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Designing a Defined-Contribution Plan: What
to Learn from Aircraft Designers

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PERSPECTIVES

Designing a Defined-Contribution Plan: What to Learn from Aircraft Designers

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*What we call the beginning is often the end
And to make an end is to make a beginning.
The end is where we start from.*

—T.S. Eliot, "Little Gidding,"
Four Quartets (1942)

Why are pension plans not designed in the same way as commercial aircraft? At first blush, this question might seem a strange one to ask. It is also, however, an instructive one, and many similarities exist between the two things. Given the astounding success of aircraft design over the last century, we show that designers of pension plans have much to learn from aircraft designers.

This article spells out these lessons by using the framework of designing a commercial aircraft to illustrate how a personal defined-contribution (DC) pension plan should be designed if it is to achieve its objective of delivering an adequate and secure pension to the retired pension plan member. Understanding the process of designing an aircraft can greatly enhance one's understanding of how an optimal DC pension plan might be designed and can considerably simplify the task of the pension plan trustees, sponsoring employers, and regulators who oversee personal DC pension plans.¹

Fasten Your Seat Belt: Lessons from the Aviation Industry

All journeys begin at the end. When we plan a journey, we know where we want to end up. The

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airline flying us there also needs to know this information because it needs to use an aircraft capable of reaching the destination and to ensure that the aircraft has enough fuel to get there. It also needs to know when we wish to reach our destination. The airline gives us some other choices that we might consider important, such as the class of service and the quality of food. But these choices, although perhaps important to us, are not really important to the airline, whose paramount concern is to get us to our destination safely—and the key word here is "safely." Safety trumps everything else: The best possible food and service will not compensate much for a crash landing. Risk is the critical issue in the design of any commercial aircraft.

In the beginning, commercial flight was quite risky, with many accidents and a lot of experimentation with new designs. But passengers demanded safety, and aircraft manufacturers and airline companies were soon able to give it to them. According to Boeing, in 2006, the accident rate on scheduled passenger airlines was 0.89 per 1 million departures. This statistic would seem to indicate that air travel is safe; compared with other modes of transport, it is very safe indeed. For a British citizen, for example, flying is 30 times safer than driving a car, about 550 times safer than walking, and nearly 800 times safer than riding a motorcycle.² Indeed, one could argue that by far the safest way to travel is by air, and the reason it is so safe is that aircraft designers have had to overcome passengers' understandable fear of their aircraft's crashing. Airline passengers can quickly figure out whether they are using a safe means of travel.

This thinking led to something quite remarkable: Aircraft manufacturers soon started building very similar aircraft with almost identical safety

standards. Sitting inside a modern commercial aircraft, one can scarcely tell whether it is a Boeing or an Airbus. If we close our eyes when listening to the safety announcement at the start of the journey, can we really tell whether the aircraft is being operated by Emirates or Qantas Airways? The main safety message is always the same: “Please fasten your seat belt.” That is about the only safety precaution a passenger needs to take.

This statement should come as no surprise. Given the trade-offs among aerodynamic efficiency, safety, and commercial viability, there are only so many ways to design an aircraft. Indeed, aircraft designers have become so successful in resolving these trade-offs that most passengers give safety barely a moment’s thought. In fact, passengers sometimes become impatient when their journeys are delayed because of safety issues.

Yet, a great deal of effort was expended to reach this point. Building a commercially successful aircraft requires advanced production processes, substantial research and development, and a highly trained and integrated workforce comprising workers from a variety of professions.

Having designed and built an aircraft, the manufacturer must persuade airlines to buy it. Any new aircraft chosen by a commercial airline must satisfy numerous criteria—including size, range, seating configurations, and cargo capacity—that depend on the airline’s routes and markets. The airline’s choice of aircraft ultimately rests on the manufacturer’s ability to deliver a safe and reliable aircraft that best meets the airline’s market requirements at the lowest cost and on the most favorable financing terms.

