II. Hierarchical Holographic Method

PROBLEM II.1: Analyzing Risks to General Aviation

The purpose of this problem is to identify diverse characteristics and attributes of a general aviation system.

DESCRIPTION

Building a Hierarchical Holographic Model (HHM) will help visualize all of the perspectives as well as the risks for general aviation. General aviation is defined as pertaining to non-commercial and non-military aircraft.

METHODOLOGY

For identifying risk factors, HHM would be generated. The Head Topics cover the major risks to general aviation, with specific details listed under each area as Subtopics. The analysis focuses on the most likely risks.

SOLUTION

The generated HHM is shown in the Figure II.1.1.

ANALYSIS

Weather: One of the greatest risk factors in flying is bad weather, and this is especially true in general aviation. While nearly all commercial carriers are equipped for flight in instrument weather conditions, many general aviation aircraft are not. Also, many pilots are either untrained or not proficient in instrument operations. Additionally, many general aviation aircraft are smaller and more susceptible to problems with high winds, and often have little or no de-icing equipment.

Emergency Response: Limited emergency response capabilities are another area in which risks are higher for general aviation. Airports with large volumes of commercial traffic are likely to have emergency response resources and plans in place. Small general aviation airports with little traffic are much less likely to have good emergency response capabilities. Also, it can be difficult to locate small airplanes that have crashed away from an airport. Because small aircraft are frequently not tracked by air traffic control, they may be difficult to find after a crash or emergency landing.

Flight Operations: There are numerous risks associated with flight operations, many of which are closely tied to the other Head Topics identified in the HHM. Mechanical and electrical failures and human errors are all closely tied to the risks of flight operations. Disorientation, getting lost, running out of fuel, and flying into terrain are just a few of the risks associated with general aviation flight operations.

Mechanical Failure: In an aircraft, failure of nearly any mechanical system can be potentially dangerous. Engine failure, flight-control failure, or any structural failure may be catastrophic. Failures in the landing gear, doors, windows, propellers, and even seats can also be serious problems.

Electrical Failure: The electrical system is an important component of nearly any aircraft. The engine ignition system is of course critical to engine operation, and some instruments depend on the electrical system. Communications systems are also extremely important and are electrically operated. Particularly around airports, exterior lighting is important to reduce the risk of collision.

Human Errors: In almost any endeavor there are risks associated with human errors. In general aviation, the largest risk is pilot error. Because general aviation pilots tend to be less experienced and not as well trained as commercial pilots, the risks of pilot error are greater. Also, there are risks associated with errors by inexperienced pilots in other planes. Errors by air traffic control personnel, both flight and ground controllers, as well as by preflight briefers, constitute other risks.

Ground Operations: At busy airports, ground operations can become very hazardous and are a major concern for all air traffic. For general aviation pilots who may be less familiar than commercial pilots are with a given airport, the risks may be increased. Also, because general aviation aircraft tend to be small, a collision with a larger aircraft is likely to be catastrophic.

Security: Though general aviation is rarely a target of terrorism or sabotage, this possibility cannot be completely discounted. Also, attacks against commercial carriers could cause secondary effects which affect general aviation, such as damage to airport air traffic control facilities. Also, some level of security is important to keep people from unintentionally causing problems by straying onto runways and taxiways. Keeping animals out of airport operation areas is still another important consideration.

