**Coursework 2 – Report**

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Course

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**Introduction**

In an attempt to ensure that the ISS program stands the test of time and goes on to the realization of its objectives, various mechanisms have been put in place. The risk management initiatives are continuous initiatives given that the ISS program is susceptible to risks at any given time. This makes the risk profile of the organization to be a bit high. The paper considers an in-depth analysis of the organization's risk and identification of its profile, identification of the ERM systems that were in place and if they were compliant to the regulations, the corporate governance of this organization, and the impact of all stakeholders on risk management processes that were in place and recommendations of appropriate risk management that could improve ISS performance.

**Analysis of the Organization’s Risk and Identification of its Profile**

The International Space Station (ISS) and its astronauts face a series of potentially disastrous risks in Earth Orbit. The risks are many. For instance, the impact from the space debris and micrometeorites are some of the potentially serious risks that can harm the ISS astronauts, force an orbital evacuation, and go ahead to destroy the half-built space station. There is a possibility Micrometeoroid and orbital debris damage/penetration (MMOD) is likely to injure a crew member and cause harm following damage or penetration of one of the ISS models. Consistent with other risks, there is also the risk of potential fire, of which adequate mechanisms have been put in place to mitigate the potential outbreak of fire. For instance, when the fire is detected on board, the crew is in a position to locate the fire source using multiple methods, which removes power from the affected area, extinguishes fire, and coordinates with the ground in an attempt to address the fire. There is a possibility of toxic spills as well. The quantities and types of materials onboard the ISS, which could lead to loss of crew, or the ISS tend to be more limited than those, which could lead to crew health concerns or premature abandonment. There is also likely to be a compromise of an information technology system that happens to be a threat to any computing network, and the existence of a deliberate attack that uses the ground command system to issue commands to the ISS systems is likely to have catastrophic results. The threat of premature abandonment is also significant (Popov, 2020). This is caused by numerous factors such as loss of ground/support, inability to supply adequate consumables and critical spares, inability to maintain the major technical systems required for operation, and the inability to maintain a pressurized environment the station crew members can work safely.

The threats and risks are significant enough to warrant adequate design and operational controls that are tailored towards ensuring that the threats do not materialize in a manner that will force the ISS to be abandoned before the completion of its planned mission. The control and management processes that have been put in place need continuous review and improvement. There exist problems that result in vulnerabilities and therefore call for the need to develop improvements. ISS Program is supposed to reduce the risk of the ISS crew and the ISS program by considering the many tradeoffs and loopholes that expose the ISS. The fighting activities continue to remain a challenging endeavor for both humans and machines, and therefore, there is no room for loopholes as far as risk management is concerned. The risk assessments show that great strides have been made in the decades of space flights, and there exist many others, which remain unknown. There are many dangers, which can only be mitigated by ensuring the program's highest diligence and support to ensure that the problems can be found before they escalate to catastrophic events (Gaffney et al., 2020). Given the nature of the program, the magnitude of the interventions that have been out in place, and improvements that are yet to be factored in, it suffices to say that the ISS program's risk profile is profound.

**Identification of the ERM Systems That Were In Place and If They Were Compliant To Regulations**

Early in the preparation and planning stage, the potential risks must be categorized, identified, and evaluated. Indeed, there have been numerous ERM systems that have been put in place by the ISS program stakeholders to curb most of the uncertainties. Micrometeoroid and Orbital Debris (MMOD) protection designs are tailored towards mitigating the existing risks. For instance, there is a mechanism whereby the MMOD threat is studied by first maintaining and developing an environmental model of the density and sizes of the debris and micrometeoroids present in near-Earth orbit (Cooney, 2016). The environmental model is then used with another model that helps predict damage to the station in a particular attitude and configurations to calculate the probabilities of the various categories of damage to the ISS. The environmental models are developed by the use of ground-based observations such as optical telescopes and radar and investigation of hardware, which is returned from space. MMOD risk requirements should be developed and approved by NASA by considering the trade between the design complexity and the weight of the resulting design. For instance, it is required that it comply with the overall ISS shielding penetration probability requirement of less than 24% over 10 years, which equates to a "probability of no penetration" of 0.76 (Bacholle et al., 2021).

