System Dynamics / Zachman Framework Characterization of UAV T&E

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- Analysis
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Introduction:

- A system is a complex area which contains a lot of entities and activities with different loops.
- The purpose of sophisticated modeling techniques is to make the model as realistic a reflection of the real world as possible, considering all constraints of available data, analyst time availability, and computational resources needed to evaluate the model.
- Our main objective is to obtain a better way to analyze a complex system with less time consumption.
- In this study, plausible narratives for UAV battle space decisions were examined in detail not only to extract key factors involved in decision making processes, but also to illustrate the wide ontological origin of key decision making factors.

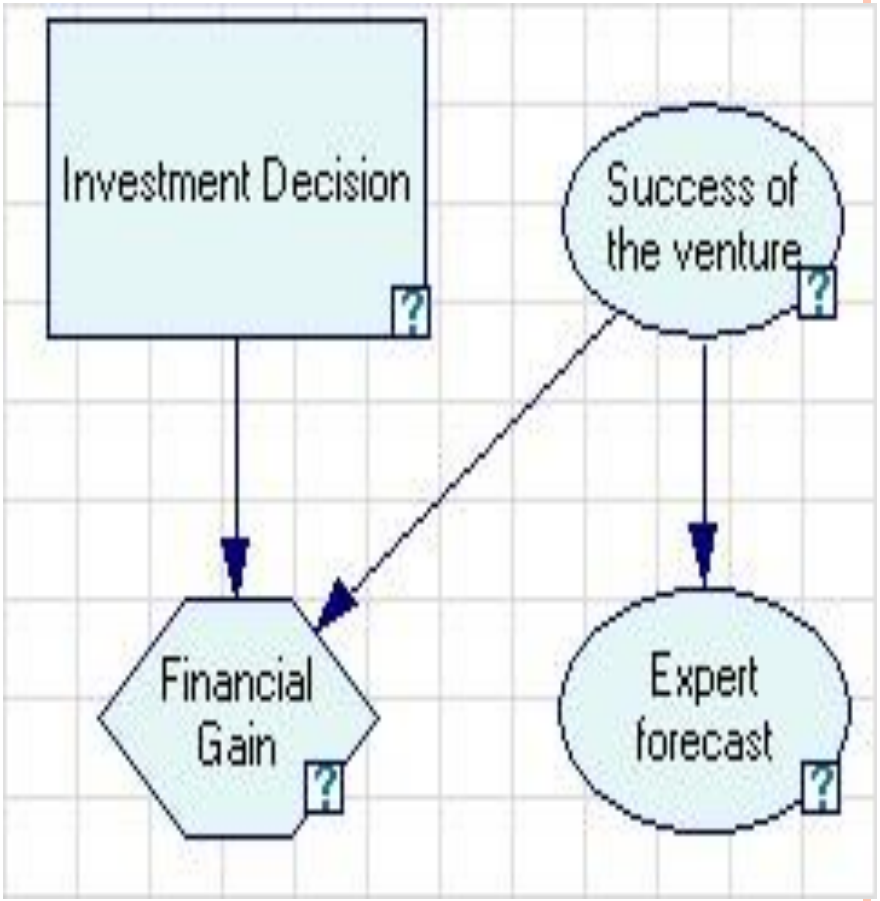
Zachman Framework Model:

- This is an Enterprise modeling tool that summarizes any system in a highly formal way. It classifies the entities and actions involved in the process.
- A Zachman Framework also modifies an informal structured System Dynamics model into a well structured model.
- Rows or Views represents the total view of the solution from a particular perspective.
- Columns focus on some fundamental questions and answers from that viewpoint creating different descriptive representations.
- Each element on either axis of matrix is distinguishable from other elements since they represent different descriptions.