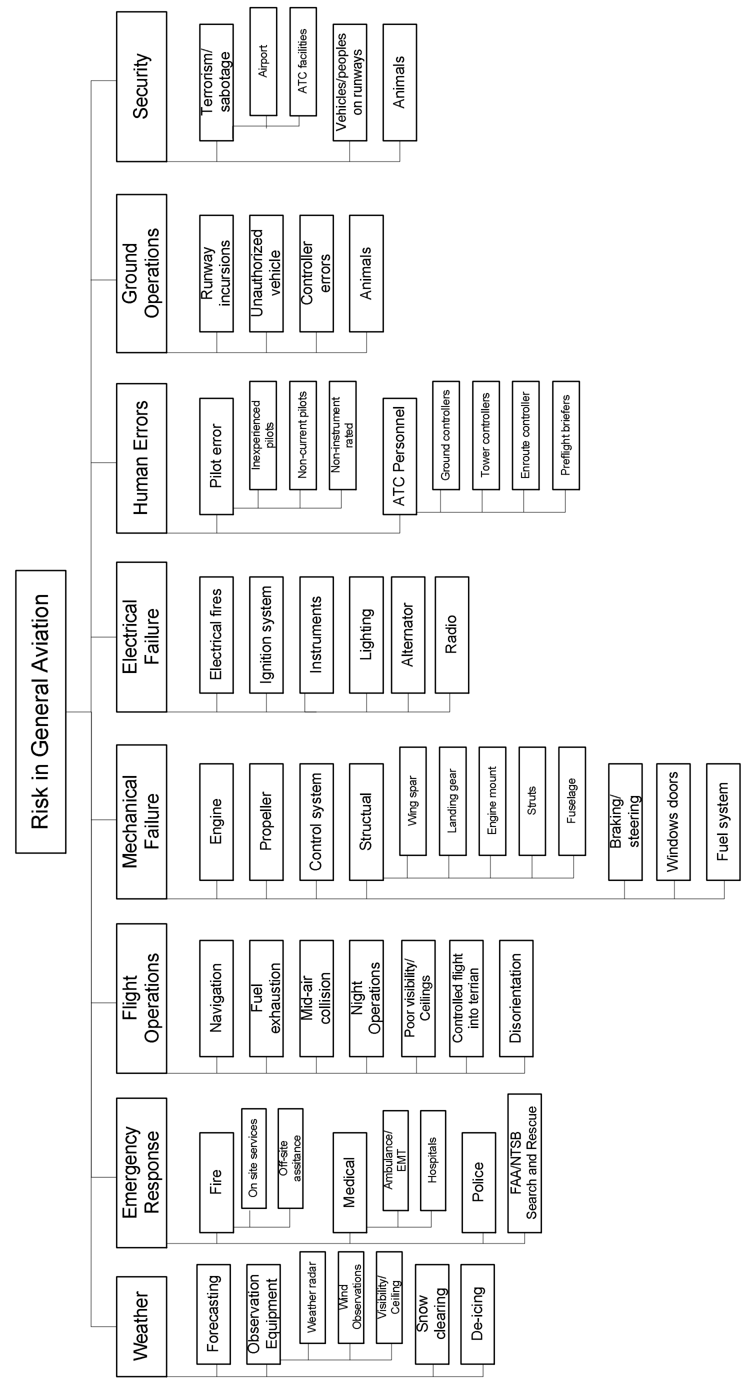

Figure II.1.1. HHM for General Aviation

PROBLEM II.2: Transforming the US Army

The purpose of this problem is to identify diverse characteristics and attributes of the U.S. army.

DESCRIPTION

The supreme test of all armies is to adapt rapidly to circumstances that it cannot foresee. Transformation is the US Army's answer to this challenge. Modularity, a major part of the transformation campaign, allows the Army to retain a wide range of capabilities while significantly improving its agility and versatility. Joint and expeditionary units, with interchangeable force structures, satisfy the requirements of current and future operational challenges. However, Army modularity is not without its risks.

METHODOLOGY

A Hierarchical Holographic Model (HHM) for the US Army modularity initiative provides a holistic approach to risk assessment by considering many dimensions as Head Topics.

SOLUTION

The solution is as shown in the HHM (Figure II.2.1).

ANALYSIS

As a way of addressing emerging security threats and adapting to a changing strategic theatre, the US Army needs the capability to conduct swift, simultaneous, and non-contiguous military operations. The major risk topics considered were: *temporal, institutional, organizational, force management, operational, resource allocation, future challenges,* and *consequences.* Under these Head Topics, Subtopics were listed in a risk hierarchy in order to identify areas of risk within Army modularization. This decomposition allows tradeoff analyses to be performed among subsystems, while maintaining the integrity of the overall system. In the real world we are faced with resource constraints, which prevent us from eliminating risk from all possible sources. The HHM approach to the risks of Army modularization allows relaxing some of these constraints by focusing on smaller, more manageable subproblems.

