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AMPERSAND STUDIO: A SOCIAL DESIGN CASE STUDY OF AN ANTI-VENOM DELIVERY SYSTEM IN WESTERN AFRICA

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ABSTRACT

The Ampersand Studio is an undergraduate multidisciplinary social design studio at the University of Kansas focused on working with outside partners and stakeholders to solve large-scale and complex social problems. This case study presents a one-semester project with undergraduate students from industrial design and graphic design. Students worked with medical experts, aeronautical engineers, and human-computer interaction experts in the United States, Mexico, and Guinea to understand and design a strategy for reducing the death and amputation rate from venomous snake bites in Western Africa, specifically Sierra Leone and Guinea.

In this paper, we discuss how students defined and found approaches the partners at Talon Launch had not considered. A rapid design process that could be efficiently implemented was necessary as the stakeholders were looking to save lives as soon as possible. The students employed an in-depth research study including interviews with experts and users, which helped them understand the needs of a wide range of stakeholders. Through this process, they provided systematic design options that went well beyond the partner's initial focus on a drone delivery system. Instead of jumping to only a complex and highly expensive drone system to help address this issue, students proposed a series of solutions, which included a step, leap, and jump.

The key contributions of the paper center around how design thinking can lead to a more comprehensive range of solutions in complex and large-scale social design problems, providing stakeholders with a variety of options that can be implemented in appropriate stages.

Keywords: Social design, design thinking, drones, industrial design, antivenom

1 INTRODUCTION

This paper presents a case study of an undergraduate multi-disciplinary design studio project at the University of Kansas partnered with a non-profit and a team of professionals at Talon Launch, including herpetologists, medical experts, aeronautical engineers, and drone specialists in three countries. The project brief was to design an autonomous drone antivenom delivery system for use in rural communities affected by venomous snake bites in Sierra Leone and Guinea.

Designers often work with stakeholders who either have a pre-determined set of design expectations or are reluctant to pursue innovation or solutions outside of the initial brief scope. This project utilized design research and design thinking in conjunction with using a *Step, Leap, Jump* strategy to get buy in from the stakeholders on expanding the scope of the project, and to introduce solutions in an accessible way.

1.1 Step Leap Jump

Designers are tasked with addressing a broad range of problems when working for clients, from small aesthetic updates to large-scale system design with multiple stakeholders. Through initial research, "how might we?" exercises, [1] and investigations designers may find opportunities that would benefit the project but may push beyond the scope of the initial brief. [2] This requires designers have the ability to help the stakeholder accept innovation and broader project scopes by using clear communication, empathy, and through building trust. [3] Designers in industry often utilize a concept known as *Step, Leap, Jump* to walk stakeholders through a series of concepts that gradually expand from the initial intent of the brief. [4] The initial concept the designer would present falls under the *Step* category. The *Step* relates closely to the initial prompt from the brief and meets the needs as stated. The designer would present the research as it relates to the *Step* design, this phase of S*tep, Leap, Jump* is critical in receiving buy-in from the stakeholder as it shows the designer sees value in the brief as it was presented and is not dismissive of the original need.

After the designer presents the S*tep* concept they advance to the *Leap* option. They present the relevant research and any initial ideation for this design direction. This concept builds on the *Step* option and/or the research making it feel incremental and having seen the Step concept the stakeholder knows their needs have been met leading them to feel more comfortable with a concept that moves beyond the brief. Finally, the designer presents the *Jump* concept, which also is presented with relevant research and/or initial ideation and is the most innovative or expansive concept from the brief. If designers only presented a concept that did not adhere to the brief the stakeholders may feel disregarded and frustrated. By presenting incremental concepts expanding or shifting from the brief accompanied with design research and thinking the stakeholder will be able to consider a broader range of solutions as they know their initial needs as outlined in the brief are being considered and met. [4]