	Structure (What)	Activities (How)	Locations (Where)	People (Who)	Time (When)	Motivation (Why)
Objectives/ Scope (Planner's View)	Most significant business concepts	Mission	International view of where organization operates	Human resource philosophies and strategies	Annual planning	Enterprise vision
Enterprise Model (Business Owner's View)	Business language used	Strategies and high-level business processes	Offices and relationships between them	Positions and relationships between positions	Business events	Goals, objectives, business policies
Model of Fundamental Concepts (Architect's View)	Specific entities and relationships between them	Business functions and tactics	Roles played in each location and relationships between roles	Actual and potential interactions between people	System events	Detailed business rules
Technology Model (Designer's View)	System representation of entites and relationships	Program functions/ operations	Hardware, network, middleware	User interface design	System triggers	Business rule design
Detailed Representation (Builder's View)	Implementation strategy for entities and relationships	Implementation design of functions/ operations	Protocols, hardware components, deployed software items	Implementation of user interface	Implementation of system triggers	Implementation of business rules
Functioning System	Classes, components, tables, ...	Deployed functions/ operations	Deployed hardware, middleware, and software	Deployed user interface (including documentation)	Deployed systems	Deployed software

Influence diagram: System Dynamics

- Influence diagrams are acyclic directed graphs representing decision problems.
- The goal of influence diagram modeling is choosing such a decision alternative that will lead to the highest expected gain.



- Influence diagrams are very useful in showing the structure of the domain, i.e., the structure of the decision problem.

Manned Aerial Vehicles:

- On April 14, 1994, two U.S. Air Force F-15's patrolling the NFZ shot down two U.S. Army Black Hawk helicopters carrying 26 people including 15 U.S. citizens and 11 others.
- Both flights were flying under the control of an AWACS (Airborne Warning and Control Systems) aircraft, the most advanced system of its type in the world.

BLACKHAWK INCIDENT:

US Air Force

No fly Zone (IRAQ)

