

Entrepreneurship Within General Aviation

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Abstract

Many modern economic theories place great importance upon entrepreneurship in the economy. Some see the entrepreneur as the individual who bears risk of operating a business in the face of uncertainty about future conditions and who is rewarded through profits and losses. The 20th century economist Joseph Schumpeter saw the entrepreneur as the medium by which advancing technology is incorporated into society as businesses seek competitive advantages through more efficient product development processes.

Due to the importance that capitalistic systems place upon entrepreneurship, it has become a well studied subject with many texts to discuss how entrepreneurs can succeed in modern society. Many entrepreneuring and business management courses go so far as to discuss the characteristic phases and prominent challenges that fledgling companies face in their efforts to bring a new product into a competitive market. However, even with all of these aids, start-up companies fail at an enormous rate. Indeed, the odds of shepherding a new company through the travails of becoming a well-established company (as measured by the ability to reach initial public offering (IPO)) have been estimated to be six in 1,000,000.

Each niche industry has characteristic challenges which act as barriers to entry for new products into that industry. Thus, the applicability of broad generalizations is subject to limitations within niche markets. This paper will discuss entrepreneurship as it relates to general aviation. The goals of this paper will be to:

- Introduce general aviation.
- Discuss the details of marrying entrepreneurship with general aviation.
- Present a sample business plan which would characterize a possible entrepreneurial venture.

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- Do not participate in an IPO but stay privately owned and operated instead.
- Do not participate in an IPO because they are bought by another company.

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General Aviation

General aviation is all air travel save the scheduled air carriers. This definition includes air taxi, recreational flying, agricultural spraying, instructional flying, and business transportation. The general aviation (GA) fleet represents 96 percent of all civil aircraft registered in the United

¹ **Encyclopedia Britannica - Macropedia - Knowledge in Depth**, 15th Edition, Encyclopedia Britannica, Inc.: Chicago, 1981.

² **High Tech Ventures - The Guide for Entrepreneuring Success**, C. Gordon Bell, Addison-Wesley Publishing Company, Inc.: Reading, Massachusetts, 1991.

States. These aircraft accumulate approximately 80 percent of all of the total hours flown and carry one in three intercity passengers.³

Despite these impressive statistics, GA is in decline. It operated in a cyclical manner where it closely mirrored the performance of the GNP and slowly built more capacity with each economic upturn until 1978, where it delivered at 17,811 new aircraft deliveries. Since that peak, it has atrophied to a level where a mere 964 units are shipped per year. Export of GA aircraft declined from 3,995 aircraft in 1979 to 336 in 1984 -- which can be seen to closely parallel the decline in domestic sales.

It is a well-established fact that there was a correlation between the rate of new GA aircraft production and the gross national product of the United States of America prior to 1978 - - i.e. as GNP increased so did GA new aircraft shipments. However, two metrics have become uncoupled since 1978 -- i.e. the GA industry failed to recover from the economic slump of the early 1980s and has continued to decline despite overall economic recovery.

Much analysis of the market has been made of the loss of correlation between GNP and new GA aircraft shipments. Possible causes include:

- Increasing costs of owning and operating a GA aircraft.
- Increasing costs and risks of manufacturing GA aircraft due to product liability concerns.
- Increasing value of the dollar caused foreign exports to decline due to higher prices in the foreign currency³.
- Changes in the tax code which made owning GA aircraft less attractive financially.
- Increasing competitiveness of airline transportation due to the Airline Deregulation Act of 1978⁴.

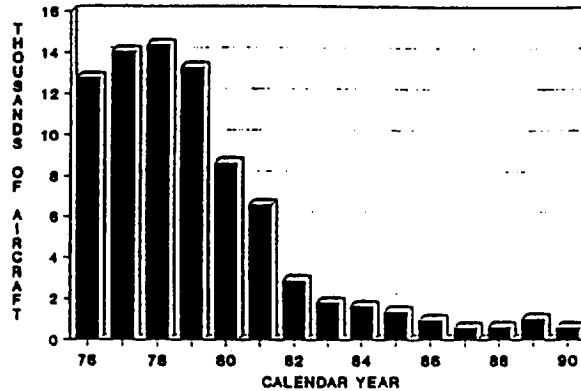
It is the view of the author that the primary reason for the downturn in GA is primarily related to the increases in direct acquisition and operating costs. It can be seen in Figure 1 that the direct acquisition, operating, and maintenance costs increased dramatically in the years 1978-1982 - the precise years which saw a precipitous decline in GA production. From 1978 through 1984, . . . single-engine piston aircraft prices increased at a yearly rate of close to 12 percent . . . [which] adjusted for inflation, grew at approximately five percent per year⁵.

