The rise and fall of unmanned cargo aircraft

Platform Unmanned Cargo Aircraft

Introduction

New technological developments are often hailed by their proponents as redefining our lives. It is easy to do this with unmanned cargo aircraft (UCA). They can make everyone a potential shipper, like the Internet made everybody a potential publisher, banker or trader. UCA can make isolated, underdeveloped areas prosper and optimize production processes by increasing the freedom of choice for plant locations. Who could possibly be against UCA? But take note: wars may be won by propaganda, but they can be lost by believing in one's own propaganda. UCA have their limitations. Their introduction into society is a complicated undertaking, and perhaps they will not be with us in the far future. In this contribution, I propose a five-phase model of the life-cycle of UCA, rounded off by some concluding remarks. The phases of the model are:

1: Introduction into niche markets.

2: Entry into developed aviation markets.

3: Competition with established transport modes.

4: UCA as commodities.

5: Newer modes of transport take over.

Phase 1: Introduction into niche markets

The introduction of UCA involves certain technical, regulatory and business risks. This new type of aircraft has yet to establish a safety record. Although it is my firm belief that unmanned aircraft are potentially at least as safe as their manned cousins, the present unmanned aircraft have yet to prove themselves in that respect. The practical use of UCA may reveal human interaction behavior with these vehicles that designers have not foreseen. Regulations for the operation of UCA are not yet in place in many countries. Operating cost estimates for UCA remain theoretical at present, and it is unclear what customers want to pay for delivery of goods by UCA, and what could be viable revenue models.

For these reasons, UCA are likely to be introduced in thinly populated areas with limited infrastructure. Chances of damage or loss of life as a consequence of accidents are relatively small, while the added value of transport in such areas may be significant. Think of regions where roads are unusable during the Monsoon season. In these areas regulations may well be less restrictive than in, for example, Europe or the US, making trials with UCA less complicated and costly. The first entrants on these regional markets, like Astral Aviation in Kenya, by definition face little competition. But the nineteenth-century German Chancellor Otto von Bismarck had a point when he said: 'Idiots learn from their mistakes. I prefer to learn from other peoples' mistakes'. The pioneer companies enter unchartered territory. They will not want to invest large sums in UCA, and they need aircraft that can operate under adverse, unforeseen circumstances, and are so cheap to operate that they can yield a profit transporting even small volumes of cargo. Low cost and low technical risk are more important than, for example, productivity. The FlyOx UCA, built by Singular Aircraft, is a good example.

Phase 2: Entry into developed aviation markets

When the safety and usefulness of UCA have been proven, both manufacturers and operators of these aircraft will look for new markets, for both offensive and defensive reasons. Success breeds competition, and the pioneer companies will want to utilize their assets and experience in markets where they do not yet face competition from followers, and where larger cargo volumes and higher buying power of customers (shippers etc.) may well bring more profit. The markets well suited for such expansion are niches in developed aviation markets not yet exploited by established airlines. Examples are long-distance routes with cargo volumes too small for manned aircraft, and short-range specialized transport of, for example, medicines or time-critical spare parts. Another almost ready-made opportunity is: complementing routes to secondary destinations in hub-and-spoke route networks, again using UCA when cargo volumes are too small for manned aircraft.

These applications require more sophisticated UCA. It is no longer sufficient to merely deliver cargo to customers who rejoice in delivery being possible at all. Customers in developed aviation markets do have alternatives, and UCA will have to have a minimum level of efficiency to deliver goods on time and against acceptable cost. So, efficiency and reliability become more important. These more sophisticated UCA are likely to be employed by either specialized companies or affiliates from large organizations such as airlines or logistic service companies.

With the growing numbers and sophistication of UCA flying in regions with safety-conscious residents, and the increasing diversity of operators, it is a question of time before the first headline-grabbing incidents or accidents will occur. The UCA industry has to be prepared for this, by mitigating risks and being open about them to policymakers, administrators, opinion leaders and the general public. And by devising 'damage control' strategies before the first incidents occur. If the UCA industry can avoid major incidents until the general public is used to UCA and appreciates their benefits, the disruptive effect of incidents will likely diminish. A historical precedent is the case of ETOPS: extended-range operations using twin-engined passenger aircraft. The safety risks of flying long distances over water with twinjets were fiercely debated in the trade press when ETOPS was introduced, but no accidents occurred. Today twinjets are the norm and three- and four-engined aircraft are the exception.

