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A Lawyer-Flight Instructor's Prognostications on the Implementation of Free Flight: How Will the Large-Scale Introduction of GPS into General Aviation Cockpits Affect the Liabilities That Face Pilots and the Flight Instructors Who Train Them

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A LAWYER-FLIGHT INSTRUCTOR'S PROGNOSTICATIONS ON THE IMPLEMENTATION OF FREE FLIGHT: HOW WILL THE LARGE-SCALE INTRODUCTION OF GPS INTO GENERAL AVIATION COCKPITS AFFECT THE LIABILITIES THAT FACE PILOTS AND THE FLIGHT INSTRUCTORS WHO TRAIN THEM?

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I. INTRODUCTION[1]

THIS ARTICLE DOES not fall easily into the stereotypical law review genre. On the most general level, this is an article by a pilot, navigator, and flight instructor who happens to hold a

[1] I would like to extend my thanks to Messrs. Colin Cahoon of Jackson & Walker, L.L.P., Dallas, Texas; Charles Thompson of Maloney, Bean, and Horne, P.C., Las Colinas, Texas; and John Howie of Howie & Sweenie, L.L.P., Dallas, Texas, for their sage counsel in my efforts to complete this Article. I would also like to thank the many unnamed pilots and flight instructors who shared with me their experiences thus far with the implementation of GPS in general aviation cockpits. Finally, it is worthy to note that the opinions I express in this Article are not necessarily those of Akin, Gump, Strauss, Hauer & Feld, L.L.P.

law degree, attempting to theorize on if, how, and why the ongoing changes in a particular technology *might create* a related increase in liabilities and litigation. It is not a piece by a storied practitioner or professor discussing complex theories on economics and torts in an effort to explain how and why an increase in a particular technology *created* a related increase in liabilities and litigation. In other words, this is not an article that provides to the practitioner a research vehicle for finding applicable case law—because there is no applicable case law on the subject. Rather, it is an article primarily designed for aviation lawyers who are not themselves pilots or are pilots who have been out of the cockpit for awhile, providing them with some understanding of why and how the introduction of a new technology into general aviation airplanes is such a significant change in the way pilots fly those airplanes. This Article, therefore, is relatively heavy on nonlegal explanations of how pilots will navigate using a new technology and somewhat lighter on legal analysis of the consequences of these changes. Furthermore, it attempts to put down on paper—for the first time I believe on this specific topic in the air law realm—not only a potential outcome that is intuitively obvious to some (*i.e.*, with the increase in technology will come an increase in negligence cases), but also some rationale as to the process through which this outcome will occur. All of that being said, the particular technology addressed in this Article is the Global Positioning Satellite Navigation Systems and all of its various related navigational technologies (which I will collectively refer to as GPS). The related liabilities and litigation of interest are those that may face general aviation pilots and their flight instructors as a result of the advent of GPS.[2]

[2] Note that this topic—the advent of GPS and its potential impact on the liabilities facing general aviation pilots—is narrower than the Symposium's general discussion topic in this Journal: the advent of free flight. This narrowing of the subject matter is appropriate, notwithstanding basic arguments as to efficiency, because GPS is arguably a linchpin of free flight. Furthermore, this is the technology that—although not yet completely integrated into the cockpit—has begun to gain widespread use in the general aviation community, thus providing at least some anecdotal evidence as to how pilots are going to interact with the technology in the future.

See, for example, Bill Elder, Comment, *Free Flight: The Future of Air Transportation Entering the Twenty-First Century*, 62 J. AIR L. & COM. 871 (1997), published in this Symposium issue, for a discussion of the different technologies that are enabling the implementation of free flight and the observation that GPS is one of the technologies critical to the actual realization of the free flight concept.

Specifically, this Article focuses on how GPS will change the way general aviation pilots navigate, and how these changes will in turn affect the legal liabilities they face. It will begin with a brief discussion of how general aviation pilots used to navigate, or the "old way" of navigation, and how they will navigate in the future with GPS, or the "new way." Because the crux of this discussion is how pilots interact with this new technology, it is not a detailed and technical analysis of the principles behind these methods of navigation. Rather, the discussion is based on a human factors analysis, focusing on the general aviation pilot's point of view and describing how the typical pilot understands and interacts with these technologies, both old and new. The sources used to describe these methods, therefore, are sources typically available to the general aviation pilot. This section of the Article ultimately concludes that the modification in the navigation methods caused by the on-going implementation of GPS has presented a sea change in the way general aviation pilots navigate, and prepare to navigate, the skies.

This conclusion leads to the next topic of discussion: possible scenarios detailing several specific ways in which the advent of GPS will change the behavior of general aviation pilots. One of these scenarios also discusses how flight instructors might be affected by the changing needs of their students. As noted above, because this section looks to the future, it is not based on a historical review of the case law. Instead, it is based primarily on my own experience as an aviator, on a series of "official" telephone interviews with several individuals who are at the heart of the GPS revolution and have knowledge as to how it may impact the general aviation community,[3] and finally on numerous informal interviews with fellow general aviation pilots and flight instructors who discussed their experiences thus far with the implementation of GPS.

The following section then uses these scenarios to craft an analysis of how the hypothesized behavioral changes will affect legal liabilities. Because this is an article of prognostication, it borrows some basic concepts from a few other areas of the law where storied practitioners and professors actually have pro-

[3] Telephone Interview with Richard Cole, GPS Consultant to the United States Federal Aviation Administration (FAA) (Aug. 28, 1996); Telephone Interview with Mark Cato, Crown Communications, Inc. (Oct. 11, 1996) (providing contractor support for the Situational Awareness for Safety Systems Requirements Team, formed by the FAA); Telephone Interview with Roger Baker, Manager of Aviation Safety Programs for the FAA (Oct. 30, 1996).

vided complex and detailed analyses as to why technological changes in turn affected legal liabilities, and utilizes these concepts as a tool for hypothesizing as to how pilot's and flight instructor's legal liabilities might change with the advent of GPS. This section takes a worst-case-scenario approach, concluding that there may be significant increases in the number, although not the type, of liabilities facing those aviators.

This conclusion, therefore, calls for some recommendations on how to handle the potential increase in liabilities. This Article recommends that (1) the United States Federal Aviation Administration (FAA) enhances its forward-looking approach to identifying and solving the problems associated with the implementation of GPS; (2) organizations such as the Aircraft Owners and Pilots Association (AOPA) increase their efforts to assist the FAA and the general aviation community in this same endeavor; (3) the avionics and aviation software industries focus on user-friendly software, including efforts to standardize the systems at some level so that pilots transferring between systems or aircraft are not faced with completely new navigational systems; (4) aviation-law pilots and practitioners actively work to educate the general aviation community about the potential increase in liabilities it faces with the advent of GPS; and most importantly, (5) the members of the general aviation community internalize these lessons so that these potential increases might be negated to some extent, which is the main point of writing this Article. While GPS promises to offer incredible benefits to the general aviation community, the technology may also take a terrible toll, both personal and legal, on those who either misuse it or use it carelessly. I believe that one of the best ways to combat this potential outcome is to educate the general aviation community about the causes of these potential liabilities so that it can take steps to forestall them.

II. WHY THE ADVENT OF GPS IS A SEA CHANGE IN GENERAL AVIATION COCKPITS: THE METHODS AND HISTORY OF AIR NAVIGATION AND PREFLIGHT PLANNING, AN INTRODUCTION TO GPS IN GENERAL AVIATION COCKPITS, AND THREE POSSIBLE SUBSEQUENT SCENARIOS

A. AIR NAVIGATION—THE OLD WAY OF NAVIGATING FROM POINT A TO POINT B

1. *Historical Notes on the Advent of Air Navigation*

In the most basic sense, humans began using some form of navigation—from the Latin terms "navis," meaning ship, and "agere," meaning to direct or move—as soon as they started wandering away from their immediate surroundings.[4] The earliest and simplest forms of navigation began with basic dead reckoning—tracking one's progress by starting from a known position and then taking into account the direction, speed, and elapsed time of one's travel—and the primitive use of celestial observation such as following the North Star.[5] The first great leap in navigation technologies came in the 1700s, when scientists invented accurate chronometers (timepieces) and sextants (instruments to measure angular distances). The advent of this technology made it possible for the first time to accurately navigate to distant places, even when at sea and far from land.[6] Although scientists and engineers have developed many new instruments over the last two hundred years, the basic principles of navigation have not changed since the advent of chronometers and sextants in the 1700s.

A different twist to navigational development appeared at the beginning of this century with the advent of "air navigation," which is "the art of flying the airplane from one point to another and determining its position along the route."[7] Air navigation has some distinct characteristics that can make it significantly more challenging than land or sea navigation, such as: (1) the need for continued motion—an aircraft needs constant airflow over its wings to remain aloft; (2) high rates of speed—aircraft typically travel faster than other modes of trans-

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[4] *See* U.S. DEP'T OF THE AIR FORCE & NAVY, FLYING TRAINING, U.S. AIR FORCE MANUAL 51-40, AIR NAVIGATION 1-1 (1983) [hereinafter FLYING TRAINING].

[5] *See id.* at 1-1 to 1-2; FAA, U.S. DEP'T OF TRANSP., FLIGHT TRAINING HANDBOOK, AC 61021A, at 170 (1980) [hereinafter TRAINING HANDBOOK].

[6] FLYING TRAINING, *supra* note 4, at 1-1.