Traditional design methodology has concentrated on technical design that minimizes gross takeoff weight (GTOW)—the objective being to lower operating costs through reduced fuel consumption. Designing financially viable aircraft, however, is also important. This requirement calls for a multidisciplinary design optimization (MDO) approach that not only examines performance but also incorporates financial modeling, such as life-cycle cost, direct operating cost, and product-demand analyses. In addition, MDO involves the evaluation of design risk—that is, how both technical and financial uncertainty influence performance and value—and makes use of stochastic dynamic programming to aid in decision making at each stage of the design process. MDO is thus a very complicated process that takes into account all manner of technical and financial issues, including the trade-offs and major risks involved.³

Again, the reason that so much effort goes into the design of commercial aircraft is the *immediate* and very public reputational damage to both the designer and the airline in the case of a catastrophic design failure. Airline passengers might not know much about the technical aspects of aircraft design, but they can certainly recognize a catastrophic design failure when they see one. In that sense, they can be classified as “intelligent consumers” who demand safety.

Current Design of DC Pension Plan Investment Strategies

We can think of DC plans as having three stages: initial marketing, accumulation, and decumulation. Curiously enough, little connection currently exists among them. One reason for this disconnect is that the three stages are arranged by three different and independent groups of people: the sales agent of a pension plan provider that competes against other providers, the fund manager appointed by the chosen provider, and the annuity seller—who often works for a life insurer that is not part of the same group as either the plan provider or the fund manager.⁴ Another reason for the disconnect is that the customer, the potential pension plan member, generally has a very poor understanding of each stage and of the resources required and risks involved in the delivery of an adequate pension. The customer often buys into a pension plan with very little idea of how much retirement income the plan will eventually provide.

Because pension plan providers are not dealing with “intelligent consumers,” they have little incentive to give much thought to pension plan design, let alone take an integrated approach to it. Many potential young customers have little interest in starting a plan and little spare money with which to do so. To induce potential customers to sign up, the sales agent will often suggest starting the plan at the minimum level of contribution that the plan provider will accept or that regulations allow. In the case of U.K. stakeholder pension plans (i.e., regulated personal DC plans with capped charges), this contribution might be as little as £20 (US\$40) a month—a small fraction of the amount that a typical young person in the United Kingdom would spend on more immediate concerns, such as alcohol.⁵ For a young person with credit card and college debts, a possible mortgage, and an active social life, this amount might seem like a lot of money, but it is, in fact, wholly inadequate to build up a decent pension entitlement. Nevertheless, it will be of no concern to the DC fund manager, who has no target retirement lump sum to reach. When

the plan member finally retires, the annuity provider will take whatever lump sum the fund manager delivers and offer an annuity based on current interest rates and mortality prospects, with no concern about the standard of living that this payout might provide to the plan member. By the time the plan member discovers how small the pension is, it is too late to do anything about it.⁶

In terms of investment strategy, the fund manager's only concern vis-à-vis the customer is to invest the contributions in a portfolio of assets in accordance with the customer's so-called attitude to risk—an intimidating concept to the average person and a somewhat nebulous one even to most financial experts. The fund manager asks the customer whether she or he would prefer a more stable return profile that generates a lower expected return or a more volatile return profile that might earn a higher return. On the basis of the customer's answer, the fund manager advises the customer on a "suitable" investment strategy. Such advice, however, is woefully inadequate and has virtually no relevance to someone who wants an investment strategy that targets a particular pension level—let alone whether the fund manager could reach such a target.⁷ Instead, the fund manager's advice reflects what Bernstein (1992) colorfully called the "interior decorator fallacy"—namely, the argument that portfolios should reflect "attitudes to risk" in the same way that interior decorators reflect the personal tastes of their clients.