At the end of Phase 2, the UCA industry will be large enough, with enough vested interests, to seek further expansion in markets that promise more volume and revenues than niche markets. It is time for the next phase.

Phase 3: Competition with established transport modes

At some time, niche markets will not provide enough growth opportunities for the growing number of UCA operators. Just like domestic airlines in the U.S. started to confront European carriers on transatlantic routes after having become 'lean and mean' by domestic competition in the 'eighties as a consequence of air transport deregulation, so will UCA affect the current transport infrastructure. Intracontinental package transport is a case in point. Aircraft like the Cessna Caravan, used for hub-and-spoke package transport, could in the future well be replaced by UCA, with their potential for lower operating cost and greater flexibility. In the case of Europe, a UCA with a range of 1000 miles could cover virtually the whole continent from a well-situated hub. This opens the possibility of electric, or hybrid-electric, propulsion. This form of propulsion promises low operating cost, perhaps less than half the cost of conventional aircraft, less community noise and potentially less environmental damage. The energy density of batteries is as yet insufficient to replace fissile fuels. But UCA, which can be more aerodynamically efficient than manned aircraft, may well be among the first air vehicles with electric propulsion. The lack of a crew makes unconventional configurations possible. An example is the Blended Wing-Body (BWB) shape; a wing with a short, stubby fuselage and no tail. Energy consumption could be reduced by 25%. This type of UCA will be expensive to develop, but the growth of the market will allow amortization of development cost over increasing numbers of UCA. The size of UCA operators will likely increase, either by takeovers or mergers of pioneer companies or by large established players like airlines entering the market. These larger organizations will be able to bear the higher acquisition cost of more sophisticated UCA, as long as increased costs are matched by higher earning power. Higher operating cost will have to be compensated for by high utilization and high productivity, made possible by increasing performance in cruising and climb speed, short turnaround times and high reliability, necessary for fast-paced operations under tight time constraints, possibly in hub-and-spoke systems.

The above is just an example of how markets of UCA may develop. Other possibilities include direct flights, either bypassing hubs or flying into airports with insufficient passenger volumes to warrant combined passenger and belly cargo services.

With the increasing number of UCA operating, not all of them electric, noise pollution, and environmental impact will increase. Even if UCA will in many cases be more efficient than manned aircraft, their increasing numbers will likely generate opposition from hindered or environmentally concerned residents.

At the end of Phase 3, UCA are an established element of the transport infrastructure. The step to a mature industry can now be taken.

Phase 4: UCA as commodities

Witness the air transport industry, and you have a fair idea how the UCA industry will develop. We will see an increasing emphasis on lowering cost, as economies of scale push towards entering market segments with progressively lower buying power or less manifest need for UCA. Performance of UCA in terms of payload or range will probably not increase much. If UCA payloads become too large, say above 15-20 tons, they will increasingly compete with passenger aircraft transporting belly cargo - a battle they cannot win. The other battle, that for increased productivity, the mirror of lower cost, will continue unabated. But there will be enough market potential for the foreseeable future, if only because UCA both contribute to and benefit from the increasing dominance of the so-called 24/7 economy and its cultural mirror image; the 'I want it here and now' attitude of consumers. UCA will also become increasingly user-friendly, in the search for new groups of operators equipped to reach new customer groups. The day may come when operators of lorries start adding UCA to their fleets. This creates new challenges for aviation authorities: how to certify and monitor numbers of users orders of magnitude larger than traditional airlines, and without the organizational and cultural emphasis on safety of traditional aircraft operators? ATC-providers face similar challenges. The number of (unmanned) aircraft in non-segregated airspace will increase dramatically, as will the variation in applications, for example operating at night from access roads of industrial parks, temporarily closed off for road traffic. Techniques like very steep approaches and no-flare landings will make this possible. These landing sites may be situated much closer to built-up areas than traditional airports. And this challenge comes on top of the continued growth in manned aviation and increased use of unmanned aerial vehicles for applications such as surveillance. If quantum computers ever become practically usable, ATC may be a good application for them.