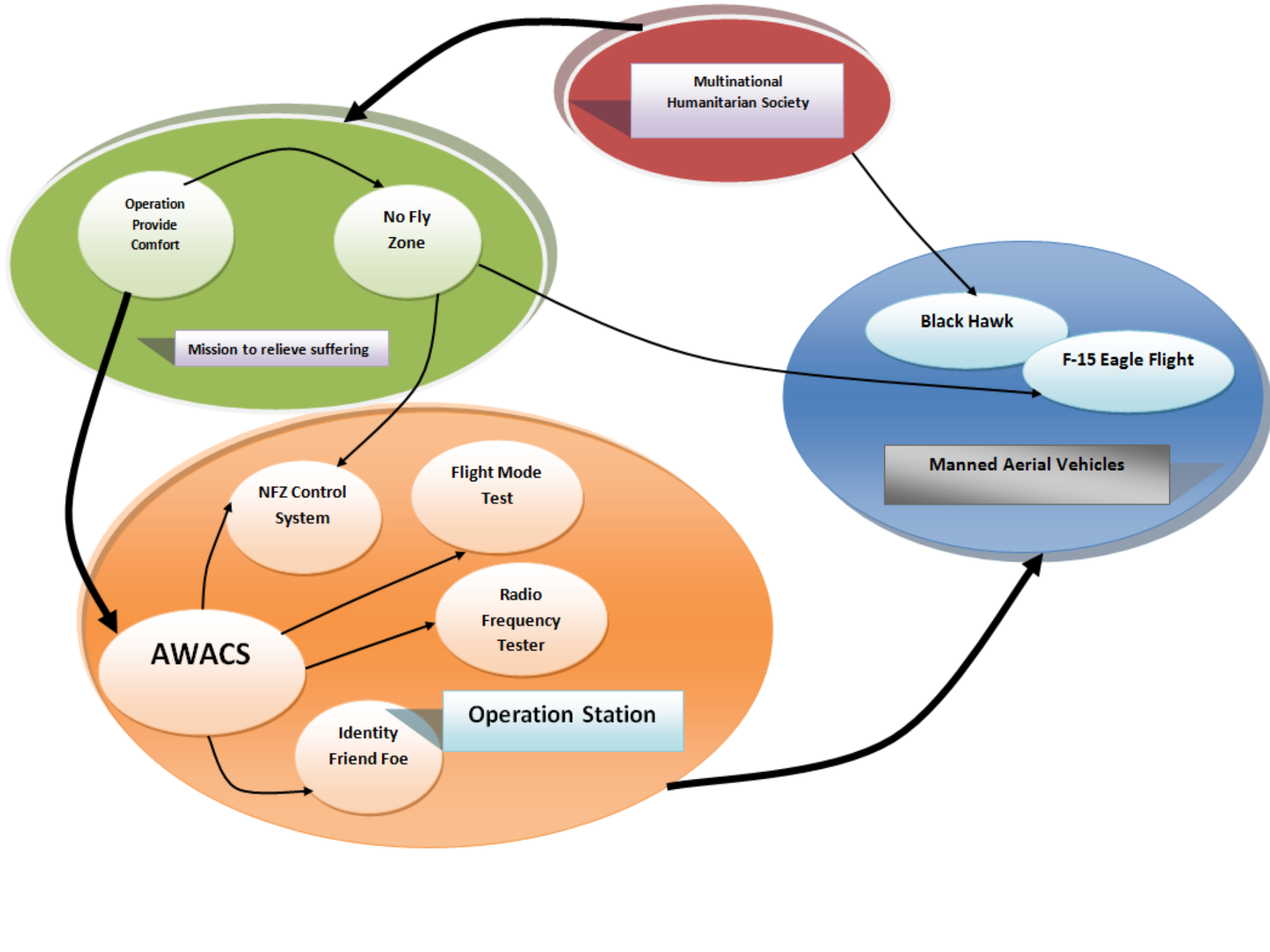
F-15 plane

Back Hawk

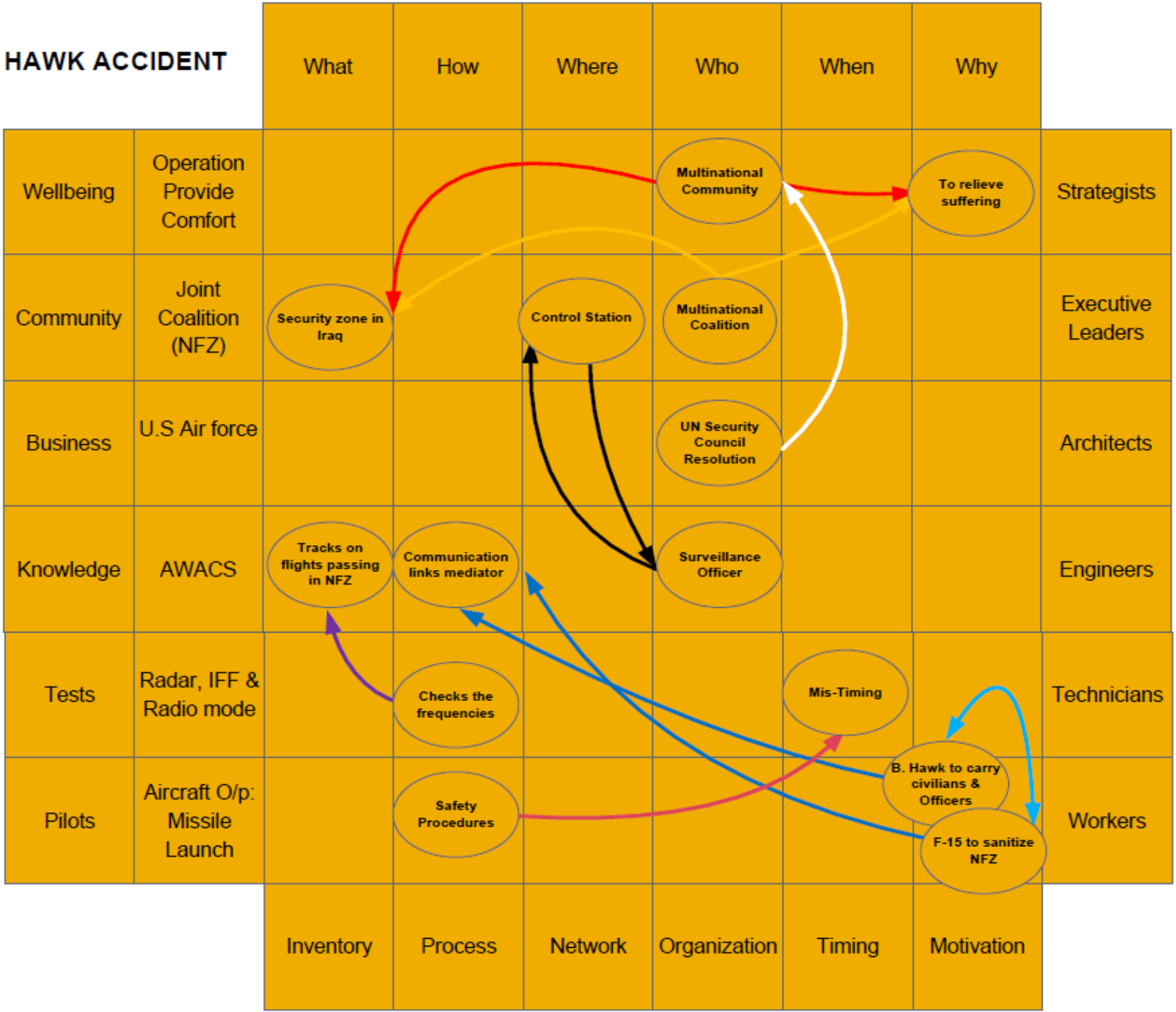
AWACS

CONTINUED….

- Due to miscommunication, AWACS and F-15 could not identify the Black Hawk's and considered it as enemy flight.
- After certain trails in checking their identity, they failed to receive a positive response. Finally F-15 fired missiles on Black Hawk's and destroyed.


Multinational
Humanitarian Society
Operation
Provide
Comfort
No Fly
Zone
Mission to relieve suffering
Black Hawk
F-15 Eagle Flight
Manned Aerial Vehicles
NFZ Control
System
Flight Mode
Test
Radio
Frequency
Tester
AWACS
Identity
Friend Foe
Operation Station

