



CONRADCHALLENGE.ORG

Conrad Challenge Innovation Brief

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The Innovation Brief is the most important submission item reviewed by the judges in the Innovation Stage. You'll answer 10 essential questions that will tell your story, describe your innovation and its impact, detail your progress, explain your market, and propose your business model.

Each question has a strict word limit, and in total you'll need to capture everything in 3000 words or less. If it feels hard to fit everything in, that's by design! The Innovation Brief challenges you to communicate concisely, as real entrepreneurs must learn to do.

1. Elevator Pitch: Pitch your innovation, sharing the essence of your innovation, impact, customers and business potential.

This is an amazing innovation. By using the cutting-edge tilt-rotor technology, we've created an unmanned, tilt-rotor, smart and fast small-cargo aircraft.

Our customers will mostly be all kinds of delivery companies. Specifically, our target segment is intra-city instant delivery, from door to door. In 2022, there are 40 billion orders for intra-city instant delivery in China, up 30% year over year. The demand for instant delivery in the US, is also growing very fast.

The business potential is huge-- people need our innovation because it is convenient, jaw-droppingly cheap and effective. By 2027, the total addressable market would grow to 3.7 billion yuan (\$500 million). If it is spent evenly for the next five years, our annual potential revenue stream on selling devices could be 740 million yuan (\$105 million). And by selling at a competitive price, with large scale production, the net margin could be above 20%.

2. Team: How did your team form? What role will each team member play? What motivates you to make your innovation? What special capabilities, resources or experiences do your team members bring?

Our team is composed of three classmates in the same school, same class. Antony, grade

7, is the chief designer of the whole plane and the hardware engineering, together with controlling the plane. Bruce is mainly responsible for supply chain management and manufacturing. Last but not least, Zehua is our chief financial officer and also responsible for marketing.

All of us are very interested in aviation and aerospace, so as we grown up, we all had a dream of making a plane of our own. Antony is the president of the Advanced Aircraft Club in the school, and has some leadership experience. He is an expert in 3D rendering and modeling. He is also good at doing aerodynamic analysis and structure analysis. Bruce has 5 years' experience in making DIY models. Zehua is excellent at doing calculations and also finance. We have strong connections with COMAC and other commercial companies.

3. Opportunity: What issue or pain point does your innovation address?

Nowadays, thanks to the Internet, we can go online shopping, order online food and such more on any device. However, the delivery technology is still outdated. When people order online, the actual people that deliver are still humans, not machines. Even though unmanned-drone delivery is about to appear at the delivery market, due to the fact that the majority is propelled by four propellers, it's too slow and has to charge for a long time after a short flight. Meanwhile, the current delivery approach is also relatively expensive.

Our innovation aims at the intra-city instant delivery market, which demands much more for time efficiency and cost, as well as higher requirement for door-to-door fulfillment.

Our innovation could, potentially address these pain points. By using a tilt-rotor mechanism, it can turn the propeller to face different directions, allowing it to take off vertically and cruise like a normal propeller plane. In this way, the aircraft is able to reach places much faster than a normal four propeller drone. Meanwhile, with a wing to generate lift, it doesn't need a lot of power for the electrical motors, which leads to a longer flight and battery range. With all these advantages, the plane can accomplish long distance point-to-point deliveries, more than 100km, such as from city center to countryside. What's more, it is capable of landing and taking off in anyone's yard, bringing about exquisite delivery experience.

In conclusion, we believe this innovative aircraft could empower delivery companies and e-com platforms to deliver more goods, at faster speed and cheaper costs, with better customer experience. This will disrupt the instant delivery market completely.

4. Innovation: Describe your innovation, its design, and your technology. How does it work? What is new or proprietary about the innovation?

How does it meet needs and resolve pain points? What impact does your

innovation create for individual users and for humankind?

Describe qualitatively and quantitatively. How can new or proprietary aspects be protected and made valuable by one or more methods such as a patent, trade secret, copyright or otherwise competitively defensible configuration?

Our biggest innovation is applying a tilt-rotor mechanism on the cargo drone.