Quantum computers are not the only technology complementing or influencing the evolution of UCA. Another one is 3D printing, also called additive manufacturing. It has been said that 3D printing will severely inhibit the growth of cargo transport. That may be the case in some situations, but for the foreseeable future, many complicated products will still have to be manufactured in more traditional ways. Some of these product may be time-critical, like spare parts. With 3D printing enabling a degree of decentralization of both production and consumption, the need for small-volume, longer range cargo transport will only increase - a market for which UCA are well suited.

Other technologies with an obvious link to UCA are logistical modeling, IT and decision support. The sheer number of UCA that might be flying one day, combined with their flexibility to operate from many more locations than current cargo aircraft, dramatically increase the range of options for the allocation of cargo to individual aircraft, but also the difficulty for the person doing the allocating. Current logistical models may not have the capabilities needed for efficient allocation, and may not provide the allocator with a manageable oversight of options, based on up-to-date information about which cargo is going where, in which individual aircraft. Just as with manned aircraft, the quality of integration of various technologies may make the difference between a solid but unremarkable UCA operation and one that conquers the market. Another form of integration is that with other modes of transport. UCA are not package delivery drones. Like manned aircraft, they deliver their cargo to nodes from which it has to be transported to the end customers. Trains, ships, lorries and other modes of transportation will be part of the UCA cargo transport network, and IT will be needed to hold the network together. Perhaps UCA can even serve as a catalyst for introducing or stimulating the use of other technologies into air cargo transport, like digitization.

When UCA become commodities, they will increasingly compete with other modes of transport. It is even possible that they will sometimes be the victims of their own success. When the economic growth of a region is enhanced because it is linked to the global cargo transport system by UCA, cargo, and passenger, volumes may increase to a level where manned aircraft, for example carrying belly cargo, may gain a competitive advantage. In the long term, this may lead to the next phase in the life cycle of UCA. But before we come to that phase, we have to address one ethical issue. Every technological or social development has its winners and losers. How can we make sure that there are no losers of the coming UCA revolution, or that at least the winners compensate the would-be losers; a so-called Pareto improvement? Are we going to allow that those well off benefit from timely delivery of goods by UCA, while those who cannot afford to buy those goods have to live near UCA operating sites and bear the noise pollution, if it occurs? It is my sincere belief that policymakers have the duty to consider possible redistribution of welfare as a consequence of the introduction of UCA.

Phase 5: Newer modes of transport take over

This phase is still decades, perhaps a century, off. I consulted the famous economist John Maynard Keynes about it. His answer was clear: 'In the long run we're all dead'. We know that one day UCA will be at least partly eclipsed by newer technologies, but not when and how. In the 'twenties of the last century, Zeppelins were seen as representing the future of long-distance air transport. Twenty years later they were all but gone. So it is no use to speculate about the future manifestation of Phase 5. We just have to remind ourselves occasionally that it will arrive one day.

Concluding remarks

Unmanned cargo aircraft are on the verge of entering Phase 1 of the UCA life-cycle model. For companies and entrepreneurs who want a piece of the action, now is the time to get ready. There is no master plan for the introduction of UCA, no timetable for the various phases of the life cycle model to come and go. And there are many uncertainties. What are the requirements for UCA serving the various market segments? What are suitable configurations to fulfill those requirements? How can the advantages of 'unmanned' be maximized beyond simply avoiding pilots' salary cost? There needs to be set up a Center of Expertise to help answer some of these questions. Some of these issues concern precompetitive research like market studies, the results of which should benefit all actors involved in the development, production, operation and support of UCA. It is also possible to aid in the development of (sub)systems for specific clients. In this way, the Center of Expertise can diminish uncertainty and support informed investment and policy decisions.

Whatever the questions and uncertainties, it is clear that UCA are a logical development in aviation technology. It is time for aviation organizations, policymakers and administrators to start getting ready for them.

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