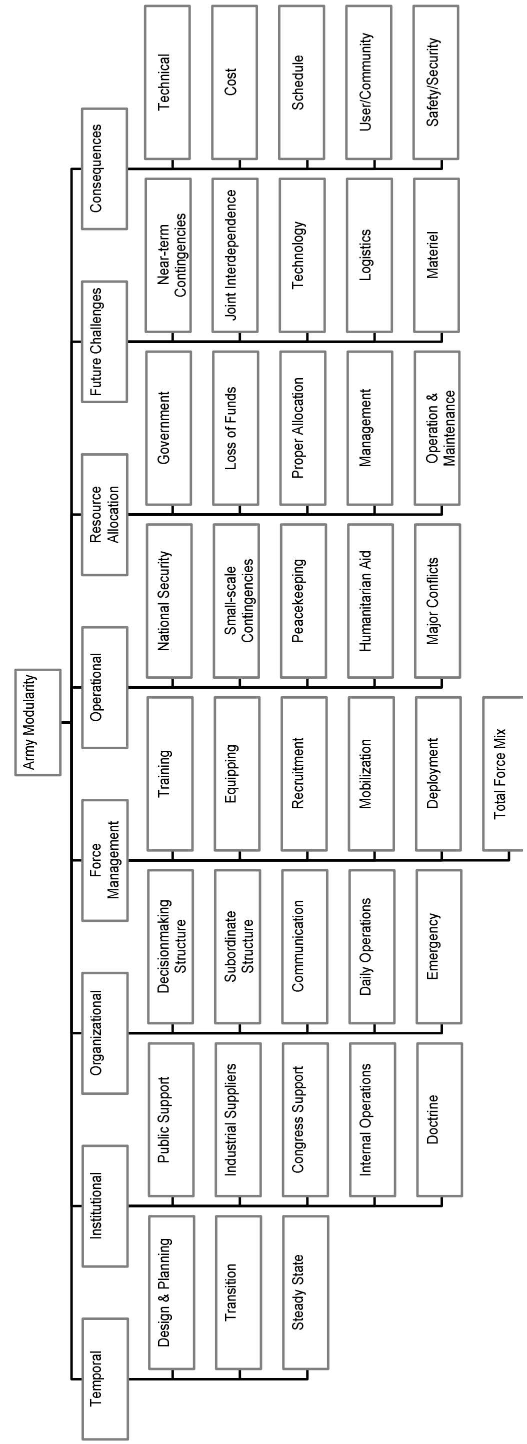

Figure II.2.1. HHM for US Army Modularity

PROBLEM II.3: Developing an Ordnance System

The purpose of this problem is to identify diverse characteristics and attributes of an ordnance system.

DESCRIPTION

Supportive elements as well as risks need to be considered when developing an ordnance system.

METHODOLOGY

A Hierarchical Holographic Modeling (HHM) is constructed to reveal the many perspectives of an ordnance system and eliminate sources of failure.

SOLUTION

The constructed HHM appears in Figure II.3.1.

ANALYSIS

The HHM helps to identify the sources of risk in the acquisition and development of ordnance systems by breaking down the concepts and developmental aspects into comprehensive categories that support the project. At the same time, HHM identifies the multiple perspectives of the system that are required for successful development. For example, the HHM identifies data which can be categorized as technical, engineering, management, and support data, as well as data depository reserved. Each of these data subcategories is unique and describes the many and diverse components required for a successful ordnance system. Technical data provides the ordnance specifications while the engineering data provides the interfaces and assembly of the technical systems.