The ERM system has also been used to enhance software security. The workstations and software which perform communications and commanding functions also have several security measures in place. All the workstations for command and telemetry tend to be continuously monitored by standard software and are scanned quarterly for vulnerabilities using the latest industry-standard security software. Password protection has been put in place in all the workstations, and there are only a few accounts, which can access ISS commanding servers, which may require additional passwords. Access is further limited by partitioning the available commands by user groups, and the users only tend to have access to the commands that are necessary for one to perform that discipline’s function. All commands to the vehicles have been well encrypted and are supposed to pass through a series of authentications and validity checks (Coil et al., 2016).

There is a system tailored towards realizing collision avoidance between the ISS and the SSRMS, which is provided through sound design. The system enables four levels of mitigation. The first one is the SSRMS design, which entails designed-in detection systems, which protect it together with the ISS from a collision. It has an automatic detection capability for impeding self-collision. There is also detection for the potential uncommented motion of the SSRMS. This is achieved by monitoring the position of the arm and the rate of motion to determine whether the arm is tracking to the intended position. The ISS crew has video feeds to assist them in monitoring SSRMS movement. The second level of mitigation is performed through mission design and the planning of the arm operations. The missions are developed by the designers who use certified models and tools in order to perform analysis and planning (Torralba et al., 2019). All the procedures are then verified before the mission by the use of high-fidelity simulators. The third level of awareness is maintained through the SSRMS and ISS cameras as well as direct viewing, and the stakeholders can monitor the activities and tend to be capable of stopping the operations. The final level has to do with ground operations whereby the operations are performed to the verified procedures, which have been verified through simulation and analysis.

A system distributes an on-orbit vehicle, and it is monitored and operated by an integrated group of experts. There is also an on-beat pre-positioning of spares which is used in risk mitigation throughout the ISS assembly. The critical spares are identified on a stage-by-stage basis to respond to the failures that are likely to threaten the loss of the ISS or alter the sequence of the stages.

**The Corporate Governance of This Organization and the Impact of All Stakeholders on Risk Management Processes That Were In Place**

The program's management is spearheaded by NASA's human spaceflight programs, which depend on a more structured process for real-time problem solving and decision-making. The problem is actually governed by the mission management team (MMT). The team operates by a complex and unique process. It is a continuous process to support the station's needs considering that the ISS is continually on orbit. The team reports out on real-time operational data, considers solution options to problems, and supports the MMT process. There is also the ISS mission and safety assurance organization, which is responsible for managing the ISS safety program.

Given that it integrates directly to the program manager, it draws support from many of its affiliate organizations. There are also safety review panels responsible for approval and review of the hazard reports and the safety data packages required for purposes of flight approval. They obtain the required technical support from the required engineering organizations. Some rigorous processes and requirements are in place to support such reviews. The Mission operations Fight Director tends to be responsible for the real-time actions taken in response to the anomalies and safeguard the vehicle (Harris and Simpson, 2016). Another important part is the fleet leader program spearheaded by the program risk advisory board that actively identifies, addresses, and communicates risks across the program. The program's corporate governance is well synchronized to realize the risk mitigation objectives of the organization. This is also meant to ensure the impact of the stakeholders is evident across the board.

**Recommendations of Appropriate Risk Management That Could Improve ISS Performance**

The ISS program is supposed to do considerable work to research and also model the MMOD environment. The work will enable the program to identify the criteria for design and determine the level of risk from MMOD to the ISS vehicle and crew. It will help the stakeholders in identifying and incorporating the design solutions to address the problem. The risk for fire outbreaks has been effectively taken care of, and there is only the need to reinforce the existing mechanisms by even taking the orbit crew through the emergency fire response refresher training to ensure that their response remains sharp at all times. For the toxic spills, the primary means of containing it can be by controlling the types and quantities of toxic materials used on the ISS vehicle (Owens and de Weck, 2018). Before the flight, all the materials, including crew provisions, systems hardware, are evaluated to determine whether they contain materials that are a toxicological threat. The same can be reinforced by having the archival samples taken at various points in time and then returned to the ground for detailed analysis by the stakeholders. Given the security concerns related to the information technology (IT) system, there is a need to continuously revise the security policy in an attempt to ensure that there is no room for risks. Command security ought to be audited by NSA on a periodic basis to ensure that the system is not susceptible to looming threats. Finally, the ISS program is supposed to implement a systematic process that will document the program lessons that have been learnt across all the ISS disciplines. The lessons learnt are supposed to be incorporated in a broader and cross-cutting institutional process to capture and teach lessons and best practices to all future programs, technical and project managers.

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