The Similarity of Pension Plans and Aircraft Journeys

Returning to our airline analogy for more guidance, let us imagine that an airline were prepared to take on passengers with no regard for whether they were willing to pay for enough fuel to get to their destination or that it considered the bumpiness of the ride to be the only safety issue, without regard for the passengers' chances of arriving at their destination safely. Why should these matters concern us? An aircraft journey and a DC pension plan have much in common. The investment strategy of a pension plan is analogous to an aircraft. The aircraft's operator is analogous to the pension plan provider. The aircraft's fuel is analogous to the contributions to the pension plan. The climb stage of the aircraft's journey is analogous to the accumulation stage of the pension plan, and the aircraft's descent stage is analogous to the pension plan's decumulation stage. The safe arrival at the destination is analogous to the pension fund's achieving its target. The actions of the pilot in flying the aircraft (e.g., dealing with turbulence and crosswinds) are

analogous to the fund manager's decisions concerning such issues as market timing and tactical asset allocation. Air traffic controllers play a role similar to that of pension trustees and regulators.

This comparison reveals some clear similarities between aircraft journeys and pension plans:

- Both seek to reach a destination: in one case, a safe landing, and in the other, a comfortable retirement.
- Both involve the commitment of significant resources.
- Both involve managing highly complex risks.
- Both involve a climb stage and a descent stage.

Although significant differences between aircraft journeys and pension plans exist, these differences are also highly instructive. For example, no uncertainty exists about the destination of an aircraft journey and the passengers can alter neither the destination nor the route once the journey has started. In contrast, with a pension plan, the destination of the journey (the desired amount of the pension), the anticipated length of the journey (the time until the member retires), and the route to be taken (the investment strategy) are generally not clearly formulated when the pension plan journey begins and can be easily changed during the journey. Whereas the airline passenger has few choices once he or she is seated, the pension plan member can change his or her mind about virtually any aspect of the pension plan, including the contribution rate, the investment strategy, the target retirement date, and the decumulation strategy. The need to accommodate this additional flexibility makes the design of a DC pension plan considerably more complicated than the design of an aircraft.

Also, the length of an aircraft journey is much shorter than that of a pension plan journey, which can be 70 years or more. Aircraft designers *must* get the design correct *before* the aircraft ever takes off; otherwise, they would soon lose their reputations, their jobs, or worse. In contrast, the designers of pension plans will have long since departed the scene by the time members discover whether their plans were well designed: The pensions that the plan members actually receive from their plans will not be the designers' problem. In fact, the incentives facing aircraft designers and pension plan designers could not be more different. After a plane crash, the airline cannot dodge responsibility by blaming the passengers for not taking more care with their flight plans or by saying that the passengers should have read the small print in their contracts.

Another important difference is that airline passengers know that they need to get to the airport by a certain time if they want to catch their plane and reach their destination. The much longer journey of

a pension plan, however, offers plenty of opportunities to delay the journey's start and consequently end up with a lower pension by the time the retirement date arrives. People delay saving for a pension for a number of reasons: They might have debts to pay or be saving to start a mortgage; they might have a mortgage to pay or children to raise; they might anticipate higher income in middle age that would allow saving for retirement to begin much later in the life cycle; or they might be willing to work longer before retiring if they discover that they would otherwise end up in poverty. People also put off pension saving because of the bounded rationality issues identified in the behavioral finance literature: They do not understand the full consequences of their decisions.⁸ A pension plan is also only one part of an individual's life-cycle financial plan; other factors must be taken into account, including the desire to make a bequest to one's children (which influences the demand for annuities in retirement), an individual's other wealth (e.g., one's home), and social security (which affects the demand to save privately for retirement). In contrast, an aircraft journey is a one-off event that rarely impinges on other aspects of an individual's life.