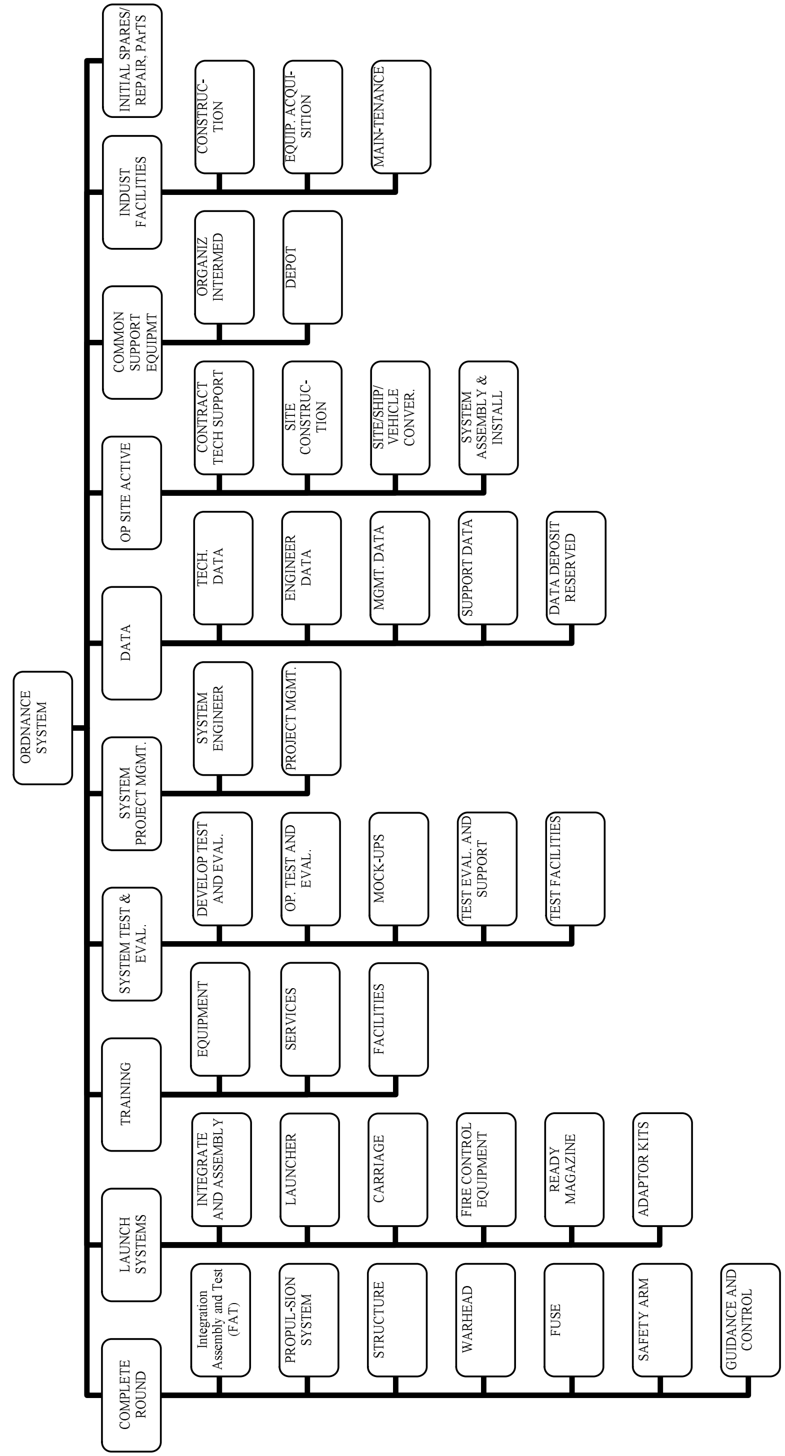

Figure II.3.1. HHM for Ordnance System

PROBLEM II.4: Assessing Risk to an Air Vehicle

The purpose of this problem is to identify diverse characteristics and attributes of an air vehicle.

DESCRIPTION

We need to determine the components that might contribute a certain amount of risk to the overall performance of the air vehicle.

METHODOLOGY

To solve this problem, we construct a Hierarchical Holographic Model (HHM) for an air vehicle. This is followed by utilizing the Risk Filtering Risk Management (RFRM) method to prioritize the most critical sources of risk.

SOLUTION

The constructed HHM is shown in Figure II.4.1.