A tiltrotor aircraft has the capability of a VTOL (vertical takeoff and landing) helicopter as well as the speed and range of a conventional fixed wing aircraft. When taking off or landing, the rotors face upwards so the plane of rotation is horizontal, or parallel to the ground, generating lift like a normal helicopter. As the aircraft gains speed, the rotors slowly tilt forward, and eventually stop tilting when the plane of rotation becomes vertical. In this mode, the rotors provide thrust as a normal propeller, and the airfoil of the wings start to generate the main lift for the aircraft, taking over the rotors. Thanks to the efficiency of propulsion and the fewer problems of a helicopter, such as retreating blade stall, the plane can reach much higher cruise speeds and takeoff weights than helicopters.

To put this mechanism into work for our prototype cargo drone: First, an electrical motor is attached to an aluminum composite bracket. A propeller is tightened onto the electrical motor. The bracket is pierced through by an axis. Then the axis is firmly glued to a servo. The servo's cords are plugged onto the receiver. The plane of rotation is controlled by the servo.

For the electrical motors, we chose 2 Sunny sky X4112S motors at the back, 2 Cyclone U3515 motors at the front. In total, there is around 10-11kg of thrust.

For the fuselage, we chose a rounded-edge square for the cross section, because it is the strongest and largest structure. We used the cutting-edge technology of 3D printing in large scale to manufacture the fuselage, which is cheaper but precise. We used a revolutionary new material called PET/GF, which is a modified version of PET.

In addition, for the wing, we selected a CLARK Y wing model as the base-exterior, which has a higher lift coefficient than other wing models in slow speed.

The total lift of the plane, flying at sea level, at 20 m/s is 105 newtons, a bit more than 10 kilograms.

We've used a Futaba controller to control the servos. The receiver is Futaba R7108SB. We've used the Pix 2.4.8 as the central flight control.

The tilt rotor mechanism transforms the four-rotor aircraft into a propeller aircraft. This mechanism has never been tried on a delivery drone ever before. There is significant increasement in speed and endurance. Nowadays, the pain points of drone delivery are battery, endurance, speed, intelligence. Our innovation has solved the first

three problems.

Firstly, by flying like a conventional fixed wing aircraft for most of its time, the battery lasts for a longer time, compared with every other four-propeller drone, because of its essential difference in the way they fly.

Secondly, this aircraft uses PET/GF, which is much more resilient and endurant than pure PET. There is better resistance from direct impact force. It's also uneasy to break when there is a torque force.

Thirdly, as regard to speed, the tiltrotor's advantage is significantly faster than a helicopter or four-propeller drone. The limit of a modern helicopter's cruise speed is about 150 knots / 277 km/h, while the four-propeller drone's maximum speed is much lower. However, with the tiltrotor this problem is avoided, because the proprotors are perpendicular to the motion in the high-speed portions of the flight regime, so the tiltrotor has relatively high maximum speed—over 300 knots / 560 km/h.

For the last problem, intelligence, we've solved half of it. Thanks to Pix 2.4.8, the aircraft can sense outer threats and potential threats, and avoid them within a few dozen milliseconds. The Pix 2.4.8 can also accomplish planned flight route, meaning flying from A to B automatically.

For our potential users, which are delivery companies and people with specific needs, the main impact our innovation has is the speed. By flying at a staggering speed compared to four-propeller drones, the value-to-price ratio of this aircraft is much higher, because it can transport larger amounts of cargo much faster than competitors. It can also save labor, thanks to the automatic route programming that doesn't need a person's interference.

As regard to how to protect proprietary aspects, we plan to apply a patent, a trade mark, and some copyrights in the future before large scale commercial production.

5. Validation and Progress: How have you validated your innovation, technology or processes? What progress have you made in developing your innovation?