2 CASE STUDY

In 2022 an international non-profit, Talon Launch, partnered with our multi-disciplinary studio at the University of Kansas consisting of 2 graphic design and 5 industrial design undergraduate students. They were seeking help in the design of a drone delivery system to deliver anti-venom for snake bites in rural Western Africa, specifically in Guinea and Sierra Leone. Talon Launch was working with multiple teams spread across three continents including aeronautical engineers, researchers, and medical experts. This passionate group was focused on the rapid implementation of a drone delivery system, with a motivation that every day the project waited to launch more people would be permanently injured or die from venomous snake bites. This sense of urgency initially restricted the scope of the design brief in order to ensure efficient deployment.

2.1 Project Brief

In Guinea and Sierra Leone there are over 24,000 snake bites annually causing over 3,600 deaths, and 4,600 amputations, primarily affecting children and farmers. The poor road conditions and intense rainfall in this region often lead to long travel times. What in a developed country would be a 30-minute to 2-hour drive, could easily be an 8–48-hour trip over washed-out roads that cars and trucks are unable to navigate, forcing sick and/or unconscious snake-bitten passengers to be transported on the back of a motorcycle.

The design problem is if the snake bite victim does not receive anti-venom, which costs $6,000 per vial, and blood within one hour the patient will likely lose a limb, and after 6 hours the victim will likely die. Vials of the anti-venom must be kept at a secure location at the snakebite clinic headquarters as theft is a serious issue. The main clinic had a network of smaller clinics in the surrounding area, up to 160 kilometres away, which were closer to victims, these clinics needed to quickly be sent the lifesaving anti-venom so the patient could then immediately make the trip to the main snakebite clinic for further treatment. The team had already started the development of an initial drone concept which would launch from the main snakebite clinic and hover over smaller clinics in the region dropping a payload with the necessary medical supplies.

Our students were tasked to solve for the following design deliverables:

- Payload which can be released while the drone is hovering in the air.
- Adjustment of drone's undercarriage to hold and release drone.
- Graphics to ensure public and government know it is a medical product.
- Integration of drone's batteries and system for charging.

Figure 1. Drone and Road Conditions

2.2 Research Findings

In the first phase of the project students conducted design research including interviews with medical professionals and snake bite experts on the ground in Guinea and Sierra Leone. They also interviewed drone experts in our country, as well as the experts on the team. Students conducted background research on current and emerging solutions to drone delivery systems throughout the world. They found multiple areas of opportunity that the initial project did not address. They presented areas of opportunity in a Step, Leap, and Jump format using the "How might we? methodology":

2.2.1 Step: Areas of Opportunity

- The initial concept of the payload was investigated, with the opportunity of how might we address loss of the payload after delivery, how might we solve for visibility at night or in a storm? How might we assist in the return of the payload container?
- Students investigated graphic options currently used for vehicles and containers.

2.2.2 Leap: Areas of Opportunity

- Patients still need to be transported to the main clinic after being treated with the anti-venom. They might be unconscious while riding on a motorcycle for 2-48 hours through difficult terrain in a rainstorm. How might we design a system to keep the patient on the motorcycle if unconscious or weak?
- Certain clinics are too far away from the main snakebite clinic and the drone would not reach them. How might we store the anti-venom at key remote clinics and ensure the main snakebite clinic remotely controls accessibility to the medicine as theft is a serious issue?

2.2.3 Jump: Areas of Opportunity

- The students found the area has consistent winds which would make it impossible for the original drone to fly 50% of the time. The original drone could not reach many of the needed locations as it had a range of 50 kilometres. How might we quickly reach clinics up to 160 kilometres away even when there is intense rain and wind, land at multiple sites, drop off blood and medicine and pick up more supplies at the main hospital then return to the main snakebite clinic? When the students presented this opportunity area, they presented existing concepts that met these needs based on information from our aeronautical engineering department.