³ **General Aviation Marketing and Management**, Wells, Alexander and Chadbourne, Bruce, Krieger Publishing Company: Malabar Florida, 1994.

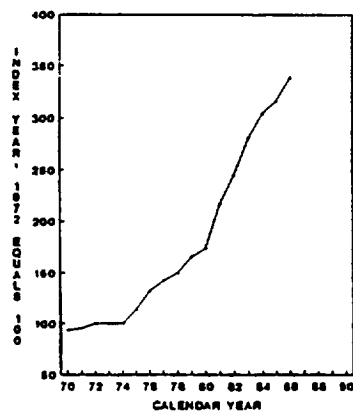
⁴ **FAA Statistical Handbook of Aviation**, 1992.

⁵ **General Aviation Marketing**, Chadbourne, Bruce D. and Wells, Alexander, T., Krieger Publishing Company: Florida, 1987.

AIRCRAFT SHIPMENTS



AIRCRAFT PRICES



OPERATING AND MAINTENANCE COSTS

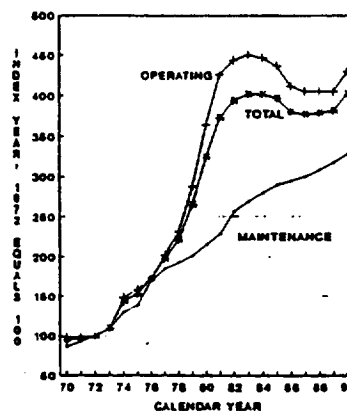


Figure 1: Correlation between Single Engine Piston Prices and Aircraft Shipments (Copied from Reference 6⁶)

Since 1978, much effort has been invested to attempt to revive the GA industry. Companies have downsized, left the market, or gone out of business. However, until recently, there has been a steady decline in the production of GA aircraft since 1978 – reaching five percent of the 1978 levels in 1994.

Entrepreneurship and General Aviation

Currently, it can be seen that GA represents a significant portion of the air transportation system of the U.S. However, the erosion of the GA fleet, ground-based infrastructure, and pilot community (with associated political constituency), all hold dire consequences for GA. If allowed to continue, the market will become antiquated, uncompetitive with other modes of transportation such as the car, and eventually shunted aside from within the airspace system.

⁶ FAA Aviation Forecasts - Fiscal Year 1991-2002, U.S. DOT - FAA, FAA-APO-91-1, February, 1991.

The economically sound application of technology to increase the attractiveness and competitiveness of GA is seen to be the only alternative to make GA more competitive. As discussed in the introduction, the entrepreneur is seen to be the medium for the introduction of this technical innovation. An important caveat must be made. It can be seen that corporations play a large part in the current entrepreneurial model. They innovate and compete on a continual basis and largely assume most of the characteristics of the individual entrepreneur. Thus, it can be seen that the individual and the corporation play a role in introducing new technologies to the marketplace.

However, the entrepreneurial aspects of the start-up GA company will be analyzed in this section as the barriers of entry to the GA marketplace are most formidable to this company instead of the well established company which has considerable resources at hand.

The primary barriers to entry into the GA market are:

- Sufficient capital.
- Management competency to organize teams (often multi-disciplinary) to produce complex new products economically.
- Inadequate time to correctly design and produce a quality product which is certifiable.⁷

There are a variety of initiatives which will overcome these barriers to entry and no unique strategic plan is necessary to navigate the difficulties. However, some primary considerations must be addressed in each issue. These considerations include:

Capital

More than any other aspect, capital determines the corporate structure of the start-up company. Sufficient capital allows for greater flexibility (e.g. by waiting with a mature product until the market becomes mature) and increased performance (e.g. by rapidly developing products by hiring a large team of designers). These additional capabilities can often mean the life and death of a fragile fledgling company.

There are several sources to raise the requisite capital for becoming a successful start-up company. Some of these sources are:

- The founders' savings -- including borrowing on assets.
- Family and friends.
- Formal investment groups, including venture capital concerns and companies that specialize in the private placement of stock.

⁷ "Entrepreneurial Spirit Combines with Hard-Headed Business Sense," Olone, Richard, *Commercial Space*, Fall, 1985.