There is also little danger of an aircraft's having insufficient fuel to reach its destination. Although a clear trade-off exists between fuel efficiency and GTOW in the design of a commercial aircraft, very few crashes are caused by running out of fuel. And of course, no improvement in fuel efficiency can compensate for insufficient fuel to reach the destination. For its part, a pension plan does involve an important trade-off between investment strategy and contributions: a low-risk investment strategy with high but stable contributions or a higher-risk investment strategy with lower but more volatile contributions. Nevertheless, as with aircraft fuel, no increase in investment risk can compensate for contributions that are inadequate to reach a particular target pension outcome. This point highlights one of the key problems in the design of current pension plans—the misguided attempt to use investment strategy to compensate for fundamentally inadequate contributions.

Another instructive difference exists in the relationship between the climb and descent stages of an aircraft journey and the accumulation and decumulation stages of a DC pension plan. Whereas the climb and descent stages of an aircraft journey make up a seamless whole, an almost complete lack of integration of the accumulation and decumulation stages exists in the current design of DC pension plans. Fund managers take whatever contributions

they receive and invest them according to members' declared level of "risk aversion"—even though fund managers know that members have no real idea what that means.⁹ Members' risk aversion is simply a ticked box on a form and means little or nothing to the fund managers, who have no incentive to deliver any specific pension target because no target has been set for them to attain. At the start of the decumulation stage, the assets are typically handed over to a life assurer. Depending on the size of the lump sum, the age and sex of the member, and whether a spouse's pension is also required, the life assurer provides a life annuity to the member. As with fund managers, life assurers have no incentive to deliver any specific retirement income target because no target has been set for them. The life assurer simply quotes a rate, and the member's accumulated pension fund is converted into an annuity stream implied by that rate; the consequences to the plan member are irrelevant to the life assurer.

The accumulation and decumulation stages of a DC pension plan contrast markedly with the design of an aircraft, in which the climb and descent stages are an integral part of the aircraft's overall design—the ultimate purpose of which is to enable the aircraft to reach its destination safely. Imagine being told by the captain of the "climb plane" that you must transfer to the "descent plane," but the descent plane is miles away and the airline has neglected to tell you how to make the transfer successfully!

Finally, a difference in competence exists between the airline passenger and the pension plan member. The passenger who knows nothing about how planes or the laws of aerodynamics operate is at no disadvantage relative to an expert: All the passenger needs to know is the destination and the airline and flight to book. The passenger can, therefore, be treated as an intelligent consumer who knows what to do. Unfortunately, many consumers are clearly not well informed or well educated regarding financial matters, especially financial products extending over long periods of time in which bounded rationality and behavioral biases come into play. These issues are particularly relevant and difficult in the case of products as complex as pension plans. Thus, we cannot treat the typical pension customer as a fully rational and adequately informed consumer. Consequently, a role might exist for a sort of surrogate "intelligent consumer" to act on behalf of pension plan members as a guide or supervisor. This role might be filled by pension trustees, sponsoring employers, or even regulators.¹⁰

Conclusion

We believe that pension plan designers have a lot to learn from aircraft designers. A typical commercial aircraft journey involves very few passenger instructions—little more than “please fasten your seat belt”—because all the risk management has already been taken care of by the aircraft’s designers. A well-designed pension plan would have similar attributes. Like an aircraft journey, it would be designed from back to front (i.e., from desired outputs to required inputs), with the goal of delivering an adequate target pension with a high degree of probability. Once a few key parameters about the plan member are known, the pension plan provider can be left to do what is needed to get the plan safely to its destination, so long as the member believes in the benefits of the pension journey and is willing and able to maintain the required contribution schedule. Risks cannot be completely eliminated, of course, but they can be understood and managed. In the future, pension plans may be thought of as pension *planes*, with the safety instruction to “fasten your seat belt” replaced by “just sign up and we’ll take care of the rest.”