BLACK HAWK ACCIDENT



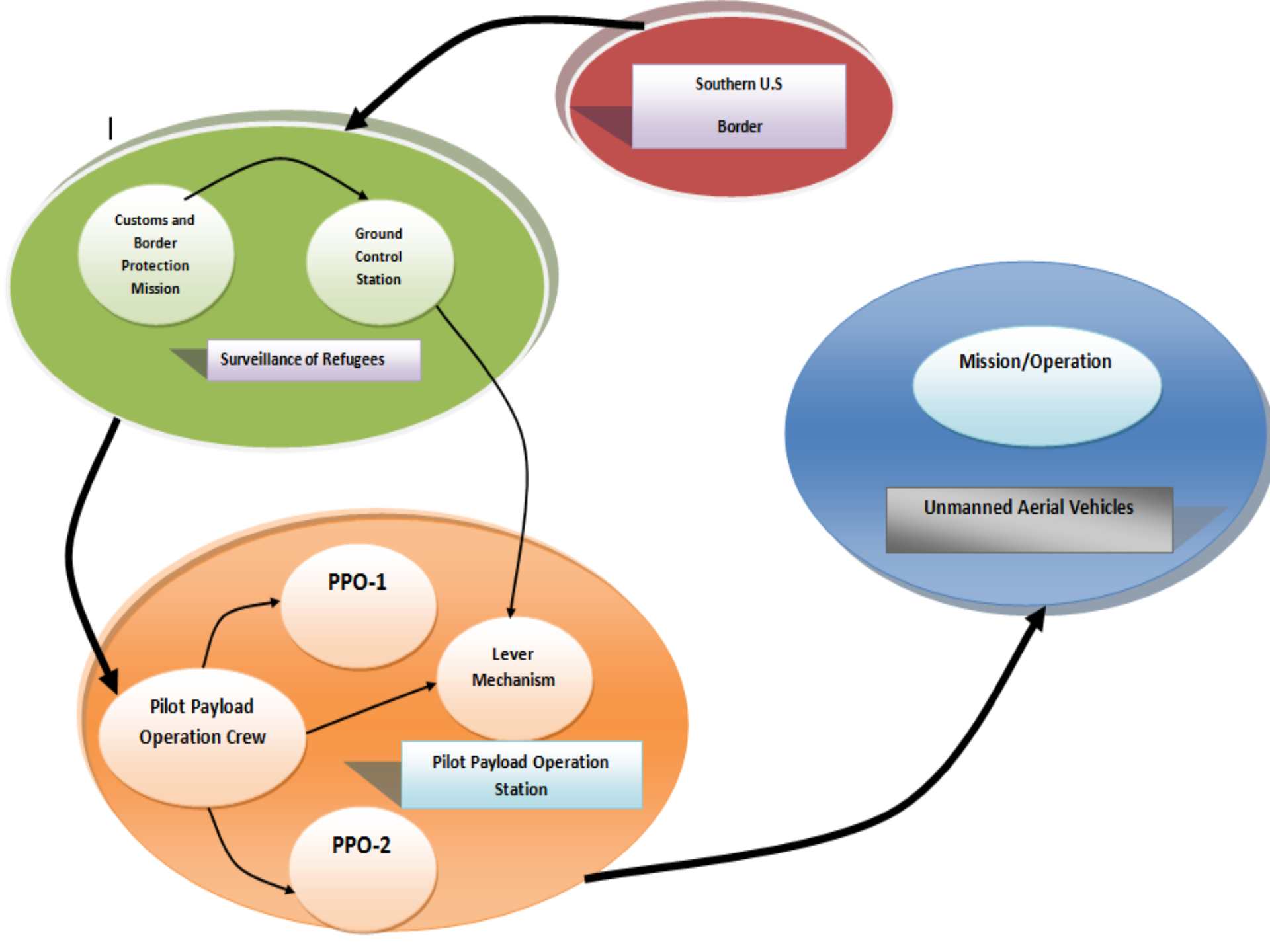
Unmanned Aerial Vehicles:

