

**AUTONOMOUS DRONE  
SWARMS:  
A POSSIBLE SOLUTION  
FOR MASS  
HUMANITARIAN  
ASSISTANCE?  
- WIP-**

**Dr Muhammad Azmat  
AIDEX 2022  
Brussels Belgium  
17.11.2022**



# Agenda



Backdrop



Current Trends



Study Focus



Preliminary Findings

# Disasters

- Disasters are serious disruptions to the functioning of a community that exceed its capacity to cope using its own resources. (IFRC)

	<b>Natural</b>	<b>Man-made</b>
<b>Sudden-onset</b>	Earthquake Hurricane Tornadoes	Terrorist Attack Coup d'Etat Chemical leak
<b>Slow-onset</b>	Famine Drought Poverty	Political Crisis Refugee Crisis

# HUMLOG Objective



SAVE LIVES!



Food, Water, Medical  
Supplies, Shelter

Where it's risky  
for aid workers to  
be on the ground,  
technology could  
help.

Russian Invasion of Ukraine >

## Aid groups fight to deliver lifesaving supplies despite losing lives to Russian shelling.

April 20, 2022  
Apoorva Mandavilli



Dmytro Sherembei, second from left, with other 100% Life volunteers in March. 100% Life

On a bracingly cold day in March, four people set out from Ukraine's capital, Kyiv, to deliver lifesaving medicines, heating devices and food to the besieged residents of Chernihiv, in the northeast.