[7] TRAINING HANDBOOK, *supra* note 5, at 165.

portation; (3) limited endurance—an aircraft does not remain aloft for extended periods of time; and (4) the relatively significant impact of weather—poor visibility can affect the pilot's ability to see landmarks; atmospheric pressure and temperature changes can affect an aircraft's altitude measuring equipment; and severe weather can force drastic (and sometimes rather harrowing) changes in flight plans and operations.[8] Along with these distinct characteristics came various methods to deal with them.

2. *Modern Methods of Air Navigation*

Modern methods of air navigation range from the simple to the complex. The most basic method of air navigation is through a combination of dead reckoning and "pilotage," which is flying cross-country using only a chart and flying from one visible landmark to another.[9] This is the first method a flight instructor teaches to a new student pilot, and it only requires a clear day, the proper chart, a watch, an airspeed indicator, and a magnetic compass (the last three of which are standard equipment on all modern aircraft certified for flight in clear weather[10]).

The next method or level of air navigation is based on a pilot's ability to accurately determine the aircraft's position through reference to some external source.[11] This external source is usually one of the various "radio aids to air navigation" or "navaids" maintained by the FAA as part of the national transportation system.[12] The basic idea behind their use requires explanation.

The most commonly used navaid in the general aviation pilot's universe is the "very high frequency omnidirectional range"

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8 FLYING TRAINING, *supra* note 4, at 1-1.

9 TRAINING HANDBOOK, *supra* note 5, at 168.

10 *See* 14 C.F.R. § 91.205(d) (1996).

11 Although pilotage in its simplest form arguably fits into this category, it is more properly a visual maneuver for purposes of this Article. The method or level of position determination discussed here goes beyond simply looking out the windscreen and fixing a position based on visible landmarks.

12 *See* BILL CLARKE, AVIATOR'S GUIDE TO GPS xix (1994); U.S. DEP'T OF TRANSP., PILOT'S HANDBOOK OF AERONAUTICAL KNOWLEDGE, 165, 183 (1980) [hereinafter PILOT'S HANDBOOK]. Another external source frequently used by navigators at one time was the celestial bodies—the sun, moon, and stars. But even in its heyday, the primary users of this method were commercial and military aircraft. Thus, celestial navigation has never played a significant role in the lives of general aviation pilots. *See id.* at 165.

radio, or "VOR."[13] Through a VOR radio receiver in the aircraft, VORs on the ground provide the pilot with "radials," which are "'line[s] of magnetic bearing[s] extending outward from the VOR station.' Radials are identified by numbers beginning with 001, which is one degree east of magnetic north, and progress in sequence through all the degrees of a circle until reaching 360."[14] In other words, if you are a pilot who is due east of the VOR station that is tuned into your VOR receiver[15] and you are flying directly toward that station (*i.e.*, you are flying a magnetic heading of 270), then the instrument will indicate that you are on that station's 090 radial. If you maintain your 270 heading, you will stay on the 090 radial until you pass directly over the station, at which time the receiver will indicate that you are now on the station's 270 radial. Thus, you now have some raw data—a "line of position" or "LOP"—with which you can work. If you have the appropriate aeronautical chart open on your lap, you can draw the radial or line out of the VOR symbolized on the chart, knowing that you are somewhere along that LOP. If you combine this knowledge with another LOP from a different, nearby VOR tuned into your second VOR receiver, or if you combine one LOP with the distance indicated on another type of radio aid—a "Distance Measuring Equipment" or "DME" station that is sometimes located with the VOR[16]—then you have two pieces of information that can now show your location over the ground at any particular moment.

This description of what a VOR is and how a pilot uses it sounds convoluted and difficult, and it is. Using these instruments is not intuitively obvious, and it takes a good deal of time and training to become proficient. The primary benefit of

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[13] CLARKE, *supra* note 12, at xix, 61. While VORs constitute only one of several types of navaids available to the general aviation pilot, they are the most commonly used. Chapter 5 of Clarke's book offers a good synopsis of the various navaids and their individual strengths and weaknesses. For a more technical description of the various types of radio aids to navigation, and their parameters and uses, see FEDERAL AVIATION REGULATIONS AND AERONAUTICAL INFORMATION MANUAL ch.1, § 1, at 1-1-1 to 1-1-39 (ASA 1996) [hereinafter AIM]. The AIM is a government publication provided by the FAA that is not regulatory in nature, but puts into clearer language the information and regulations that pilots must know and follow in order to successfully navigate in the United States national airspace system. *See id.* at 1-2.

[14] PILOT'S HANDBOOK, *supra* note 12, at 183.

[15] Because VORs are ground-based radio stations, an aircraft typically needs to be within 130 nautical miles (nm) of a VOR in order to receive an accurate signal from that station. *See* CLARKE, *supra* note 12, at 64.

[16] *See id.* at 66-67.

VORs, first substantially realized when the FAA introduced VORs in the 1950s, is that this type of technology enables pilots to accurately navigate over long distances and in any kind of weather. Therefore, you do not have to be able to see out of the cockpit window in order to know where you are. Of course, just having these types of radio aids available to determine the aircraft's present position does not explain how a pilot uses them to navigate that aircraft from point A to point B.

3. *En route Navigation and Related Preflight Planning Requirements*

About the same time that VORs made their appearance on the air navigation scene, the government designed a national "air highway" or "airway" system based primarily on those VORs. These airways are basically a series of lines from VOR to VOR that stretch from coast to coast. Hence, if you want to fly from point A to point B, say from New York to Los Angeles, you simply pull out the appropriate aeronautical charts that define these airways and select the route that gives you the straightest line to Los Angeles. But because VORs are only good to a distance of 130 nautical miles or so, your straight line will not be perfectly straight; it will be a series of straight lines from VOR to VOR.[17] This series of straight lines may add a lot of miles and, thus, a lot of time and fuel expenses to the theoretically single straight line from New York to Los Angeles.

Furthermore, the process of selecting the proper route is not just a matter of jumping in the airplane and taking off. Depending on the distances involved, whether the flight will be in clear weather as defined under the Visual Flight Rules[18] (VFR) of the Federal Air Regulations[19] (FARs) or in instrument meteorological conditions as defined under the FARs' Instrument Flight Rules[20] (IFR), and the density of traffic faced by the pilot (such as flying around Dallas as opposed to El Paso), flight planning may take anywhere from five minutes to several hours. This preflight planning process typically includes: (1) a review, as necessary, of all of the applicable regulations and aircraft performance data such as fuel endurance or weight and balance

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[17] *See* CLARKE, *supra* note 12, at 59-66 (briefly describing the airways and route systems based on VOR stations); AIM, *supra* note 13, at 5-3-4 (same).

[18] 14 C.F.R. §§ 91.151-.159.

[19] The Federal Air Regulations (FARs) are contained primarily in Title 14 of the Code of Federal Regulations.

[20] *Id.* §§ 91.167-.193.

calculations; (2) a review of the applicable forecast weather conditions at the departure, en route, and landing locations; (3) a review of the applicable departure, en route, and landing location facilities, such as runway lengths, VOR radio frequencies, possible emergency airfields, and any en route areas that might be "off limits" to your particular flight; and (4) the simple selection of the best route to get you from point A to point B.[21] Furthermore, part of this route selection and planing process will include a line-by-line computation of the leg distances (*i.e.*, the distance between each VOR), headings or courses, and fuel use (or fuel "burns"). If you are flying from New York to Los Angeles, or even from Dallas to El Paso, this can be a challenging and time-consuming process.

Once the pilot finishes the plan and gets into the air, the next phase of work begins. "Aircraft navigation is the process of piloting an aircraft from one place to another and includes position determination, establishment of course and distance to the desired destination, and computation of deviation from the desired track."[22] In other words, the pilot must point the aircraft in the right direction, tune-in and monitor the various VORs that define the selected route, communicate with Air Traffic Control as necessary, stay clear of bad weather and other airplanes as necessary, and make sure that the actual time, distance and fuel-use numbers mirror the flight plan so that the pilot does not have to make an unexpected and potentially embarrassing (if not fatal) landing short of the desired destination with empty fuel tanks.

Putting all of this together, navigating from point A to point B is not necessarily a simple proposition. The requisite flight planning can be very challenging and time consuming. Once the flight is planned and you are in the air, actually executing your plan can also be a complex and challenging exercise. Furthermore, getting from the status of student pilot to private pilot, or from VFR pilot to IFR pilot, can be daunting and time consuming. On the other hand, once a pilot goes through the requisite training and gains some experience, flying via VOR-to-VOR can become noticeably easier. After preparing the first few flight plans, the process becomes relatively easy to quickly perform. Once in the air, the pilot just repeatedly tunes-in the next VOR and then flies to it. After becoming experienced in the process

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21 *See id.* § 91.103.

22 CLARKE, *supra* note 12, at 59.

of normal en route navigation, the pilot is able to gain significant time for looking out the window and clearing for other air traffic. The experienced pilot may also use this time to think about the aircraft's present position and what is coming up next. All of these tasks are extremely important in order to safely complete the flight.

More importantly, this is a very "pilot-interactive" process. In order to fly from point A to point B, the pilot has to actually pull out the charts, create the flight plan, monitor the flight progress, and actively determine the ever-changing aircraft position and next course of action. It is the pilot's brain that is analyzing all of the planning materials and creating a detailed flight plan. It is the pilot's brain that is analyzing the raw data from the navaids and determining the aircraft's present position. And it is the pilot's brain that is combining the plan and the position to navigate the aircraft to the final destination. In other words, it is the pilot who serves as the flight-planning and air-navigation computer. This process, however, is dramatically changing with the advent of free flight and the introduction of GPS and its related technologies into the general aviation cockpit.

