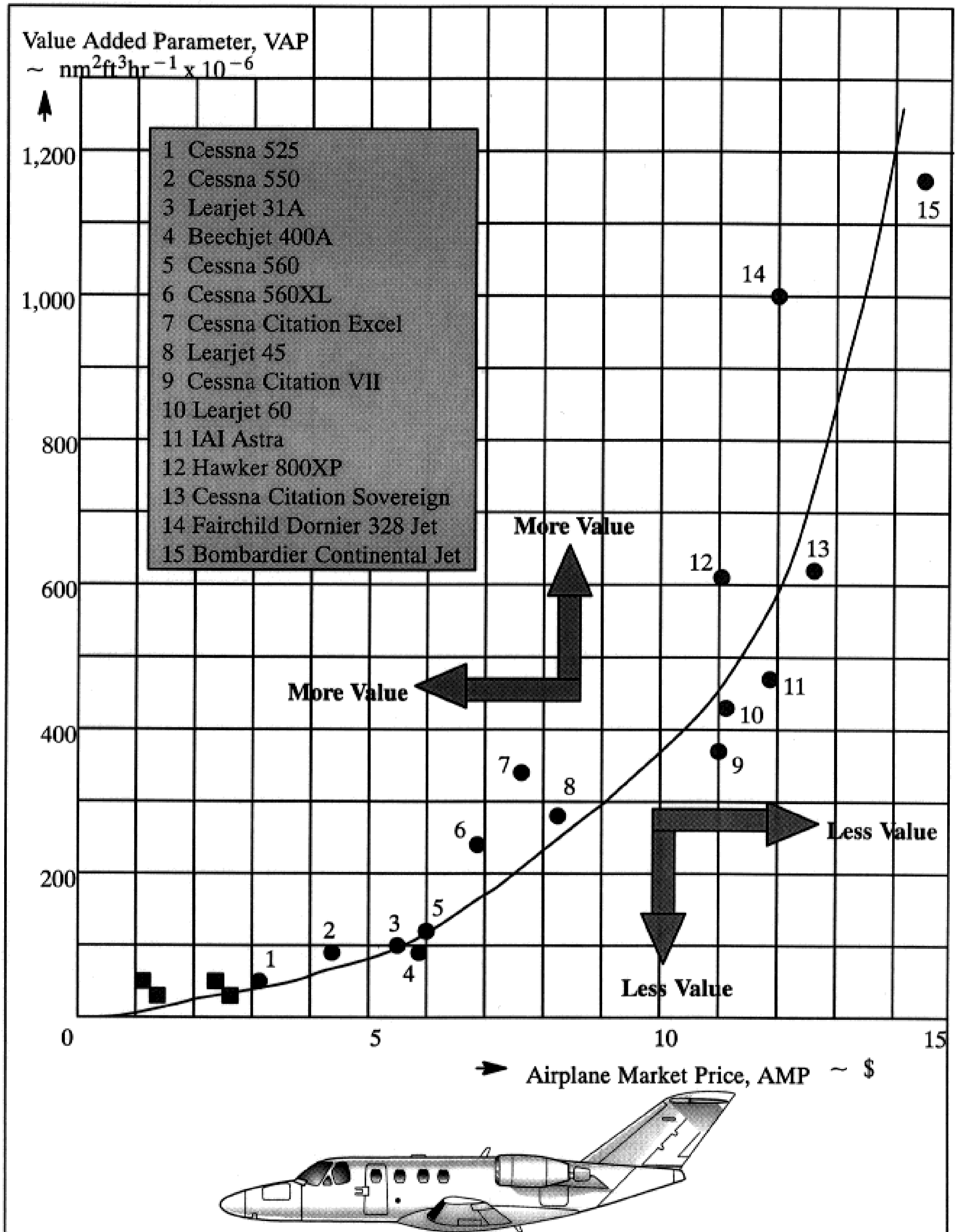

Figure 6 VAP (Value-added-parameter) as a function of Airplane Market Price

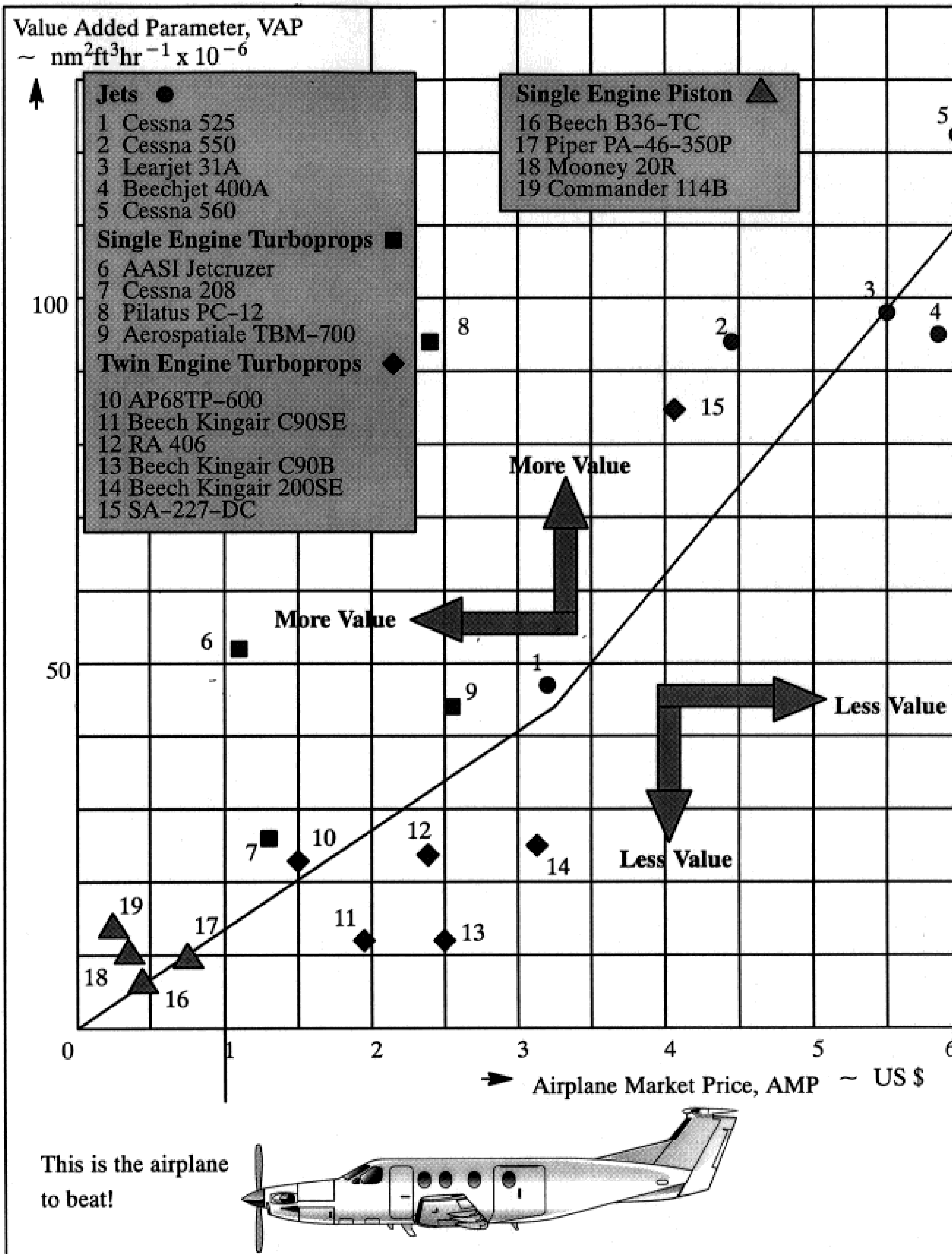

Figure 7 VAP (Value-added-parameter) as a function of Airplane Market Price

Cost savings in the manufacturing of the airframe must be realized. The author believes that this can be accomplished this by designing a large amount of commonality in a family of two airplanes: with 4–seat and 6–seat accommodations and by reducing the parts–count.

For easy reference these airplanes will be referred to as the Jayhawk–400 and Jayhawk–600 respectively. These airplanes will be designed to have aerodynamically common wings, aft fuselage, empennage as well as a common avionics/flight management and control system, common flight control actuators and common components in many other systems. Such commonality and the incorporation of automated aluminum bonding techniques should allow for a 40% reduction in manufacturing and engineering manhours.

The following areas of commonality have been identified as a result of several design studies carried out by the author's students:

* the same wing torque–box and carry–through structure
* as much commonality in the wing leading and trailing edge as practical
* the same fuselage, except for length
* the same empennage
* the same landing gear
* as much commonality in the propulsion installation as practical
* the same flight control systems
* the same basic fuel system
* the same electrical system **(no hydraulic system, period!)**

In terms of their external appearance the Jayhawk 4 and Jayhawk 6 will differ primarily in the length of the fuselage. Figures 6 and 7 show several candidate configurations which have evolved from student design studies. The airplane of Figure 6 is being developed by Mr. Charles Svoboda, a doctoral student. The airplane of Figure 7 was developed by a small team of undergraduate students.