- Foundations.
- Grants and small-business loans from various government agencies (e.g. SBIR loans (Small Business Innovative Research) from NSF, DoD, or NASA).
- Having the company's employees buy equipment and lend it to the firm.
- Obtaining the firm's capital equipment through bank loans and leasing companies.
- Forming research and development partnerships with investment companies to do incremental development.
- University endowments.
- Strategic partners that are potential customers and want early access to the start-up's product.
- Large companies and pension funds that enter into a venture-investment phase.
- Strategic partners that are manufacturers whose products would be enhanced by the start-up's product.
- Banking institutions that invest working capital based on firm orders.
- Equipment suppliers and vendors that may help a new company get started.
- Customers, including other start-ups, that may pay in advance for product or for a development contract (i.e. use someone else's venture capital).
- Going public or being acquired by a larger, more cash-rich company.²

Obtaining adequate capital is a continual challenge of all fledgling companies and is the primary cause of the cessation of business.

Management of Large, Highly Technical Products

Users of aerospace products have high expectations of products. These products are expected to perform at a high level of performance and reliability. Thus, the technical complexity of products is relatively high (when compared to other transportation industries).

Due to the technical complexity of general aviation products, managers must be adept at the management of new technologies, personnel, and personalities. This requirement is a difficult one which may result in the failure of the start-up company or the dismissal of the manager if he or she is not capable of marrying the two diverse requirements into a functioning whole.

Some manufacturers choose to "push the edge of the technological envelope" by moving to exotic materials and technologies while others manufacture components using well-established procedures and materials. The decision between these two production techniques directly influences the challenges that will be encountered in this aspect of the fledgling company.

Inadequate Time

Many start-up companies do not allow enough time to completely develop a product before entry into the market. This complication is generally closely tied with the lack of capital (i.e. an immature product often is rushed to market because there is simply no capital to allow for continued development and/or the capital from sales is needed immediately). Indeed, many business decisions are related to trading capital for time and vice versa. Thus, while it might seem that a fledgling company failed due to a lack of time, it might actually be that the company had too little capital to produce a quality product and so rushed delivery of a new product which simply wasn't complete.

Sample Business Plan

The following business plan is a hypothetical summary of the merits of a proposed new GA airframe company. It is important to note that this plan is preliminary and must be fleshed out with significant quantitative analysis of the market and justification for key decisions within the plan. In the end, although it is important to have a complete plan, it should only be ten pages in length to allow potential investors to read it quickly and to allow important points to be made quickly and efficiently.

This business plan would be used to recruit venture capital to allow for the formation of a fledgling company and is not intended to provide a description of the internal operations of the fledgling. The following additions should be included in the final business plan:

- The market analysis which presents the analysis, justification, and results of a market analysis with the primary purpose of predicting the number of airplanes that will be sold during the initial phases of the company and the return on investment for investors.
- A detailed cost survey of the industry which establishes the cost to which the airplane should be designed and a detailed breakdown of the costs of the company to allow the cost goals to be achieved
- A prediction of the capital that would be required in each phase of the development of the fledgling company.

In all, the business plan is recommended to contain the following broad pieces of information:

- Statement of the proposed company's vision, mission, and business.
- Product concept (what the product is).
- Technological uniqueness that will sustain the firm beyond the initial product.

- Rationale (why people will buy).
- Gross estimates of the target market (who will buy).
- Simple “market map” (how the product will be sold).
- Plan for reaching the seed stage [the stage of development of a company following conceptual definition], with objectives and milestones.
- Outline of a financial plan.
- Resources, in terms of dollars and people.

This business plan will follow the following format:

- Summary
- Market Brief
- Product Brief
- People

Summary

The summary concerning the plight of the GA industry is presented in the introduction of this paper. However, all of the misery within the GA industry will likely induce the response of, “Why in the world would I want to get involved in that mess?” from the prospective investor.

It should be emphasized that each problem brings opportunity with it. It is indisputable that GA is currently an anemic industry. However, this lack of size allows an agile manufacturer to dominate the industry quickly with a well-placed product entry and therefore gain the benefits of industry dominance rapidly. Some examples of the benefits from this dominance include:

- The ability to dictate the type of infrastructure support
- The ability to attract significant interest from the media and the market with each product development
- The ability to establish significant political attention from sub-contractors - thus enabling a working partnership.

There is significant evidence of a resurgence of interest in GA airplanes. New aircraft companies are entering the market and established manufacturers are beginning production anew. Approximately 30,000 used GA aircraft are bought and sold annually. In addition, the continual increase of used aircraft prices over the past several years is a strong indicator that there is significant pent-up demand for cost-effective new aircraft.