B. GPS Navigation—The New Way of Navigating from Point A to Point B

In 1869, Edward Everett Hale, in a science fiction story "The Brick Moon," postulated sending up a brick sphere into orbit 4,000 miles over the Greenwich Meridian to serve as an artificial star to greatly aid navigators in determining their position at sea. Today's reality is far beyond anything conceived twelve decades or even twelve years ago and will likely relegate celestial navigation, along with a host of modern aids to navigation for aircraft, obsolete.[23]

1. *The Basic Technology*

Today's navigational reality is based on the technological capabilities now offered by GPS and its related systems.[24] Other

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23 Jonathan M. Epstein, Comment, *Global Positioning System (GPS): Defining the Legal Issues of Its Expanding Civil Use*, 61 J. Air L. & Com. 243, 244 (1995) (footnote omitted) (referring to *The Brick Moon* by Edward E. Hale, originally published in the *Atlantic Monthly* in 1869 and cited in Arthur C. Clark, The Promise of Space 8-9 (1968)).

24 Note that GPS (and its related technologies) is not a completely new or unique method of navigation to the general aviation community. For example, LORAN-C, a computer-interfaced navigational system that uses ground-based

articles in this Symposium provide excellent detailed and technical explanations of the history and principles behind the use of the GPS navigation system.[25] For our purposes, however, it is sufficient to note that GPS fits into the higher level or method of navigation discussed above, providing another type of external navigational source in addition to the old VOR-based system. But GPS is also enormously different. First, by simply turning the GPS receiver on, the unit automatically, continuously, and to a far higher degree of accuracy than individuals can determine on their own provides the pilot with the aircraft's present position.[26] Furthermore, GPS makes basic point-to-point navigation "so simple a child can do it. And to an accuracy that exceeds that to which most maps can be read."[27] But possibly the most significant impact on general aviation will come not just from the basic power of a GPS receiver to derive a present position. It will come from the enormous information and computational power that GPS provides within its self-contained data bases and also from the power that becomes available when manufacturers and pilots combine the basic GPS with various optional data bases and other related technologies.

2. *The Capabilities of GPS and Its Related Technologies*

A recent survey of GPS systems currently available on the market compares twenty-five makes and models of portable, or hand-held, and panel-mounted GPS systems.[28] In addition to

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navaids installed outside of the FAA's radio aid system and that now provides coverage for the entire United States, offers (from the pilot's point of view) much the same type of information and capabilities provided by GPS. But because GPS is representational of these other types of navigational systems, because it will eventually replace all of these systems as the sole method of instrument navigation, and most importantly, because the true significance in the GPS revolution for the purposes of this discussion is the speed with which those navigational systems are being developed and deployed by the aviation community, the sole focus on GPS here is appropriate. *See* Thomas A. Horne, *Countdown to 2010*, AOPA PILOT, Oct. 1996, at 73, 73-76.

[25] See, for example, Bill Elder, Comment, *Free Flight: The Future of Air Transportation Entering the Twenty-First Century*, 62 J. AIR L. & COM. 871 (1997) and Allison K. Lawter, Comment, *Free Flight or Free Fall?*, 62 J. AIR L. & COM. 915 (1997), published in this Symposium issue, for a discussion of the history and use of GPS and free flight.

[26] *See* CLARKE, *supra* note 12, at xix. One commentator noted that the civilian GPS systems now routinely provide positioning—in latitude, longitude, and altitude—to accuracies of within five meters. Epstein, *supra* note 23, at 251.

[27] CLARKE, *supra* note 12, at xix.

[28] *See id.* at 193-95.

having their own internal data bases containing vast lists of VORs and airports, all of the systems offer the pilot the ability to create "user waypoints," with some capable of memorizing up to 1000 of these user-defined waypoints.[29] Furthermore, all but one of them provides the capability of memorizing multiple flight plans (not just individual waypoints), with one unit capable of memorizing up to 100.[30] Finally, twenty of these units can provide pilots with an "emergency search" function that, with the push of a button, tells a pilot the locations of the closest facilities or airports so that he or she can immediately point the aircraft in the direction of the nearest runway should the need arise to quickly land the aircraft.[31]

These capabilities are even more impressive when combined with other technologies. One of the most popular technologies manufacturers are putting together with the basic GPS positioning functions is "moving map displays." This technology combines the GPS's power to instantly and accurately determine the aircraft's position with a computer's ability to display that position, along with all of the other information the pilot might want—such as ground landmarks or en route restricted areas—right at the pilot's fingertips.[32]

Another related technology now available is a multitude of various laptop flight-planning computer programs, which further enhance pilots' abilities to more quickly and accurately plan their flights. These programs perform many of the tedious manual flight planning steps described above, but with the computer, it takes the pilot just a few keystrokes to create a highly accurate flight plan. Furthermore, pilots can connect some of these programs directly to their GPS systems while in flight, thus providing an enhanced version of the moving map displays just described.[33]

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29 *See id.* at 194-95.

30 *Id.*

31 *Id.*

32 *Id.* at 136.

33 *Id.* at 136-40. Consider the following advertisement from a recent edition of an aviation magazine:

> Ease of use, intuitive interface, and precision graphics are only some of the reasons Flitestar is the choice of more pilots than any other flight planning software. Just enter your departure and destination, and Flitestar automatically computes waypoints and fuel stops for your IFR and VFR flight plan; or point and click to customize your plan. Next, FliteStar creates your flight log, with waypoint data, time, distance, fuel, winds, temperature, [weight and

In summary, GPS and its related technologies wrap up into a neat little box many of the complex, time-consuming, and sometimes tedious preflight and en route chores that previously faced a general aviation pilot preparing to take a cross-country flight. A flight-planning computer can now select the best course with a few keystrokes, accurately determining all of the pertinent leg times, distances, and fuel burns. Or if a pilot has flown the route before and saved it in the GPS's memory, he or she can simply re-call that flight plan with even less effort. Once the flight departs, the same GPS, possibly connected to a moving map display or to the flight-planning laptop computer, can instantly and continuously display the aircraft's position along with all of the other information that a pilot could want. GPS and its related technologies can now do all of the navigating functions that pilots once had to do by hand faster, better, and far more accurately.

3. Related Factors to Consider

These changes are not inherently dangerous and, in fact, offer the potential for significantly increasing the safety in general aviation cockpits. Military and commercial aircrews have essentially been flight planning and navigating for many years with technologies that, to the pilot at least, function much like the GPS systems now appearing in general aviation cockpits. But one difference is that in the military and commercial setting, usually an *aircrew* and not a single pilot, as is the case in a general aviation setting, is involved. And those aircrews have often received several times the training and experience of many general aviation pilots who are currently flying with their GPS systems.[34]

Added to this mix is the fact that no guidelines exist as to how a flight instructor is to train a general aviation pilot on the use

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> balance,] and more. Print a trip kit with the flight log, NavData charts, and other reports for the cockpit. Plus, FliteStar can get your weather briefing, display free weather graphics and file your FAA flight plan with DUATS. FliteMap includes all of FliteStar's features, and adds real time moving map technology with WAC, approach, and NavData charts. FliteStar and FliteMap, the brightest stars on your horizon.

AOPA PILOT, Nov. 1996, at 109.

[34] These assertions were confirmed by my telephone interviews with Cole, Cato, and Baker, *supra* note 3.

of the GPS and its related products.[35] There is also a noticeable lack of uniformity in the basic programming and use among all

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[35] *Id.* A brief discussion of the general aviation flight training industry and, more importantly, the material relating to GPS that flight instructors must teach is appropriate here. A student seeking flight training may hire a flight instructor who essentially operates as an independent contractor, generally under 14 C.F.R. pts. 61 & 91, or may enroll in a flight school that operates under 14 C.F.R. pt. 141. *See, e.g.*, 14 C.F.R. § 61.39(2) (noting that as a prerequisite for a flight test, the applicant must merely have "the applicable instruction . . . prescribed in this part"). The FARs do not dictate that the instruction must be given through a certificated flight school, only that the flight instructors hold the pertinent certifications for what they are teaching. For example, a student seeking a private pilot certificate must receive ground and flight instruction from an "authorized" instructor. *See id.* §§ 61.105, 61.107. And in turn, any flight instructor who is a "holder of a flight instructor certificate is authorized, within the limitations of that person's flight instructor certificate and ratings, to give" all of the training the student needs to apply for that private pilot certificate. *Id.* § 61.193. Essentially, the only benefit, from a regulatory-requirements standpoint, that a student receives from attending a certificated flight school as opposed to using an individual flight instructor is that some of the aeronautical experience requirements are considered fulfilled without a specific showing of experience if the student presents to the flight examiner, for the purposes of taking the flight test, a graduation certificate from the flight school within a specified number of days after graduation. *Id.* § 61.71.