ANALYSIS

The HHM provides a framework of the components in the larger system. As the possible risks are analyzed, they can be prioritized using RFRM to determine which ones post the most risk and are most important to mitigate. When a new list has been constructed, this process is repeated to identify and manage the components that may contribute the most risk to the successful fielding of the air vehicle.

In the HHM below, for example, *Weight Management and Control; Fire Control and Stores; Avionics Definition*; and *Offboard Mission Support* could be determined to pose the most risk for a successful design, while *Propulsion; System Design*; and *Pilot Systems* may be thought to have little risk. Consequently, the first group will receive more attention in an attempt to reduce the risks.

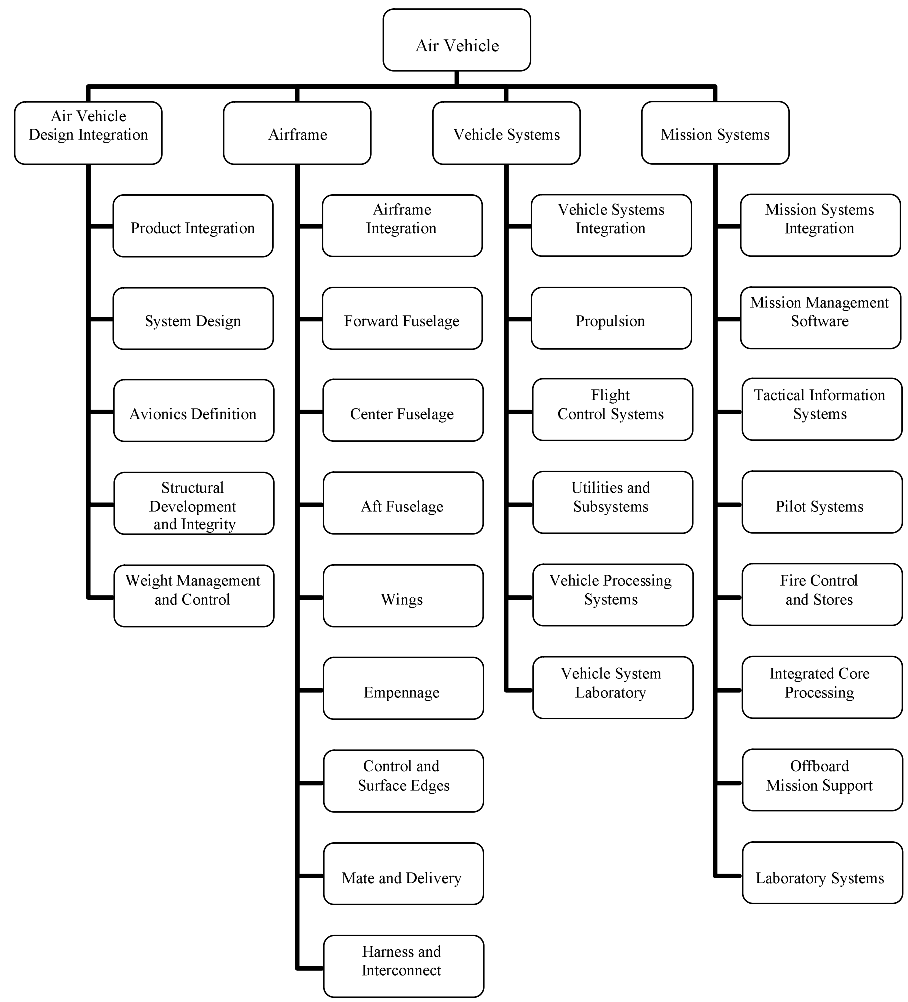

Figure II.4.1. HHM for an Air Vehicle

PROBLEM II.5: Analyzing Risks for a New River Tunnel Project

The purpose of this problem is to identify diverse characteristics and attributes of a new river tunnel building project.

A metropolitan area is divided by a river with a few bridges over it. The average highway speed during hurricanes or heavy snowfalls has been down by 20 mph compared to the normal rate of 40 mph. This condition causes heavy traffic jams and can lead to huge economic losses. The state department of transportation is now considering building a river tunnel. To assure the success of this project, the department's staff needs to characterize the risks in terms of various perspectives.