Market Brief

It can be seen that approximately 60 percent of the current prospective buyers of GA airplanes are receptive to a price of a new aircraft at \$100,000 or below⁸. This product would likely be used for trips of 450-600 statute miles in length. Longer trips are likely to be conducted via airline and shorter trips are likely to be conducted by car. (Please note that this assumption must be validated.)

Product Survey

A preliminary design analysis of this airplane shows that the following characteristics are possible:

- $W_{\text{empty}}/W_{\text{gross}} = 0.54$
- Baggage: 100#
- Useful Load: 1,140#
- Aspect Ratio: 8
- $C_{D\text{Parasite}}: 0.0200$
- Wing Efficiency (e): 0.80
- Cruise Speed: 197 MPH
- Brake HP Required: 172 HP
- Range: 824 Miles
- Passengers: 680 #
- Fuel: 360#
- Wing Area: 147 ft²
- Wing Span: 34.3 ft
- $\rho_{7,000 \text{ ft}}: 0.00193 \text{ slug/ft}^3$
- Propeller Efficiency: 0.80
- Thrust HP Required: 138 HP
- Rated HP: 230

It is important to note that these calculations do allow for induced drag⁹. It can be seen that the weight fraction is attainable, but difficult to attain, from the following weight fractions of airplanes in production today:

Airplane	Weight Fraction ($W_{\text{empty}}/W_{\text{gross}}$)
KIS Cruiser	0.522
GlaStar	0.579
RV-4	0.600

The GlaStar is a metal/ composite hybrid airplane, the RV-4 is a metal airplane, and the KIS Cruiser is a composite airplane. All of these airplanes are fixed gear airplanes.

The other primary constraint on the feasibility of this design is the amount of drag that will be produced by this airplane. It can be seen that the following airplane is feasible from the following data on production airplanes:

⁸ Conversation with Mr. Barry Bond, Utah Department of Transportation, July 6, 1995.

⁹ Study Conducted by Wilmer R. Ullmann, July 27, 1995 Reprinted by permission.

Airplane	Parasite Drag Coefficient (C_{Dp})
1. Piper Arrow	0.027
2. Beech Bonanza	0.019
3. Mooney 201	0.017

It is important to note that all of these airplanes are retractable gear designs. Thus, the primary challenge of this prospective airplane design will be to couple low drag with a low weight fraction.

People

It is important to emphasize just how important people are to a business plan and the viability of a fledgling company. Indeed, veteran venture capitalists have stated that having a sound management team is the key component of start-up companies for which they look when they decide whether to invest in a proposed company².

At the preliminary stage, it is impossible to determine who specifically may be involved in the design and production of this airplane. However, it is possible to describe the title and responsibilities of the key members of the core team:

- **The CEO:** Responsible for managing the company, setting standards, hiring people (although generally not all of them), and keeping and updating the vision of the company.
- **Engineering:** Responsible for technical analysis, design, and fabrication of hardware.
- **Marketing:** Responsible for determining what new performance capabilities, prices, and features should be incorporated into new products.
- **Research and Development:** Responsible for development of technologies to allow for increases in utility of future products.
- **Finances:** Responsible for maintaining the books and providing cost control to the company.
- **Law:** Responsible for insuring that the company remains within the spirit and the letter of the law and defending against product liability suits.
- **Tooling and Manufacture:** Responsible for producing the hardware, quality control, and determining ways to streamline manufacturing (works closely with Engineering).
- **Advanced Design:** Responsible for creating the products of the future (including derivative airplanes) (works closely with Research and Development).
- **Flight Test:** Responsible for testing new prototypes and insuring that airplanes are functioning properly prior to being shipped.

It is important to note that not all of these positions need be filled from within the company. Indeed, it is advisable that a company examine which of these features can best be filled internally and those that can be outsourced. The features of those that can best be filled

internally are that they are essential to the company's vision for the future or incorporate unique, proprietary technologies. Alternatively, outsourcing provides an avenue to tap sub-contractor expertise in areas which are not core to the business plans of the company while allowing for continuing improvement through close communication with the sub-contractor.

Conclusion

In summary, it can be seen that both GA and entrepreneurship contain many exciting aspects for the adventurous individual. By being wary of the pitfalls specific to GA and following the sound principles of entrepreneurship, one may beat the odds, capitalize upon a specific niche which is currently unfilled, and create benefits for both the individual and the general market.