Furthermore, Part 61 of the Code of Federal Regulations "prescribes the requirements for issuing pilot and flight instructor certificates and ratings, the conditions under which those certificates and ratings are necessary, and the privileges and limitations of those certificates and ratings." *Id.* § 61.1(a). Part 91 "prescribes rules governing the operation of aircraft . . . within the United States . . . ." *Id.* § 91.1(a). Finally, Part 141 "prescribes the requirements for issuing pilot school certificates, provisional pilot certificates, and associated ratings and the general operating rules for the holders of those certificates and ratings." *Id.* § 141.1. The pertinent sections from these Parts provide that students will receive flight planning and navigation instruction appropriate to the certificate sought by the student. *See, e.g., id.* § 61.107(a)(7) (a student seeking private pilot certificate must receive instruction and be judged competent in "[c]ross-country flying, using pilotage, dead reckoning, and radio aids"); *id.* § 61.65(c)(2) (a student seeking instrument rating must receive and be judged competent in "IFR navigation by the use of the VOR and ADF systems"); 14 C.F.R. pt. 141, app. C(3)(b) (flight schools must design training curriculums offering instrument rating courses to teach "IFR navigation by the use of VOR and ADF systems, including time, speed and distance computations"). However, none of these Parts specifically addresses the training or use of GPS and its related technologies. The only place a student might receive a formally designed course of instruction on the use of GPS that has been nominally reviewed and approved by the FAA is at flight schools having such instruction in their normal training syllabus outlines, which are filed with the FAA in order to receive approval as an FAA certified flight school. *See* 14 C.F.R. §§ 141.51-.57. In other words, regardless of whether students are taking courses from a flight instructor who is an independent contractor or from a certified flight school, they will not encounter any specific training on GPS and its related technologies that has been prescribed by the FARs.

of the various makes and models of GPS units currently on the market.[36] The FAA and AOPA are to be commended for offering relatively generic training programs to the general aviation community relating to the use of GPS.[37] But even these programs are relatively short and simple seminars. Because there are so many makes and models of GPS receivers currently available—each with its own unique user interface—it is extremely difficult to create a mass seminar program to properly teach the subject to a broad range of pilots. Moreover, while some members of the aviation software industry are introducing products that attempt to make the pilot-GPS interface more user-friendly,[38] there is still a wide variety of interface methods accompanying the numerous GPS models on the market. But the FAA, in conjunction with organizations such as AOPA and other members of the aviation industry, have begun to take bigger steps to address this problem.

For example, on March 6, 1996, the Challenge 2000 Subcommittee of the Federal Aviation Administration Research, Engineering, and Development Advisory Committee released its

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[36] These assertions were confirmed by my telephone interviews with Cole, Cato, and Baker, *supra* note 3.

[37] Roger Baker, FAA's Manager of Aviation Safety Programs, noted during our interview that the primary focus of the FAA's safety and training programs has been to provide at least some basic training on the generics of the GPS, but that the programs have been hampered to some extent by the wide range of interfaces available from all of the different types of units on the market. Telephone Interview with Baker, *supra* note 3. One magazine reporter wrote an article discussing the advent of GPS in general aviation cockpits primarily to introduce an AOPA seminar entitled *GPS—Magic Box or Pandora's Box?*, a program that "explains what GPS does, how it can be used, and [how] it presents some potential pitfalls." Bruce Landsberg, *The GPS Learning Curve*, AOPA PILOT, May 1996, at 111.

[38] For example, in the fall of 1996, *AOPA* opened a short article as follows:

> Hate the heads-down time, multiple keystrokes, and user-hostile methodology of conventional, pedestal-mounted flight management systems? You're not alone. For the past 5 years, Honeywell Inc.'s Business and Commuter Aviation Systems group has listened to focus groups in the pilot community, FAA, NASA, and aviation industry for ideas on how to improve the quality of the human-avionics interface. The result is Honeywell's new Primus Epic avionics suite, which promises nothing short of a revolutionary change in the way pilots manage cockpit information.

Thomas A. Horrel, *Honeywell's Primus Epic: The Point & Click Cockpit*, AOPA PILOT, Nov. 1996, at 40.

report to FAA Administrator, David R. Hinson.[39] Led by various members of the aviation community, the charge of this subcommittee was to "re-examine the agency's fundamental approach to its' [sic] certification function and its future operation."[40] Section II of this report addresses the impact of new technologies on various aviation systems and disciplines, and a portion of this section provides an analysis of the interrelationship between these technologies and human factors engineering.[41] Among other things, this report notes that the FAA should "investigate full, simulator based, human factors studies of the many and subtle interactions between pilots, aircraft instruments and displays, air traffic controllers operating in the [Air Traffic Management] mode, and the effects of their displays."[42] The report also takes note of advancing hardware technologies such as "heads-up" displays and flat panel displays.[43] "Both of these commercial technologies will be particularly important as the general aviation fleet faces the prospect of dealing with a [GPS] environment [that] can offer enhanced safety and simplified flight operations through effective presentation of massive amounts of image data to flight crews as well as other information."[44] The FAA has also taken other steps to address the problems associated with the advent of GPS.

The FAA has actively participated in and shared the funding for the Advanced General Aviation Transportation Experiments program (AGATE), although the continuing vitality of this program is uncertain.[45] AGATE "brings together the U.S. Government, NASA, industry and aviation organizations to develop technologies [that] can be incorporated into future [general aviation] aircraft, making them easier to fly and operate and, therefore, more attractive to potential pilots."[46] This program holds significant promise in finding ways to make a general aviation pilot's utilization of GPS a safer proposition.[47]

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39 *See* REPORT OF THE CHALLENGE 2000 SUBCOMM. OF THE FAA RESEARCH, ENGINEERING AND DEVELOPMENT ADVISORY COMM., FAA (1996) [hereinafter CHALLENGE 2000 REPORT].

40 *Id.* at i.

41 *See id.* at 35-40.

42 *Id.* at 24.

43 *See id.* at 29.

44 *Id.*

45 *See* Karen Walker, *FAA Closes Account on AGATE Programme*, FLIGHT INT'L, Apr. 3, 1996.

46 *Id.*

47 Telephone Interview with Baker, *supra* note 3.

Finally, in 1995 the FAA formed the Situational Awareness for Safety Systems Requirements Team (SASSRT), as part of the Aviation Rulemaking Advisory Committee structure. When SASSRT was formed, it began to solicit "information from the aviation community 'concerning flight standards, and procedural applications based on advances in human factors, cognitive pilot decision making, computer and display technology, precision navigation, data link and aviation weather systems' . . . [with an eye toward] trying to develop a cockpit-oriented operating concept to improve the situational awareness of all pilots."[48]

In summary, the FAA, organizations such as AOPA, and various members of the aviation business community have begun to recognize and address the general aviation community's future problems with the implementation of GPS. But to date, there are still no clear guidelines from the FAA on how to adopt and train on these new systems. There are few detailed training programs offered by groups like AOPA, and the manufacturers and software designers are in the early stages, at best, of creating standardized, easy-to-transfer-between interfaces between the pilot and the GPS receiver. Thus, the comparisons and contrasts between the old and new ways of navigating currently represent the reality facing general aviation pilots who are adopting GPS. As a result, this raises the question of how the changes between the old and new ways will affect the behavior patterns of these pilots and their flight instructors.

4. *Possible Pilot and Flight Instructor Behavioral Changes with the Advent of GPS*

A comparison of the old and new ways of navigating general aviation aircraft leads to some interesting observations. First of all, note that the focus of navigating under the old way was really on preflight preparation—well before the aircraft ever left the ground. This process was time-consuming and sometimes required information that a pilot could only get while still on the ground. Furthermore, because of the lack of time and information that pilots might have once the flight departed, they had a tendency to place more emphasis on considering in-flight alternatives while still on the ground so that should the need arise during flight, the pilot would already have an idea of what to do,

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[48] *New ARAC Group Focusing on Improving Situational Awareness for Pilots*, WKLY. BUS. AVIATION, June 19, 1995, at 264.

instead of trying to come up with an alternate plan during the "heat of battle."

In contrast, the new technologies have shifted the focus of the navigating function to the "immediate" preflight planning and en route phases. Granted, some things have not changed. The regulations still require that the pilot review the appropriate data, such as runway lengths and the like, before each flight.[49] But the pilot can now command the flight planning computer to do all of the leg work with regard to picking the best route, making computations, and so on. Furthermore, some pilots may now be looking at the flight plan for the first time while sitting in the aircraft, loading it into the GPS right before starting the engine. If there are changes to the flight plan or more waypoints need to be loaded into the system during the flight, the pilot may spend a great deal of time programming the system while en route.[50]

Moreover, because the computer contains most, if not all, of the information needed by the pilot to make an in-flight change to the flight plan, and because most systems have emergency search functions informing the pilot of the nearest landing strip at the touch of a button, such factors (which were normally considered during the preflight phases under the old way) now might not receive nearly as much attention until the aircraft has departed and is well on its way. In other words, pilots now have the luxury of "disconnecting" from the planning and navigating functions of flying a general aviation aircraft to some extent, and various sources from the general aviation community tell me that this is actually what is happening on occasion. All of these observations, therefore, lead to the possibility of several different scenarios that could impact the liabilities facing pilots and the flight instructors who train them as the general aviation community moves toward the full-time use of GPS.

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[49] *See* discussion on preflight planning requirements *supra* part II.A.3.

[50] Consider the following quote from a recent article discussing the advent of GPS in general aviation cockpits: "An autopilot, or at least a wing leveler, can be awfully handy if you're in a hurry to launch and don't get the gizmo programmed before becoming airborne." Landsberg, *supra* note 37, at 111.

C. Possible Scenarios Resulting from the Implementation of GPS[51]

1. *Overall Positional Unawareness*

Contemplation of the old way of navigating and how it is being changed by the implementation of GPS and its related technologies raise a number of possible scenarios that might have an impact on the liabilities currently facing general aviation pilots and flight instructors. I will discuss three of these scenarios. I will call the first scenario "overall position awareness," or more aptly, "positional unawareness." This concerns the type of positional awareness that begins in the flight-planning room well before the wheels ever leave the ground. It is the cognition of where the pilot is in time and space that comes from the detailed drafting, review, and execution of a flight plan. As noted above, when the pilot has to pull out the charts and use the "raw data" to select the best route, it is the pilot's brain that is serving as the flight planning computer. As the flight progresses and determination of the pilot's position must be made by interpreting the VOR data, it is that pilot's brain that is serving as the navigational computer. Flight-planning laptops and GPS receivers now perform these functions infinitely better than the human pilot, but I fear that some important aspects may be lost in the process. As a recent *AOPA* magazine article noted, GPS "is capable of taking you anywhere on the globe and at virtually any altitude. It can route you straight through a hot restricted area, into communication airspace without a clearance, or directly into the side of a mountain while you *think* you are on approach."[52] This capability is exacerbated by the fact that pilots are trained to believe their instruments (even when their instincts tell them not to), and there is usually for good cause for that. But when you follow your GPS into the side of a mountain because you did not pay close enough attention to where you really were, all of the multiple benefits offered by the GPS become moot. This type of positional unawareness, then, might be generally characterized as simple inadvertence or carelessness. Another type of positional unawareness is misfeasance.