**Only one survived.**

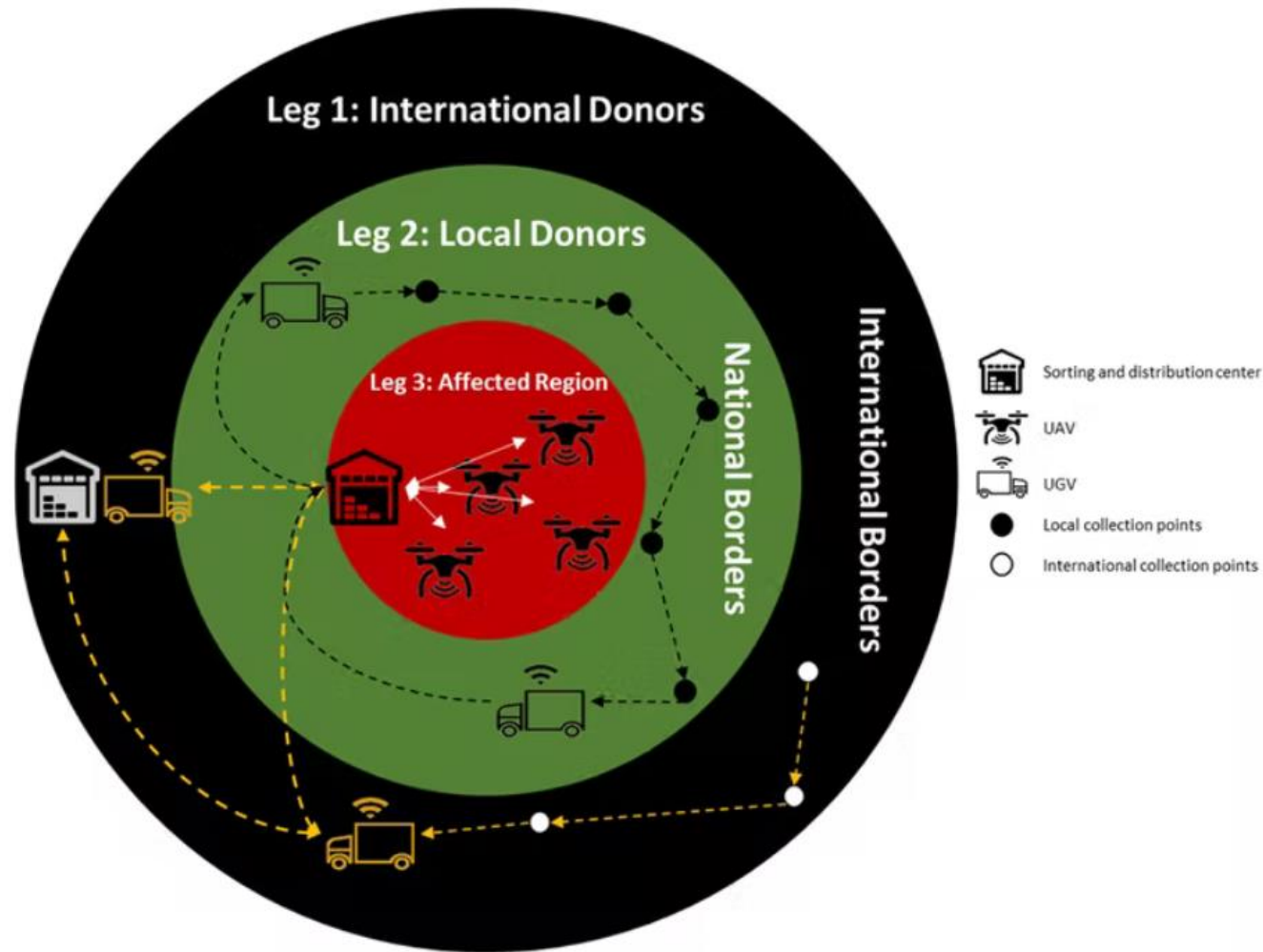


## Average Value of Statistical Life!

\$10 million - It's the same number whether  
you're 2 or 42 or 82.

<https://www.npr.org/2020/04/23/843310123/how-government-agencies-determine-the-dollar-value-of-human-life?t=1650591498372>

## How it could work



Muhammad Azmat, Author provided


So, Why put any more lives in jeopardy – Autonomous Vehicles are capable of **'Dirty, Dull, and Dangerous (3D) missions!**

# Drones and driverless cars could help with Ukraine's humanitarian crisis

- <https://theconversation.com/drones-and-driverless-cars-could-help-with-ukraines-humanitarian-crisis-180261>

**THE CONVERSATION**  
Academic rigour, journalistic flair

COVID-19 Arts + Culture Business + Economy Cities Education Environment Health Politics + Society **Science + Technology** Podcasts



## Drones and driverless cars could help with Ukraine's humanitarian crisis

Published: April 4, 2022 7:00pm BST


RoClickMag/Shutterstock

Email 29  
Twitter 32  
Facebook  
LinkedIn  
Print


The Russian invasion of Ukraine has led to a serious [humanitarian crisis](#). Of Ukraine's 44 million people, almost [one-quarter](#) have been displaced. Around 8.7 million have escaped to neighbouring European countries, while around 6.5 million are estimated to be displaced inside Ukraine. Tragically, deaths and injuries continue to rise.

Meanwhile, Ukrainians are faced with catastrophic shortages of essential supplies and services. They're [in need of](#) safe shelter, food, water, access to information, psychosocial support and medicine, especially for chronic diseases (such as insulin to treat diabetes).

To access essential supplies, Ukrainian people urgently need assistance from humanitarian and government organisations. But the volatile situation presents a

**Author**  
 **Muhammad Azmat**  
Lecturer, Engineering Systems & Supply Chain Management, Aston University

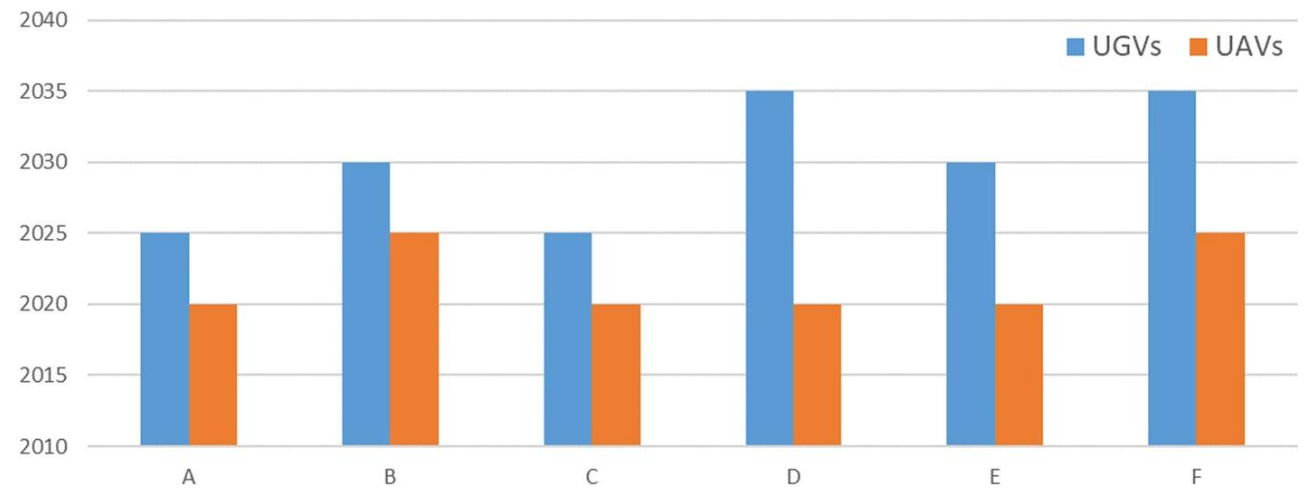
**Disclosure statement**  
Muhammad Azmat does not work for, consult, own shares in or receive funding from any company or organisation that would benefit from this article, and has disclosed no relevant affiliations beyond their academic appointment.