- We've validated our innovation by having a system check, a ground test and a test flight. For the system check and the ground test, we've checked the electric motor spin, the receiver responds, the elevator, aileron and rudder respond, the 4 electric motor arrays respond, the throttle respond, the roll respond, the pitch respond and the aerodynamic flaw check. The plane has passed all tests.
- For the test flight, we've tested the plane taking off smoothly and stabilizing for 10 seconds, then landing smoothly. It was 4 degrees Celsius, 8:00 pm, wind speed 1m/s. The plane took off smoothly, climbed to an altitude of 10 feet, then descended for 3 seconds and landed. It was a successful flight.
- As regard to the progress so far, we've already finished the goal decision, cost estimate, design, 3D printing, component purchase, final assembly, ground testing,

maiden flight and business plan of our innovation.

- For the goal decision, we've decided to make a long-range, agile, densely packed, tilt-rotor, autonomous aircraft. For the cost estimate, we've estimated the total cost (design, manufacture, test flight) of one single test-flight aircraft would be around \$3000.
- For the component and avionics purchase, we've spent \$800 buying everything we need, including 8 T300 carbon fiber pipes, 1 Futaba R7108SB receiver, 4 bottles of epoxy, 4 bottles of 502 glue, a bottle of screw fitting glue, 1 pix 2.4.8 flight control, 5 servos, 4 60A ESCs, 4 electrical motors, 30 banana headlines, 100 servo lines, foam tape, 10 XT-60 lines, a TATTU 10000mah battery, 2 TATTU 1800mah batteries, a balanced charger, a tool kit, a welding set. We've also purchased a 2-month use for Fusion 360, a professional design software.
- For the 3D printing, in total we spent \$1700 to get the outer shell of the plane, weighing 6.2kg.
- For the final assembly, we spent around 10 hours to process some raw materials into useful parts, then assembling them, finally checking every single part.

6. Market: Describe your customer and your target segments. What is important to them? What is the size of the opportunity? Is the buyer or payer different from the customer in this market? Describe the industry ecosystem.

Our customers will mostly be all kinds of delivery companies. For the delivery companies, they always want to transport more cargo with less money, at the fastest speed. Our opportunity is massive because our innovation could be adopted for most delivery companies.

Specifically, our target segment is mostly intra-city instant delivery service. In 2022, there are 40 billion orders for intra-city instant delivery in China, up 30% year over year, and that number is expected to grow at 20% CAGR in the next five years. According to the National Development and Reform Committee, the current market size of instant delivery is 200 billion yuan (or \$30 billion). Suppose 10% being delivered through unmanned drones, that would be 4 billion packages per year. Assume that each aircraft could deliver 72 orders per day, then the total demand for unmanned aircraft would be 150,000 planes. One plane is 10000 yuan (\$1400), so the total CAPEX of instant delivery aircraft is 1.5 billion yuan (\$200 million). Five years from now, the market size would have grown to 3.7 billion yuan (\$500 million). If this 3.7 billion is spent evenly for the next five years, every year, our potential revenue stream on selling devices could be 740 million yuan (\$105 million).

Firstly, the innovator designs and produces the planes. Then, some of the planes will be directly delivered to the large delivery companies that have signed contracts.

Secondly, for small companies, they can rent in units of days, which means that third-

party rental companies could buy the device from us and rent to the smaller companies.

Besides, we can directly sale online to individual customers. The planes that are crashed or too old will be sent back to the factory, and we will select the useful parts to recycle. It acts as an ecosystem.

7. Competition: What competes with your innovation, and how does your innovation compare? What are the advantages and disadvantages of your innovation? What is your positioning?

There are a few competitors in the drone delivery market. These competitors all use four-propeller drones to deliver cargo. For example, JD logistics and Amazon are using their self-developed drones on pilot-delivery stage, but our innovation has an essential difference with these drones, because it is tilt rotor propelled. This kind of propelling method allows the plane to fly at speeds instantly faster than our competitors, which unlocks the long-distance point-to-point delivery market. This is the main advantage of our innovation, which is also the most important. Our plane's theoretical top-speed is around 150 km/h, compared with only 100 km/h for JD's delivery drones, and 90 km/h for Amazon's Prime Air.