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51 I discussed and received general agreement on all of these possible scenarios during my telephone interviews with Cole, Cato, and Baker, *supra* note 3, and with various pilots and flight instructors in the general aviation community.

52 Landsberg, *supra* note 37, at 111 (emphasis in original).

The inadvertent positional unawareness that pilots may face can be, and, in most cases, probably will be, easily remedied by taking a few extra moments to look at and think about the flight plan or to take a little extra care in thinking about the aircraft's position instead of blindly following the computer's guidance. But because the GPS's capabilities are so incredibly powerful, there will be a great temptation to forego the flight-planning tasks to some extent, if not all together, simply launch into the wild blue yonder, and thus put complete faith in the GPS to get you there on its own. This scenario is not pure speculation. A flight-instructor colleague of mine recently described a trip that she took to South Texas. A fully qualified but relatively inexperienced pilot asked if she would like to go along for fun. Because she had no other flights scheduled for that day, my colleague arrived at the airport on the appointed morning and climbed into the airplane—already preflight planned and checked, according to the new pilot in command. As they headed south on their VFR flight plan, she observed that the pilot appeared to be using his hand-held GPS as the sole source of navigation. This worked fine until the unit died for some reason, and the pilot suddenly realized he was lost over Southwest Texas without a clue because he had neglected to bring the appropriate aeronautical charts and failed to pay attention to the computer's indication of where he was. That was when the flight instructor discovered, contrary to what she had been told, that the pilot had not really prepared for the flight, but instead had completely relied upon his GPS for all of the preflight planning and en route navigating chores. Being the good flight instructor she was, my colleague pulled the proper charts out of her flight bag. Eventually, they completed the flight and safely arrived at their destination. Discussions with other flight instructors and general aviation pilots indicate that this is not a unique occurrence.

An even more disturbing permutation of this situation deals with pilots who are not certified to fly in hazardous weather: VFR pilots. Arguably, one of the most dangerous things VFR pilots can do is to fly into weather conditions with which they are not trained to cope. Furthermore, while many, if not most, VFR pilots do not violate this prohibition merely because it is the correct and safe thing to do, a major reason why some VFR pilots do not fly into hazardous weather is because they cannot see the ground and, thus, cannot tell where they are. A GPS with a moving map display essentially solves this problem and, to

some extent, tempts some pilots to enter into conditions that they normally would not have entered pre-GPS, resulting in unhappy consequences. I, therefore, anticipate that instances of overall positional unawareness—comprised of both cases of misfeasance and simple inadvertence or carelessness—will increase with the advent of GPS technologies in general aviation cockpits. In fact, the advent of these technologies may give rise to another anticipated scenario.

2. *Immediate Situational Unawareness*

The second scenario that I foresee will be called the lack of immediate situational awareness, or situational unawareness. Of the three scenarios I am proposing, this is the scenario that has the greatest potential of actually occurring and the one that has already been actively recognized by various members of the aviation community involved in the implementation of the GPS technologies.[53] Quite simply, this scenario arises from the fact that "[p]ilots tend to be gadget freaks, and many enjoy the challenge of loading the navigation unit—sometimes to the detriment of other very important tasks, such as looking for other aircraft or maintaining altitude and heading."[54]

One of the first rules my instructors taught me when I began my flight training was *the* general rule of piloting: Aviate, Navigate, Communicate. In other words, before you worry about responding to the controller's radio call or making the required position report, first make sure that you know where you are. Before you worry about figuring out just where you are, make sure that you are simply flying the airplane. Furthermore, simply flying the airplane means not only maintaining positive control of the aircraft—keeping the right side up and the airspeed where you want it—but also knowing where your aircraft actually is in all three dimensions, knowing where you are going to put it next, and keeping an eye out for other air traffic. The proper balance among these factors depends on the particular situation: are you cruising along at 10,000 feet with the autopilot on, or are you at 2000 feet in a high-traffic area and at a relatively slow airspeed while configuring the aircraft for ap-

53 This is the type of scenario that is most likely to consistently re-occur (and probably already is consistently occurring) with the arrival of GPS in the general aviation cockpit, according to my interviews with Cole, Cato, and Baker, *supra* note 3. This is also the tenor of Landsberg's article, *supra* note 37, at 111.

54 Landsberg, *supra* note 37, at 111.

proach? Taking extra time to concentrate on the navigating and communicating functions rather than worrying primarily about "aviating" is more appropriate in the first situation than in the second.

But GPS-type technologies have a tendency to cause pilots to inadvertently change this rule around. Because these technologies are so powerful and so enticing to pilots, the strong temptation is to turn to and play with the magical boxes at the most inopportune times. As already observed above, this tendency can be exacerbated by GPS systems that are not intuitively obvious to operate or are functionally different to operate than systems that the pilot may have used on different occasions in a different airplane. Finally, this type of technology and the problems that it presents are relatively new to most general aviation pilots.

Please consider this tale: A captain for a major airline told me of a recent experience that he had while his First Officer was flying the approach to their destination airfield. When the tower cleared them to land on a different runway than they had planned, the First Officer stuck his head down into the cockpit and started to reprogram his flight-guidance equipment. Because it was a beautiful, clear day, and the airfield was in sight, the Captain suggested that the First Officer simply look out the window. The First Officer did and sheepishly continued the approach visually to an uneventful landing on the parallel runway. The First Officer technically did not do anything wrong. This story simply illustrates the pull that technology has over pilots, even when they absolutely do not need it. Consider also the Cali, Colombia crash where the pull and the inadvertent use of this type of equipment might have contributed to a highly trained and experienced flight crew flying an otherwise good commercial aircraft into the side of a mountain.[55] If this type of technology occasionally presents situational unawareness

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[55] *See, e.g.*, Ramon Lopez, *U.S. Safety Board Sees Need for Post-Cali Crash Modifications*, FLIGHT INT'L, Oct. 9, 1996, at 9 ("Columbian investigators ruled that pilot errors, reflecting poor pilot situational-awareness, were to blame for the crash into a mountainside at night."); G. Chambers Williams III, *FAA Promises to Keep People in Charge of Air Traffic*, FORT WORTH STAR TELEGRAM, Oct. 18, 1996, at A3 ("some have blamed [the Cali, Columbia crash] on the pilots' inattention to flying the plane while they were trying to solve a cockpit automation problem"). It is worth noting that the FAA has already begun to pay a great deal of attention to the same types of problems that are the focus of this Article, but in the commercial rather than the general aviation setting. For an interesting article that outlines these similar concerns in the commercial aviation world, arriving at

problems for highly experienced and intensely trained multiperson aircrews, imagine how new private pilots are going to perform when they first put their new GPS systems into their airplanes and head out toward heavily trafficked airports. The thought of this eventuality, and its attendant implications, leads to the third foreseeable scenario.

3. Flight Instructors' Failure to Teach

This third scenario deals not so much with a private pilot's interface with the GPS, but with the private pilot's interface with the flight instructor who is trying to teach the pilot how to use the GPS. For many years, the FAA's focus with regard to the training of private pilots has been very "hands-off." A simple review of the FARs shows that the FAA grants an enormous amount of discretion to flight instructors and flight schools on the actual hands-on facets of training student pilots. It only directly becomes involved at the end of the process when students take a written test and undergo an in-flight evaluation with an FAA evaluator or designated check airman, with a check-ride lasting perhaps an hour or so and providing only a snapshot of that pilot's actual capabilities with regard to the certificate being sought.[56] This system has arguably served the general aviation community very well, considering that there are currently many outstanding flight instructors and evaluators as well as safe and well-trained general aviation pilots. Part of this success is due to the relatively simple nature of the topics and technologies with which the general aviation community has had to deal to date;[57] it is not necessary, or preferable, to have a comprehensive, complex FAA-designed syllabus in place that instructors are required to use in teaching individuals the very basics of how to fly a Cessna 152.

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essentially the same conclusions and making the same type of recommendations, see David Learmount, *Unwanted Demands*, FLIGHT INT'L, Oct. 9, 1996, at 26.

56 Consider the discussion, *supra* note 35, on the basic requirements prescribed by the FARs for the training of flight students. These observations were confirmed during my telephone interviews with Cole, Cato, and Baker, *supra* note 3.

57 As Landsberg observes:

> "Instrument training devotes at least 15 hours of concerted practice on making peace with the electronics and learning to interpret the arcane displays of 40 or more years ago. GPS is a more versatile tool that will provide fabulous benefits—but, as in the case of the apple, there is a price to be paid. We have to learn how to use it."

Landsberg, *supra* note 37, at 111.

With the introduction of GPS, however, comes an entirely new level of complexity to the general aviation cockpit. The FAA currently provides no unifying guidance to flight instructors on either how to use this new technology or how to train pilots to use it.