Using HHM, develop comprehensive risk scenarios to capture societal elements taking into account the presence of multiple decision makers and stakeholders.

PROBLEM II.6: Controlling River Flooding

A river supports the economic and social activities of the surrounding community. However, controlling its seasonal channel overflow also poses a huge challenge to the government. The adverse effects of the annual river channel overflow have caused the city millions in terms of emergency response activities, economic losses, and the rehabilitation of affected communities, among other aspects. To address the problem, this exercise aims to apply risk assessment through the art and science of modeling.

Construct a Hierarchical Holographic Model (HHM) to identify the different perspectives of the river flooding problem described above.

PROBLEM II.7: Developing an HHM for a High-Speed Rail Project

The purpose of this problem is to identify diverse characteristics and attributes of a high-speed rail project. A High-Speed Rail (HSR) project is currently the most important transportation goal in one state and will be a key component in its economic future. This is the first state public infrastructure project based on the *Build, Operate, Transfer (BOT)* method, This means that the state invites investment proposals from the private sector, to select the main contractor for the project. The state government then negotiates a Construction & Operation Agreement (C&OA) with the main contractor to secure financing for the project and design, construct, operate, and maintain the complete system, then ultimately transfer it back to the government. According to the C&OA, the main contractor will build and operate the HSR system for a period of 35 years. The government also grants the main contractor the exclusive right to undertake property development around station areas for a period of 50 years.

Construct a Hierarchical Holographic Model (HHM) to identify risks in the HSR project described above. Through identification of potential risks in the HSR project, government decisionmakers will be able to gain insights into all the system components as well as to identify risks and their relationships to system components.

PROBLEM II.8: Waste Management

The purpose of this problem is to identify diverse characteristics and attributes of a waste management system.

An acid distillation plant located in a small city processes raw-grade reagents such as sulfuric acid (H_2SO_4). An urgent concern of the company is the proper disposal of the acid byproducts, which are assumed to be extremely injurious. The company currently commissions a trucking company to dispose of its waste to the three treatment facilities located in New York, Arkansas, and Illinois. The company has also considered options such as building its own treatment facility or, better yet, improving its materials and processes to minimize, if not eliminate, the accumulation of the hazardous byproducts.

Sulfuric acid is widely used in industrial products such as car batteries. The typical transformation of a raw-grade reagent to a commercial-grade sulfuric acid consists of the following activities:

1. Procurement of raw-grade reagents from suppliers
2. Airing of reagents to remove sulfates (SO_3) and other impurities
3. Distillation
4. Separation of toxic byproducts
5. Cooling of distillate
6. Laboratory testing and inspection
7. Bottling (1-L Containers) and sealing
8. Packaging
9. Delivery of commercial-grade H_2SO_4 to end-users

The 1-L bottles are double-checked for cleanliness. In-house subcontractors perform three-step washing, which includes dipping the bottles into a detergent solution, rinsing with tap water, and a final rinsing using distilled water.

Develop a Hierarchical Holographic Model (HHM) to identify the sources of risk to help determine the best option for disposing of the waste.

PROBLEM II.9: Evaluating Risks for a New Shopping Mall

A construction firm wants to develop a new shopping mall. Before starting the project, they would like to check any potential risk scenarios involved in order to avoid or minimize financial and non-financial losses.

Develop a Hierarchical Holographic Model (HHM) to capture and represent the diverse characteristics and attributes of building, operating, and maintaining a shopping mall.

PROBLEM II.10: Identifying Risks for the Airline Industry

The purpose of this problem is to identify diverse characteristics and attributes of the airline industry. Risk identification is a critical first step to effectively manage and mitigate risks to the airline industry to the maximum extent possible and provide safe and efficient air travel while maintaining profitability and stability.

Construct a Hierarchical Holographic Model (HHM) to identify sources of risk for the airline industry by considering planning factors such as level of complexity and industry impact.