The disadvantage of our innovation is the agility. Our competitors have all aimed towards the intra-city delivery market, which requires relatively high speed and safe delivery. If our plane flies as a four-propeller drone, the disadvantage of the battery will show up. However, this isn't a large disadvantage, because our positioning is toward the inter-town, or possibly inter-city delivery within certain metropolitan areas. This market has not yet opened yet, which means that we are the first to open the market.

Currently, the door-to-door instant delivery from city to town is yet unlocked. In China, there are still 600 million people living in the countryside. Given that almost half of the people live in the rural areas and their growing personal income is demanding for more and better e-com services, the demand is growing much faster than the relative mature e-com market in downtown areas. There are currently no any competitors providing services in this market, no matter China or the United States. Meanwhile, the delivery cost is also much lower, despite longer distances. Therefore, we believe our unique positioning would fulfill this untapped market demand.

8. Go-to-Market: How will you attract and sell to customers? Who are the best initial or pilot customers? Is the market best served through direct sales, distribution, licensing, strategic partnerships or other strategies?

There will be three kinds of customers—Large delivery companies, small delivery /

startup companies and individual people. The best initial customers will be large delivery companies, because after they give us good feedback of the plane, more and more potential customers will be attracted, and our innovation will slowly start to become popular. We will provide our prototype aircraft free for their pilot use in the first stage.

As what we've known so far, the delivery drone market is best served through strategic partnerships, because it is the most effective way of earning a profit in a more sustainable way with client stickiness. There will be a very small number of direct sales, but there will be a lot of renting service at extremely low prices, allowing the average person to afford using it. By having renting services, the profit will grow gargantuanly, because of the low price.

9. Business Model: What are your key revenues and costs? What are the pricing and costs to deliver one product or service unit?

There are three kinds of revenue streams.

Firstly, direct sales of device to larger logistics companies. Potential clients include JD logistics, Meituan On-line Food Delivery, Amazon, Door Dash, etc. Our product would be price at around 10000 yuan (\$1400).

Secondly, direct sales to rental companies, who will rent in units of days to smaller logistics companies.

Thirdly, direct sales online to individual customers. The price will be 10% higher, considering the higher e-com expense paid to the platforms, such as Alibaba, Amazon. In this sales channel, we will provide infinitely long free post-sell service for these customers. Lastly, there will be also a maintenance fee which is around 2% of the sales price for our direct sales clients.

Our cost on direct manufacturing of the plane is around 7000 yuan, which consists of four parts—the 3D printing cost (40%), the avionics cost (45%), the components cost (10%) and the labor cost (5%).

Our expense mainly is mainly composed of R&D (80%), Administrative (15%), Sales (5%). Our total employment number would be 30, including 20 R&D personnel, 5 management personnel and 5 sales. The total compensation per year would be 4.5 million yuan (\$650k). These costs are relatively fixed, so the unit-expense per aircraft will depend on the scale of sales.

We estimate that in the first five years, the annual demand for instant delivery drones would be 75,000 aircraft. Assume that we take 20% market share, our sales volume per annum would be 15,000 aircraft, which gives us a revenue under direct sales of 150 million yuan (\$20 million), and direct cost would be 105 million yuan (\$ 15 million).

Gross profit per unit is 3000 yuan (\$400). Fixed expense per unit would be 300 yuan (\$40). So, the profit before tax per unit could be 2700 yuan.

10. Fundraising: What funds do you need to get started, and how will you use these funds? How much will it cost to develop the product and roll it out? What different sources will you pursue funding, and why are these a fit?

Considering the fixed compensation cost per year of 4.5 million yuan (\$650 k) as well as the rental cost for operating office and plant facility, we need at least 10 million yuan (\$ 1.5 million) to get started.

We will consider two ways to raise money—one is by crowdfunding. The other is ventral capital. We plan to get the funds in two rounds—the first round will be through crowdfunding, which is also a way of advertising our innovation ideas to the public. The second round will be from angel investors. These two rounds of funding combined together would account for 10% of stake in our start-up, which means the valuation of the company would be 100 million yuan (\$15mn). The potential candidate of angel investor should be from innovation-related fields, through which we could leverage their experience in supply chains, market orientation, or sales channels.