More importantly, because of the ten-to-fifteen year transition time between using GPS as a secondary system and using GPS as the sole navigation system,[58] flight instructors who are training students now are faced with the question of whether or not to even train their students on its use at all. This dilemma will disappear as full implementation approaches, but until then, the dilemma is aggravated by the unavailability of training programs and a wide diversity of GPS-pilot interfaces due to the lack of standardization between makes and models of the units. How many different types of units must the instructor, or the student for that matter, learn in order to be "proficient" in the use of GPS? Who is going to provide all of the makes and models of these systems to the instructors so that they can learn each system? These types of issues appear to raise substantial barriers to the prospect of adequately training general aviation pilots on how to use GPS; yet, all the while, the full implementation of GPS as a sole source of navigation is rapidly approaching. For the next few years, it may be difficult for general aviation pilots to find flight instructors who have had the time and money to become proficient on GPS and who are able to pass that knowledge on to their students. Therefore, during this early phase of the transition to GPS as the sole source of navigation, flight instructors may not adequately train students on the use of GPS, partly because there is no incentive to do so—full implementation is at least fifteen years away—and partly because of all of the barriers that currently make it difficult to do so.

Overall, GPS and its related technologies promise to offer vast benefits to the general aviation community. But these technologies also promise to introduce some serious new problems to the community—at least until the transition to GPS is complete, the systems' use and training bugs are worked out, and everyone is competent on GPS to the level that they are competent on the old system today. It is these various problems that may poten-

[58] Horne, *supra* note 24, at 74 ("As it now stands, the FAA's implementation timetable has a target date of 2010. That's the year that we'll supposedly make the switch to an all-GPS navigation system.").

tially change the mix of liabilities currently facing general aviation pilots and their flight instructors.

III. THE LIABILITIES FACING PILOTS AND FLIGHT INSTRUCTORS, AND HOW THEY MIGHT CHANGE WITH THE ADVENT OF GPS

A. CURRENT LIABILITIES

1. *Pilots*

The liabilities that face general aviation pilots are governed generally by the law of negligence, except where modified by various state statutes.[59] Furthermore, general aviation is a highly regulated endeavor. A plaintiff asserting a claim for personal injury against a pilot must show duty, breach, cause, and harm, and may also be able to assert violations of the FARs to support these basic elements. Thus, under both the basic principles of negligence and the various FARs that govern general aviation flight,[60] pilots assume numerous duties whenever they commence a flight. For example, as pilot in command of an aircraft, the pilot is directly responsible for and is the final authority as to the safe operation of that aircraft. Furthermore, the pilot in command has a duty before each flight to "become familiar with all the available information concerning that flight, including weather conditions, airport conditions, alternate airfields, aircraft condition, the nature of the terrain over which he or she will be flying, and any pertinent information contained in the latest Airman's Information Manual, Advisory Circulars, and Notices to Airmen."[61] Other examples of the duties that a pilot assumes include: the general duty to operate the aircraft in a safe manner; the duty to see and avoid other air traffic when possible; the duty to not proceed into a known hazard, such as adverse weather; and the duty of reasonable care, both to their passengers and to other aircraft, which may be an objective duty that does not vary with a pilot's level of experience.[62]

2. *Flight Instructors*

The same basic principles that apply to general aviation pilots also apply to flight instructors in their roles as pilots. But "[a]

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59 WINDLE TURLEY, AVIATION LITIGATION 118 (1986 & Supp. 1993).

60 General aviation flight is primarily regulated under 14 C.F.R. pt. 91.

61 TURLEY, *supra* note 59, at 119.

62 *See id.* at 119-21.

flight instructor [also] takes on complete responsibility for the training of the student, the safety of the aircraft, plus the performance of the student while flying solo training exercises."[63] In other words, while flight instructors are in the aircraft with their students, they are not only ultimately responsible for the safe operation of the aircraft under all of the duties that apply to general aviation pilots,[64] but they may also be liable for improperly instructing students or for inadvertent actions such as giving a student an unsafe aircraft for solo flight.[65] But the common wisdom is that this second instructor-liability chain severs once the students take their flight test and become certified pilots. For example, G. Val Tollefson, in a paper prepared and presented to the 1996 SMU Air Law Symposium, argued persuasively that the liabilities facing flight instructors vis-à-vis their students, which are based primarily on the concept of educational malpractice, should terminate once the students have received their certificates.[66] Essentially, flight instructors confront not only the same types of liabilities challenging general aviation pilots, but also higher levels of liabilities related to their role of teaching those pilots. These liabilities arguably vanish, however, once the students receive their certificates. The question then is how the implementation of GPS might affect all of these various liabilities.

B. Possible Liability Changes

1. *Pilots*

The *types* of liabilities currently facing general aviation pilots will not change significantly with the implementation of GPS. Pilots will still have a duty to adequately prepare for the flight and to execute that flight in a safe manner. But the amount of liabilities, or the *number* of violations of the same basic duties, has the potential to significantly increase with the advent of GPS in general aviation cockpits. As a vehicle to justify this premonition, I would like to borrow some concepts from a law review article written by Professor Mark F. Grady in 1988.[67] At the risk

63 V. Foster Rollo, Aviation Law: An Introduction 200 (3d ed. 3d prtg. 1989).

64 *See id.* at 200; Turley, *supra* note 59, at 128.

65 *Id.* at 129.

66 *See* G. Val Tollefson, *Flight Instructor Negligence: Does This Tiger Have a Tail?*, 1996 SMU Air L. Symp., Feb. 29, 1996, at 7-9.

67 Mark F. Grady, *Why Are People Negligent? Technology, Nondurable Precautions, and the Medical Malpractice Explosion*, 82 Nw. U. L. Rev. 293 (1988). The professor

of oversimplification, Professor Grady's article is an attempt to suggest a valid model for explaining the significant increases in medical malpractice litigation during the 1980s. More generally, the article discusses the impact that increases in technology have on the tort-liability mix.

Two aspects or observations from the article help to illustrate why it is particularly pertinent to the present discussion on the possible changes in the liabilities facing pilots. First, Professor Grady notes that while human beings have medically treated other human beings for many years, it has only been within the relatively short time frame of the last 100 years that significant, technologically based strides have been swiftly made in improving medical treatment.[68] In a similar vein, while humans have been engaged in some form of air navigation since the first hot air balloon left the ground, it has only been in the last ten or fifteen years that significant, technologically based strides have been made toward improving the ability to accurately and quickly perform this navigation.[69] Second, Professor Grady uses, *inter alia*, empirical data from the aviation industry in support of his own arguments dealing with the effect of technological increases on the liabilities confronting medical doctors.[70] This use of data tends to support the notion that because his arguments are based, at least in part, on happenings in the aviation industry, his conclusions might also be applicable, at least in part, to potential changes in the aviation industry. Therefore, to the extent that Professor Grady's article presents one model for analyzing how increases in technology *changed* the liabilities facing medical doctors, his article also provides a model for analyzing

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opens his article by noting that "[n]egligence law is fundamentally a creature of technology; really, it is the common law's response to technology. Advances in technology can easily cause corresponding increases in the number of negligence claims. Revolutions in an industry's technology will often impose tremendous new loads on the negligence system." *Id.* at 293.

68 *See id.* at 293, 296-300.

69 In fact, one author noted:

> Ordinarily, aviation technology proceeds at a cautious pace, at a speed befitting the conservative approach that safety demands. But since 1990, when GPS receivers hit the market en masse, this nifty new way of going from A to B has shaken up the avionics industry, the FAA, the airspace system, and users alike in ways that haven't occurred since the advent of ATC radar in the 1950s.

Horne, *supra* note 24, at 73.

70 *See* Grady, *supra* note 67, at 328-31.

how current increases in air navigation technologies *might change* the liabilities facing general aviation pilots.[71]

Professor Grady opens his article by offering observations that provide a basic framework for his ensuing arguments. Grady notes that patients used to frequently die from kidney disease and the doctors who treated them were not considered negligent because there was no effective treatment for the malady.[72] But with the advent of kidney dialysis, these same doctors now might be considered negligent where they once would not have been. "The very effectiveness of new medical technology increases potential liability, because it creates the possibility that someone will negligently deprive the patient of what is now a substantial benefit."[73] Furthermore, actual liability can also appear more frequently in the modern era. While older medical procedures probably required less physician advertence or care, the modern patient may be attached to a multitude of medical devices giving a doctor an enormous amount of technological data to monitor and a greater need for advertence.

> Negligence—trespass on the case—increases because these machines round up the mustang risks of disease and domesticate them. Once technology tames disease, there can be relentless legal problems if [the doctor] momentarily forgets what he is doing. The reason is that negligence law does not forgive inadvertence, even reasonable amounts of it.[74]

In other words, the gravamen of Professor Grady's article is that increases in technology can increase the occurrence of negli-

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71 Professor Grady's article is not the only one to address the relationship between changes in technology and related changes in tort liability (although it appears to be the one that presents analysis most analogous to the subject of this Article). In fact, his article has generated some scholarly comment touching on the subject. For articles generally supporting Professor Grady's conclusions, see Donald N. Dewees et al., *The Medical Malpractice Crisis: A Comparative Empirical Perspective*, 54 LAW & CONTEMP. PROBS. 232, 233-35 (1991); Joseph Sanders & Craig Joyce, *"Off to the Races": The 1980s Tort Crisis and the Law Reform Process*, 27 HOUS. L. REV. 207, 246 (1990). For an article that respectfully disagrees with Professor Grady's conclusions, see Paul J. Heald, *Mindlessness and Nondurable Precautions*, 27 GA. L. REV. 673 *passim* (1993). For an article that approaches the entire subject from a different angle—focusing on the actual effect of new technologies, such as birth defects from new drugs versus changes in liabilities from the use of new technologies—and that argues what the new tort-liability mix should be, see Mary L. Lyndon, *Tort Law and Technology*, 12 YALE J. ON REG. 137 *passim* (1995).