**Partners**  




# Are Humanitarian Organizations Interested?

- <https://ajssr.springeropen.com/articles/10.1186/s41180-020-0033-7>



A white quadcopter drone is shown in flight, carrying a brown cardboard box. The box has a barcode, a recycling symbol, a fragile symbol (a glass with a crack), and a 'this side up' symbol (two upward-pointing arrows). The drone is centered in the frame against a blurred background of a city street.

# Drones in Different Settings

Military  
Commercial  
Humanitarian



Past



Present



Future

# Drones History

- The use of drones in military operations can be traced back to the early days of World War I. In fact, the first successful drone mission was conducted by the British Royal Navy in 1917. At that time, they used a pilotless aircraft called the "Queen Bee" for target practice.
- Then during World War II, drones were used for bombing missions. However, they were not very successful because of their limited range and payload capacity.
- Drones were also used for military purposes in the early 2000s during the Iraq War. They were sent to gather intelligence and conduct airstrikes.

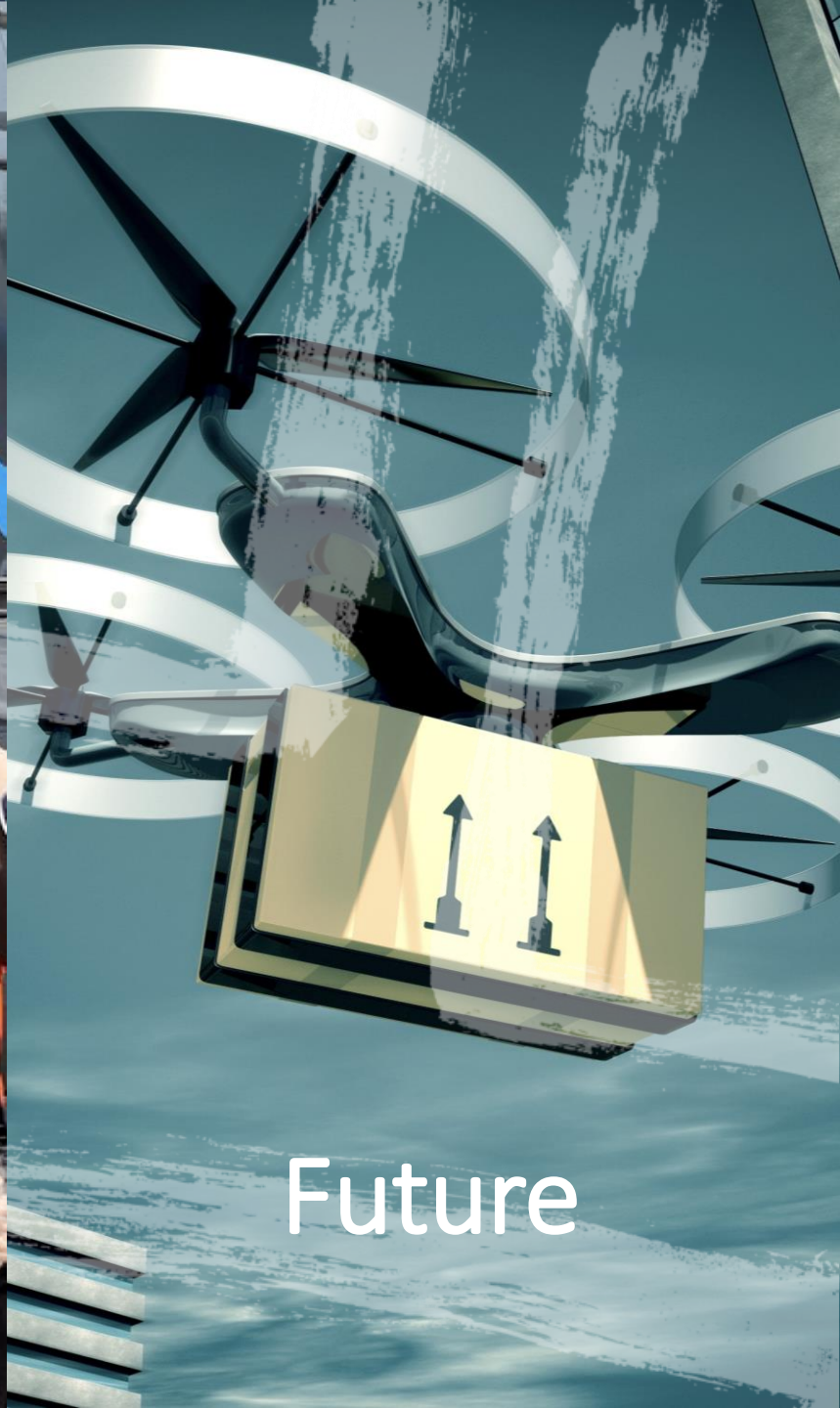




Past



Present



Future

## Global Commercial Drone Market

share, by end-use, 2020 (%)



● Agriculture ● Delivery & Logistics ● Energy ● Media & Entertainment  
● Real Estate & Construction ● Security & Law Enforcement ● Others



GRAND VIEW RESEARCH

**\$13.4B**

Global Market Size,  
2020

Source:  
[www.grandviewresearch.com](http://www.grandviewresearch.com)

Drones  
around us!

Report Attribute	Details
Market size value in 2021	USD 20.8 billion
Revenue forecast in 2028	USD 501.4 billion
Growth rate	CAGR of 57.5% from 2021 to 2028
Base year for estimation	2020
Historical data	2016 - 2019
Forecast period	2021 - 2028
Quantitative units	Revenue in USD million/billion, Shipment in Thousand Units and CAGR from 2021 to 2028
Regional scope	North America; Europe; Asia Pacific; Latin America; MEA
Country scope	U.S.; Canada; Germany; U.K.; France; Italy; China; Australia; Japan; South Korea; Brazil; Mexico; UAE; Israel; South Africa
Key companies profiled	SZ DJI Technology Co. Ltd (DJI), The Boeing Company (Insitu) Terra Drone Corporation, Intel Corporation, BirdsEyeView Aerobotics, Parrot Drones SAS, Yuneec, Delair SAS