Current pension plans fall far short of this ideal. Indeed, to the extent that pension plans are “designed” at all, they are designed the wrong way around—that is, from front to back, beginning with the question, How much would you like to contribute to your pension plan? before putting off poten-

tial members with the next question, What is your attitude to risk?¹¹ The intimidated customer signs up and pledges £25 (US\$50) a week; the salesperson reassures the customer that the latter’s long-term financial future is secured. Thereafter, no one gives much thought to the long-term outcome until the customer gets a very rude shock 40 years or so down the road. By that stage, those who are most responsible—especially those who designed the pension plan in the first place—will have long since departed from the scene.

This article is a much abbreviated version of a working paper entitled “Turning Pension Plans into Pension Planes: What Investment Strategy Designers of Defined Contribution Pension Plans Can Learn from Commercial Aircraft Designers,” prepared for the World Bank’s Pension Competition and Asset Allocation Policies for Mandatory DC Funds research project (P102187) and presented at the World Bank’s Fourth Contractual Savings Conference: Supervisory and Regulatory Issues in Private Pensions and Life Insurance, held in Washington, DC, 2–4 April 2008. The authors gratefully acknowledge the constructive comments on earlier drafts from Arjan Berkelaar, Greg Brunner, Steijn Claessens, Gregorio Impavido, Jeppe Ladekar, Heinz Rudolph, Sergio Schmukler, and Eduardo Levy Yeyati. The original paper is available at www.pensions-institute.org/workingpapers/wp0806.pdf.

This article qualifies for 0.5 CE credit.

Notes

1. Since we wrote the first draft of this article, we have become aware of Robert Merton’s elegant essay on the future of retirement planning (Merton 2007), in which he draws a parallel between the design of an optimal DC pension plan and the design of an automobile. We highly recommend Merton’s essay.
2. Office for National Statistics (2000, Table 12.21; 2006, Table 12.21).
3. For more information on aircraft design, see Peoples and Wilcox (2006).
4. Strictly speaking, a true pension plan always involves the purchase of an annuity because only an annuity guarantees the plan member a specified stream of income until the member’s death. Any other type of plan is merely a long-term investment involving the very real risk that the member will outlive his or her resources.
5. Or so the U.K. television series *Booze Britain* would lead one to believe.
6. Of course, cirrhosis might have come to the plan member’s rescue by then because risks tend to diversify.
7. Most pension funds provide both active fund management and investment strategies that involve market timing, but the evidence shows that the vast majority of professional fund managers produce negative returns from active fund management and are especially poor at market timing (see Lakonishok, Shleifer, and Vishny 1992; Blake, Lehmann, and Timmermann 1999, 2002).
8. In addition, most young people simply do not want to think about pensions. As Woody Allen observed, there are some things in life that are worse than death, such as spending the evening with an insurance (or, dare we say, a pension) salesman.
9. As real experts know, “risk aversion” is simply an artificial construct in the minds of financial economists.
10. Two other issues should be noted: (1) The laws of aerodynamics are known and unchanging, whereas our understanding of the processes generating asset returns is still poor. No one would expect anyone contemplating an aircraft journey to have a deep understanding of the laws of aerodynamics, yet those investors considering joining a DC pension plan are, in effect, expected to make very

complex investment choices that presume a knowledge of asset return processes that even experts arguably do not possess (see also Merton 2007, pp. 6–7). (2) Economies of scale are an integral feature of the design of commercial aircraft and are essential to keep prices low and demand high. Although the superrich can afford their own jets, no feasible mass market exists for individual commercial airline flights. With pensions, however, a large market for personal DC plans exists, but such plans are very expensive (in terms of charge extraction via reduction in yield) to design and manage, especially if the plans are voluntary and have to be marketed to individuals separately. This

issue also raises other difficult questions concerning how much choice is feasible in retail DC pension schemes, not to mention the underlying problem of what a “good” retail DC scheme might look like in the first place. Both of these issues reinforce our main point that the design of good DC pension plans is considerably more complicated than the design of commercial airliners.

11. The word “designed” implies a conscious intent or purpose and some degree of forethought about the eventual outcome, none of which seem to be apparent in most current DC pension plans.

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