72 Grady, *supra* note 67, at 297.

73 *Id.* at 294.

74 *Id.* at 294-95.

gent behavior. Because this type of negligent behavior is not excused by the courts, the increase in the occurrence of technology-induced negligent behavior gives rise to an increase in litigation resulting from that behavior. The detailed and scholarly analysis that Professor Grady uses to justify these conclusions is beyond the scope of this Article, but his basic methodology and terms are useful in prognosticating on how the implementation of GPS might affect pilots and flight instructors.

The professor notes as part of his analysis that technologies can create various types of risks. That is, there are risk-transferring technologies, risk-dumping technologies, and risk-loading technologies.[75] Furthermore, one type of technological advance can create each of these different types of effects.[76] Consider the manufacture and sale of a new model of automobile. To the extent that the new automobile simply replaces older models already on the road, the accompanying risks are simply transferred from the old model to the new one. To the extent that the model adds features making it much safer to operate or increasing the chances of survival should an accident occur, the new car is a risk-dumping technology. This same model might also encourage more people to buy a car and add to the traffic on the local highways, or it might include various features that require more, or more complex, periodic maintenance. In this sense, the model is a risk-loading technology because there are more chances for negligent behavior due to more people being on the road or to more potential maintenance problems accompanying the new car.

This analysis transfers easily to the advent of GPS in general aviation cockpits. To the extent that GPS is merely another method of navigating an aircraft via an external positioning source, or to the extent its related technologies merely provide another method for preflight and en route flight planning, GPS and its technologies are risk-transferring in nature. To the extent that GPS can more accurately, quickly, and safely determine the aircraft's position, or to the extent that its related technologies can more quickly and safely provide a flight plan, GPS and its new technologies are risk-dumping in nature. Finally, to the extent that (1) these technologies increase the complexity of the pilot's chores in the cockpit (thereby diverting attention away from the basic flying of the aircraft), (2) they induce pilots

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[75] *See id.* at 296-98.

[76] *See id.*

to reduce the care they take in preflight planning or en route execution of those plans, or (3) the pilot fails to properly learn to use, or the flight instructor fails to teach, a technology that promises to be a risk-dumping system, these new technologies are risk-loading in nature. Thus, this analysis explains why the new GPS technologies can increase the potential for negligent behavior, but it does not explain why this increase would necessarily increase the amount of litigation related to the behavior.

Professor Grady proposes a theory that explains this tie between changes in technology and changes in liability, or litigation resulting from that liability, by noting that technological increases can create the need for two types of precautionary behavior: durable precautions and nondurable precautions.[77] For example, the creation of a smoke detector can be viewed as a durable precaution[78] because once the technology is created and a reasonable person installs it, the smoke detector would passively sit and wait to sound its alarm should a fire occur. If any individuals fail to install a smoke alarm, they might be considered negligent for not doing so.

This same smoke alarm also creates the need for nondurable precautions. Depending on the make and model of the smoke detector, the same individuals who placed the detector in their homes or businesses have the active duty to occasionally change the smoke detector's batteries or test its functions. A failure to perform these necessary functions on even one occasion could also be considered negligence, notwithstanding all of the times in the past that the individuals repeatedly remembered to perform those functions. Utilizing Judge Learned Hand's famous equation on the assessment of negligent behavior, Professor Grady then posits that because the courts do not discount for the relatively high cost of having to repeatedly remember to perform these nondurable precautions, the existence of these precautions basically amounts to a form of strict liability on the part of the smoke detector's owner. The first time that the owner forgets to change the batteries over any period of time and a fire occurs, the owner will be liable, regardless of how many times in the past the owner remembered to change the batteries.[79]

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77 *Id.* at 299.

78 For other examples of durable precautions, see *id.* at 301.

79 This summation is a very basic recounting of Professor Grady's theoretical propositions and analysis, but it conveys, in a nutshell, the gist of his thoughts and justifications. For a full analysis of his position, see *id.* at 299-310.

Most significantly, note that this smoke detector can act as both a risk-dumping and a risk-loading technology. To the extent that the detector increases the chances of surviving a fire, it is a risk-dumping technology. But to the extent that it increases the chances of inadvertent behavior, such as failing to install a smoke detector or forgetting to change the batteries, it is a risk-loading technology. Furthermore, note that some of the behaviors that give this new technology its risk-loading nature are also the types of behavior that constitute nondurable precautions—precautions that effectively impose strict liability on the actor. Therefore, if the advent of smoke detectors increases the chance that people will forget to change the batteries in those smoke detectors, it also increases the chance that the smoke detector owners will essentially be held liable *per se* by the courts for failing to change those batteries. With the advent of a new technology, there are more things that you might do wrong because more things may be required of you. As a result, there are more ways you may be held liable for inadvertence or misfeasance.

Applying these concepts to the present setting leads to the following possible scenario. If certain manufacturers create a new technology that dramatically increases the ability of pilots to safely and accurately navigate the aircraft and that will soon become the sole source of navigation available to pilots, then arguably the pilots are under a duty to install the technology—a new durable precaution—in their aircraft. Failure to utilize this risk-dumping technology may be a form of negligent behavior. Along with this durable precaution also comes a number of nondurable precautions—precautions that are also risk-loading in nature. Pilots must learn to properly and continuously use this new technology. For example, pilots must remember to keep an eye out of the cockpit, meaning they must aviate first and navigate second, rather than the reverse. They also must not surrender to the temptation of allowing the new technology to do all of the preflight or en route planning without paying close attention to the validity of the plan that the computer spits out; an accurate and fast plan does not do much good if it directs the aircraft into a mountainside.

In summary, GPS promises to offer to general aviation pilots substantial benefits from new systems that serve as both risk-dumping technologies and durable-precaution technologies. But these new systems can also be technologies that are risk-loading in nature, increasing the amount of nondurable precau-

tions confronting the pilot. The combination of the two—an increase in risks tied to an increase in the chance of being held liable for those risks—leads to the conclusion that the advent of GPS and its related technologies will give rise to a potential increase in the liabilities facing the general aviation pilots using those technologies. But what of the flight instructors who will train these pilots?

2. *Flight Instructors*

Flight instructors, in their capacities as pilots in command of the aircraft in which they are training their students, arguably encounter, for the same reasons, the same types of liability changes challenging general aviation pilots. But, as already noted, flight instructors have to deal with additional liabilities—liabilities resulting from how they train pilots—that go beyond the basic liabilities discussed previously. Furthermore, while GPS's risk-loading aspects will not change merely because the operator is an instructor (users must still remember all of the pertinent nondurable precautions whether they are pilots or flight instructors), another risk-dumping aspect of GPS might impose a different aspect of heightened liability on instructors. If instructors have a new tool—one that although not yet required but that could make significant strides in increasing the safety of their students—would not the instructors be negligent for failing to use or teach this durable precaution? This question, in turn, raises another one: how does this theory of instructor negligence mesh with the theoretical basis that is usually discussed in the context of possible flight instructor liability resulting from educational malpractice?

For the sake of argument, consider companion articles recently published by the *Cleveland State Law Review* that debate in detail the reasons for and against a court's adoption of educational malpractice as a cause of action available to plaintiffs in general.[80] One article by Frank Aquila opposed this imposition of educational malpractice, listing several policy reasons why it would be difficult, if not improper.[81] But question whether

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[80] *See* Frank D. Aquila, *Educational Malpractice: A Tort* En Ventre, 39 CLEV. ST. L. REV. 323, 342-50 (1991); Johnny C. Parker, *Educational Malpractice: A Tort Is Born*, 39 CLEV. ST. L. REV. 301, 314-20 (1991). For more analysis on the subject, see also Ryland F. Mahathey, Comment, *Tort Law: Can an Educator Be Liable for a Student's Failure?; The Tort of Educational Malpractice*, 34 WASHBURN L. J. 147, 166-72 (1993).

[81] *See* Aquila, *supra* note 80, at 342-50.

these policy reasons are valid in discussing the possibility of a plaintiff's imposing an educational malpractice claim against instructors who either did not teach the use of GPS to their students or who improperly taught that usage. Aquila's article first notes that educational malpractice should not be a cause of action because the courts have not been able to define a standard of care for the general education of students that could create a legally recognized duty.[82] In other words, how does one define a unified standard of care regarding the broad spheres of knowledge that grade school teachers from all around the state or the nation regularly impart to their students? But consider this argument in light of a heavily regulated aviation industry, complete with practical test standards and biennial flight review standards that clearly prescribe the proficiency a student must have before showing up for the flight evaluation or before the flight instructor signs the pilot's log indicating the requisite proficiency under the FARs.[83] Do these standards effectively form a unified, easily definable standard of care? Of course, as noted above, there are no standards right now specifically addressing the use or training of GPS; therefore, this argument becomes somewhat moot.

Aquila's article next notes that courts do not allow educational malpractice claims in part because they do not wish to interfere with educational policy making.[84] "Courts have great difficulty determining what is the proper exercise of professional judgment and what is a negligent educational act because educational policies have historically been developed locally."[85] Like the first justification, this argument loses some force in the context of flight instructors teaching under a national set of guidelines and performance criteria, namely the FARs and the flight evaluation criteria.

Third, Aquila's article concludes that "[t]he basic reason that courts have refused to recognize an educational negligence tort is that it is difficult for the plaintiff to establish the school system as the sole or proximate cause of the injury."[86] Aquila also ob-

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[82] *Id.* at 343.