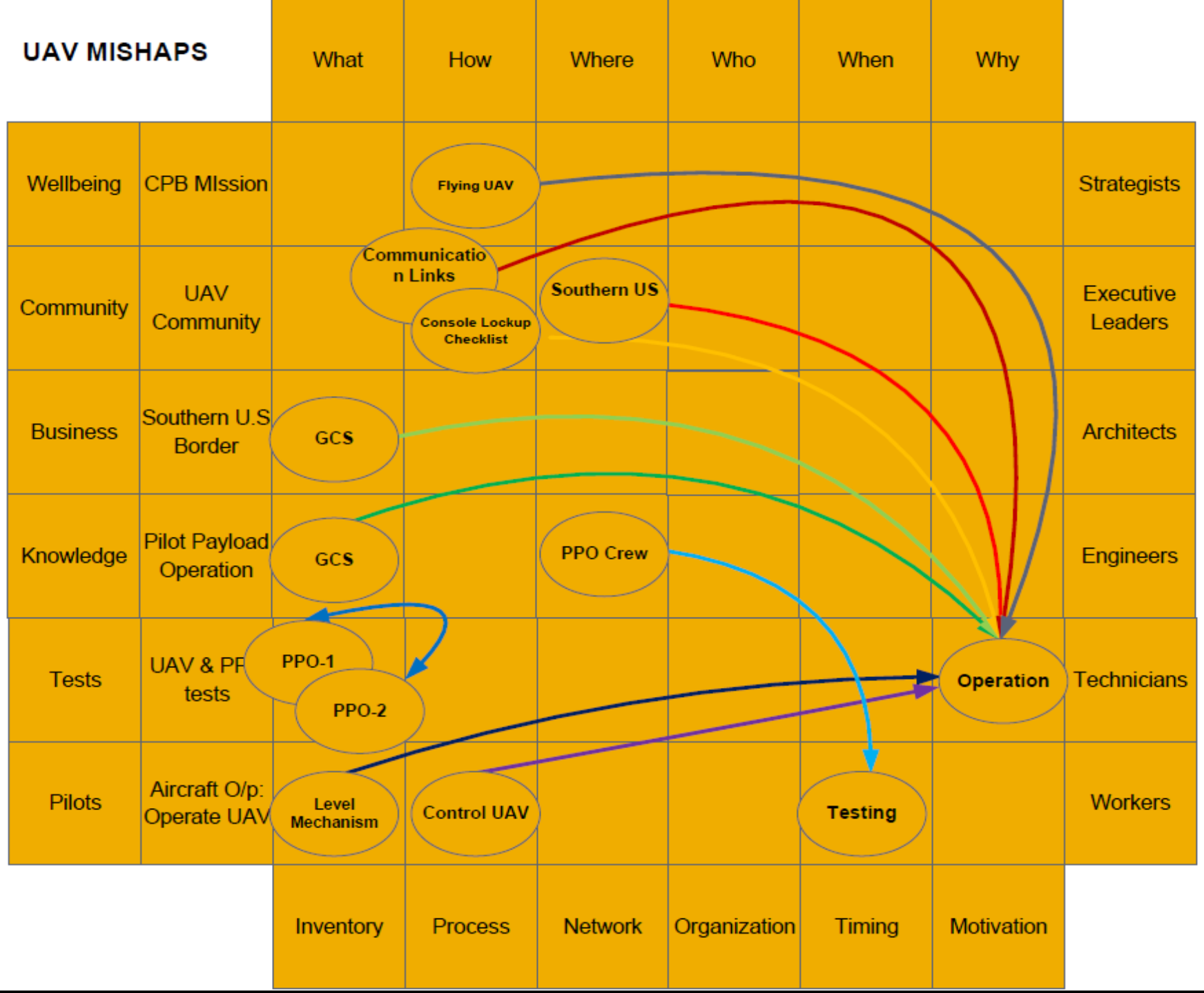
- In April 2006, an unmanned aircraft (UA) collided with the terrain due to loss of engine power while patrolling the southern U.S. border on a Customs and Border Protection (CPB) mission.

- Pilot Payload Operator (PPO-1) was used for initial power-up and to control the fuel valve and Camera Control console (PPO-2) was to adjust the camera.

CONTINUED….

- The flight was being flown from the Ground Control System (GCS). The pilot was ordered to check the instruction manual before changing the controller from PPO-1 to PPO-2.
- The lever position should match in both before shifting the lever. Operator failed to check the matching and that resulted in complete fuel cut off and shut down of the engine.
- Within few minutes UAV lost its amplitude and communication with GCS and crashed


Southern U.S
Border
Customs and Border Protection Mission
Ground Control Station
Surveillance of Refugees
Mission/Operation
Unmanned Aerial Vehicles
PPO-1
Lever Mechanism
Pilot Payload Operation Crew
Pilot Payload Operation Station
PPO-2


UAV MISHAPS
What
How
Where
Who
When
Why
Wellbeing
CPB MIssion
Strategists
Community
UAV Community
Executive Leaders
Business
Southern U.S Border
Architects
Knowledge
Pilot Payload Operation
Engineers
Tests
UAV & PF tests
Technicians
Pilots
Aircraft O/p: Operate UAV
Workers
Flying UAV
Communicatio n Links
Console Lockup Checklist
Southern US
GCS
GCS
PPO Crew
PPO-1
PPO-2
Operation
Level Mechanism
Control UAV
Testing
Inventory
Process
Network
Organization
Timing
Motivation

Conclusion:

- In most cases experiments are followed by failures. But it's important to identify the reasons behind the failures to avoid future damages.
- System Dynamics and Zachman Frame work are two different techniques that helps in understanding the complex nature of any system.
- The above mentioned techniques served the purpose with some limitations.
- The present case that was analyzed using two techniques helped in understanding the situations and provided a chance to regulate similar failures in future.

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