By presenting research broken down into Step, Leap, and Jump categories using the "how might we" method, the students had buy-in from the stakeholders and they were excited about what the students could do. The stakeholders knew that the work they needed to complete the payload and other immediate issues were being addressed and were more open to innovation and concepts that strayed from the original brief.

2.3 Concepts

The students moved forward with their Step, Leap, and Jump opportunities, breaking into teams of 2-3 students to work on different concepts.

2.3.1 Step: Concepts

The students designed a drone payload system as originally specified, while adding some features to solve for needs they found during their research phase. The payload could hold multiple vials of anti-venom, blood, and other supplies. It was visible at night and had a parachute for smooth landing. The payload was integrated into the body of the drone and had a quick charge system with a removable battery. The clients have integrated this design into their drone and are moving forward with production. Although this design will not reach all the needed users it will be effective at vastly improving the situation on the ground, can be implemented quickly, and is more economical to deploy.

Figure 2. Step: Final Payload and Drone Concept

2.3.2 Leap: Concepts

After finding a need for immediate remote access of medications at key clinics, students designed a locker cabinet system which only the central snakebite clinic could unlock as can be seen in Figure 3. This would be refilled when supplies run low and would prohibit theft of the $6,000. per vial antivenom. Often patients need 2 vials of venom before they can make the trip to the snakebite clinic. This system had not been considered by the nonprofit group as they had settled on drones early on, they are implementing a similar system moving forward.

Figure 3. Leap: Lockbox System

A simple motorcycle harness was also designed, this is based on straps used by the military to move injured bodies and is simple and adjustable so children and adults can be safely transported even if they are unconscious from the smaller clinics to the main snakebite clinic. A key feature is the need for this system to fit into the limited space of the drone payload.

Figure 4. Leap: Harness

2.3.3 Jump: Concepts

Students collaborated with our aerodynamic engineering department to create a concept, shown in figure 5, which can meet many of the needs of the snakebite clinic including the ability to fly through intense rain and wind. It can travel using its combustion engines up to 100 miles making multiple stops to drop off anti-venom and blood along the way. Its durable design can withstand harsh conditions. This concept is being used by the non-profit to fundraise for a more robust drone based on this design.

Figure 5. Jump: Concept Drone

3 CONCLUSIONS

This paper is a case study of how designers can present research and concepts which extend beyond the initial brief. Initially, the students felt pressure to solve all of the needs of the user at once, the added context of saving lives made it difficult for them to initially focus on meeting the immediate needs of the brief. The *Step, Leap, Jump* methodology enabled the students to design to the original brief and systematically expand the scope of the project based on their broad initial research. By breaking research and ideation into categories students were able to keep their Step concept closer to the brief and integrate more innovative ideas which might have been too far outside of the initial brief to the Jump concept. This process led to a more comprehensive range of solutions for a complex and large-scale social design problem.

Partners on the ground in Guinea and Sierra Leone and at Talon Launch were pleased with the project meeting their immediate needs as well as with the additional scope of the project that our students investigated. They reflected that the initial research presentation formatted in Step, Leap, Jump in a "How might we" format made them feel more comfortable with the project scope expanding. They believed their pressing needs were being met and they were being heard, but also felt included in the design process by the research being presented in a broader question format. The design process did not include co-design with the partners, but the research felt the design outcomes were less prescriptive and more investigative. They were excited by the Step, Leap, Jump methodology and appreciated the breakout of concepts, it made it easy for them to navigate possibilities and how different ideas might be strategically deployed.

The students also learned how to present concepts that are beyond what the immediate ask was from the partner. In design we are often working with partners who may be hesitant, these partners were excited about the possibilities and saw potential in many of the concepts the students presented. They also were provided a variety of options that could be implemented in appropriate stages. Often industry partners may be hesitant to take risks or push for innovation. A Step, Leap, Jump method can help walk them towards concepts which are out of their comfort zone and show that the designer is able to meet them where they are while showing them where they can go.

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