[83] Part 61 of the FARs provides the training and currency requirements that each individual must demonstrate in order to take a flight test or maintain currency. *See* 14 C.F.R. pt. 61. For a discussion of the various FAR provisions that apply to the training of general aviation pilots, see *supra* part II.A.3.

[84] Aquila, *supra* note 80, at 344.

[85] *Id.* at 344.

[86] *Id.*

serves that proximate cause is almost always difficult to establish and is simply one of the burdens that plaintiffs must bear in putting on their case.[87] Moreover, if the situation dictates narrowing the issue to whether or not the instructors taught the use of GPS at all, rather than the more general issue of how well they taught the subject, does not the change in focus potentially reduce the difficulty in establishing proximate cause?

Fourth, Aquila declares that "[a] key reason which courts have given for not recognizing the tort of educational malpractice is that there are administrative remedies within the school system for aggrieved parties."[88] Notwithstanding the fact that there are no administrative remedies available to private personal-injury plaintiffs who claim to be injured because of a flight instructor's alleged negligence, this policy reason arguably loses impact when the nature of the claim is for personal injury or death as opposed to an allegation that a person receiving a diploma cannot read it.

Finally, Aquila states that another reason that courts have been reluctant to allow educational malpractice claims is the fear of a subsequent flood of litigation that the schools would encounter.[89] Whether this same risk would transfer to flight instructors, where a significant number of flight instructors are essentially independent contractors with little financial means or insurance policies guarding against liability, is debatable. Aquila concludes with the interesting statement that there "is a more powerful argument supporting the recognition of educational malpractice: the people may want it recognized."[90] Consider whether general aviation pilots might become disaffected to some extent with flight instructors who are not teaching them what they need to know about GPS, especially in light of its impending implementation.

Notwithstanding this analysis of educational malpractice policies in the general context, a symposium article by G. Val Tollefson, specifically addressing the potential liability of flight instructors, offers some compelling reasons unique to aviation as to why this liability should not be expanded to include educational malpractice causes of action.[91] For example, after noting that the FARs provide detailed standards for flight training, li-

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87 *Id.* at 344-45.

88 *Id.* at 345.

89 *Id.*

90 *Id.* at 355.

91 *See* Tollefson, *supra* note 66, at 23-24.

censing, and postlicensing performance by pilots, Tollefson posits, "If courts begin monitoring flight schools by creating a special claim for educational malpractice in this area, they will usurp functions and powers which Congress has chosen to give to the FAA."[92] (Of course, the fact that the manufacture and certification of aircraft themselves are highly regulated by the FAA has apparently not stopped aircraft makers from being sued under basic negligence and products liability claims.)

Tollefson also notes that some of the general policy arguments against the courts' adoption of an educational malpractice claim, such as those previously discussed, apply with equal force to flight instruction.

> There is an acceptable degree of latitude in teaching methods for pilots. It would be nearly impossible for pilots to prove that a gap in their knowledge was caused by improper teaching rather than inattentiveness or forgetfulness. Since there is no accepted standard of care, and no way to prove proximate cause, a former student's claim should not be permitted.[93]

Tollefson's arguments are strong, and they are further enhanced by the nature of the specific issue addressed here—the implementation of GPS.

While it may be difficult to show that a flight instructor failed to adequately teach those basic skills that have existed (and are now well documented) since the dawn of powered flight—basic concepts such as how to fly the airplane with stick and rudder—it is arguably much more difficult to teach that which has not been condensed to final form. Although the FAA has been offering generic training on the concepts behind GPS, and AOPA has seminars on the operations of some specific makes and models, about the only training information available to pilots regarding their new GPS receivers is the documentation that comes with it. While inducing military or commercial pilots to study such documentation is relatively easy in part because they are paid for doing so, there is no such incentive for general aviation pilots. Once general aviation pilots buy their units, it is up to them to decide how well to read the material and to learn it. Beyond the pilot's desire to learn, there is not much a flight instructor can do to provide further incentives. Furthermore, if the pilot makes an appointment for a flight check or asks a flight instructor for a biennial flight review and shows up with

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[92] *Id.* at 23.

[93] *Id.*

an airplane that does not yet contain a GPS receiver, how can the evaluator or instructor be held accountable by the plaintiff for the pilot's not knowing how to use a GPS? In other words, until GPS becomes the only method of instrument air navigation, there will be pilots who simply can circumvent the system through no fault of the evaluator or the instructor.

Within this context, it is hard to envision the courts' extending educational malpractice claims to flight instructors. Many policy arguments, and the current realities of the system, strongly weigh against such an imposition. On the other hand, due to the unique nature of this area of training and education, many of those policy arguments lose at least some of their force when the inquiry focuses on whether the student received any education on the use of GPS during this nebulous period when the sole use of GPS is not yet required but is looming on the horizon. My guess is that this is the most vulnerable chink in the flight instructor's armor with respect to the imposition of additional liabilities due to the implementation of GPS and its related technologies. This guess also ends my analysis of the liabilities that may face general aviation pilots with the advent of GPS. The next question is what can be done to reduce the chances that this increase in liabilities will occur?

IV. RECOMMENDATIONS

A. The FAA: Maintain and Enhance Steps Already Taken

Although the FAA has already taken steps to deal with the potential problems just addressed, I suggest that the FAA might do more.

Pilots need a special "sign-off" from a properly trained flight instructor to fly and land tail-wheel airplanes because there are unique aspects to controlling those airplanes that suggest a little extra and specific training might be a good idea.[94] Pilots who wish to satisfy the "currency" requirement under the FARs to fly in instrument flight conditions must fly and record a certain amount of instrument time and a certain number of practice instrument approaches every six months in order to legally fly into the clouds when they really need to. In the alternative, these same pilots may receive an instrument review and sign-off from a properly trained flight instructor to qualify. This is because there are certain aspects of flying in the weather that re-

[94] 14 C.F.R. § 61.31(g).

quire a little extra training and on-going practice.[95] All pilots wishing to maintain proficiency under the FARs to fly in any kind of weather must perform a "biennial flight review" with their flight instructors, including a certain amount of time on the ground to review various subjects and enough time in the air to demonstrate basic proficiency in flight because the FAA recognizes that on-going training, as a minimum, is necessary to keep pilots basically safe in operating their aircraft.[96]

If GPS represents a sea change in the complexity facing pilots who fly from point A to point B, it makes sense to draft some basic regulatory language, or even some nonregulatory recommendations, stating that pilots who want to use this technology must receive a minimum amount of initial and on-going training. Furthermore, if these pilots are required to have this training, then there is an incentive created for flight instructors to go out of their way and learn how to use the various systems as soon as possible in order for the pilots to rely on them for the necessary training. I realize that suggesting the FAA draft more regulations will be an anathema to many in the general aviation community, and I am largely in agreement with that feeling. But as nicely stated by one cliché, an ounce of prevention now may be worth a pound of cure later. My experience as a professional pilot tells me that sometimes a well-drafted and narrowly tailored rule can go a long way toward making a particular operation significantly safer than it would be without the attention. I also realize that this might sound like a simplistic recommendation, but I do believe that it will be, if narrowly taken, a step in the right direction. The drawbacks of having to deal with some new training requirements now might save the anguish of having to deal with a lot of legal, and possibly funeral, costs later.

B. The General Aviation Community

Of even more importance, and providing even more potential benefit than any possible governmental intervention, the general aviation community itself needs to take steps to deal with potential increases in the liabilities facing pilots and flight instructors. AOPA has already taken the lead in making this happen by providing programs such as GPS training seminars. Furthermore, some members of the manufacturing and software design communities have taken steps to make their

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95 *Id.* § 61.57(e).

96 *Id.* § 61.56(c).

products more user-friendly and more interchangeable between different cockpits. These entities should be highly encouraged to continue along this path. They should explore ways to appropriately expand such training programs, to work with each other to engender the proper amount of standardization between the various navigation products, and to consult with the government on the proper regulatory steps to be taken to ensure that pilots and flight instructors participate in appropriate training on the use of the new technologies. Finally, and perhaps most importantly, the individual members of the community themselves must make the effort to really learn how to use these new systems and not succumb to the temptation to learn "on the go" in high-traffic-area airspace.

C. The Aviation Law Community

Part of the incentive for members of the general aviation community to actively learn how to use these new technologies must come from members of the aviation law community who realize the potential legal impact of misusing these products. Pilots and flight instructors need to be informed and understand that the misuse, either through simple carelessness or actual misfeasance, of these technologies might not only lead to harm to themselves but also to enormous legal ramifications. Having this knowledge might provide a further incentive to these pilots to receive adequate training and actually use that training, thereby reducing the possibility that legal liability and litigation will increase.

V. CONCLUSION

All of these recommendations, and the discussion from which they were derived, can be wrapped up in one word: training. The advent of GPS promises great strides in making the general aviation skies much safer than they currently are. But this advent also promises to cause a great deal of harm if the technology is used incorrectly, carelessly, or possibly not even used at all. The government and the general aviation community, therefore, need to continue to work together on identifying the problems that the advent of GPS will generate for general aviation pilots and flight instructors. They need to define appropriate measures to provide the proper training for pilots and instructors to deal with these problems. The aviation law community needs to educate pilots and instructors on the possible ramifications of their failure to gain and use this training. Fi-

nally, pilots and flight instructors themselves must take on the task of absorbing all of this information and putting it to good use. Thus, these recommendations offer one way of helping to make the implementation of GPS a truly beneficial endeavor for the general aviation community.

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