# Commercial Drone Market Report Scope



Past



Present



Future





# Flooding in Pakistan 2022

# Current Practices – Pak Flooding 2022



# Drone Swarms

---

- Group of three or more drones that perform tasks cooperatively while receiving limited or no control from human operators (Ross Arnold).
  - There does not seem to be a consensus on the definition of UAS swarms, all preliminary definitions mention multiple UAS (anywhere from 2 to 40+) that use individual behaviours to work as a unit.
- 



# Guiding Principle

---

- Separate: Keep a certain minimum distance from your nearest neighbours.
  - Align: Steer towards the average heading of your neighbors at the same speed.
  - Cohere: Attempt to move toward the average position of your neighbors, keeping the flock together.
- 



# Why Drone Swarms are future?

- Speed
- Agility
- Precision
- Cost reduction
- Better opportunities
- Competitive advantage
- Number of applications

---

# Focus of the Study & Methodology

---

- Focus
  - Understanding potential use cases for drone swarms in humanitarian relief operation
- Method
  - Semi structured open ended interviews with relief organizations with help of associations such as HLA, WANGO, PDMA
  - Subject matter expert interviews with CS and AI individuals to understand the potential and technological limitations of UAS

# Preliminary Findings

---

- Drone swarm is a new but rapidly developing area
- Applications are limited to warfare ([DSIAC](#)):
  - Area search and attack where target distribution and location are not known
  - Surveillance, diversion, and suppression of hostile force's actions
  - Psychological warfare
  - System software complexity reduction (as proper algorithms allow the UAS to make collective decisions rather than individual UAS control).
- Applications are limited due to the small average size of drones used in swarm.
- Barriers: Payload, Infrastructural inadequacies, and Cyber Threat

Technology is here  
to HELP!







**Dr. Muhammad Azmat (Azi), MSc., MBA**  
Assistant Professor in Logistics and Supply Chain Management  
Department of Engineering Systems and SCM  
Aston University

Email: [m.azmat@aston.ac.uk](mailto:m.azmat@aston.ac.uk)



<https://www.linkedin.com/in/mazmat/>

