System Engineering

*(A Case Study of NASA’s Advanced Communications Technology Satellite)*Baby Vennela Kothakonda

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# Introduction

The research report is developed to explore the competence of the ACTS (Advanced Communications Technology Satellite) project of NASA in terms of the usage of efficient designing and implementation processes. The stakeholders linked with the accomplishment of the ACTS project are highlighted along with elaborating the communication and collaboration process used among them to have effective project completion. Further, the method of decision-making method used within the selection and management of components of ACTS is analyzed and this is ultimately used to document learnings achieved from the project.

# Key Objective of the ACTS Project and Respective Scope in Augmenting Communication Technology

The vital objectives of the ACTS project are highlighted as follows along with highlighting the respective scope in augmenting communication technology-

* The project focussed on exploring and implementing innovative techniques of the on-board process. The objective aided the ACTS project to develop the capability of digital processes for managing different communication tasks like decoding and recording easily.
* The project aimed at exploring the implication of the technique of multiple HBA (Hopping Beam Antenna). The finalization of the objective assisted the ACTS project in using and reusing allocated frequencies efficiently (White & Jean, 2011).
* The objective of the ACTS project was to augment the technology of communication exclusively for the Ka-band in order to develop progress in space. The determination of the objective aided the ACTS project to provide flexibility and agility in the enhancement of communication services of U.S. entities.

# Challenges Tackled by NASA in Framing and Deploying ACTS

The vital challenges tackled by NASA in the framing and deployment of the ACTS project are-

* The team of the ACTS project faced technical complexities while using and implementing techniques like multiple HBA and on-board processing because of the requirement of time-time experiments.

In order to explore the technical challenges existing in the operation of the ACTS project, the respective team followed the framework of architectural evaluation detailed in the iLearn case as this enabled finding the inefficiency in the system against the upcoming requirement in the space project (White & Jean, 2011). The incorporation of the information technology (IT) infrastructure evaluation model helped in finding how the existing data fetching capability within functions like HBA would help in getting the required information periodically and frequently which ultimately aided in finding possible deviation from the determined goal.

* The team of the ACTS project faced signal propagation and interference-related challenges while using high frequency during the project management.

Using the cause-and-impact analysis model, it became feasible for the team of the ACTS project to know the pros and cons of the high-frequency system usage which ultimately enabled in finding and challenge of interference and signal propagation management. The signal quality management-related problem associated with the ACTS project was overcome by adjusting the signal system appropriately as per the requirement to avoid related risks in the future.

* The management of the ACTS project faced challenges in ensuring a collaborative framework across the operation because of the involvement of different disciplines like sociology and philosophy.

The team of ACTS followed the change management-related model to recognize the possible challenges while implementing and accomplishing the ACTS project and this enabled finding the risk of innovation and lesser collaboration among the entire departments. In order to overcome the innovation and creativity-related challenge possible in the case of the accomplishment of the ACTS project, respective leaders followed the model of a cross-departmental approach which enabled it to involve employees of different units and expertise in the development of different technical traits. The involvement of different experts in the solution development process of the ACTS project enabled us to overcome the innovation-related challenge by evaluating every problem in different aspects.

* The team of the ACTS project faced a budget limitation challenge as the respective approval made by Congress was limited.

In order to estimate and predict the budgeting-related challenge possible in the case of the ACTS project, respective team usage predictive technique of analytics and degree of collaboration from the team of Congress as this helped in finding probable differences in financial resource allocation and usage (White & Jean, 2011). Following the budget estimation and respective requirements in the different stages of the ACTS project, the leaders of the project became efficient in sourcing the necessary amount of working capital in advance by proposing respective budgets from Congress which ultimately aided in allocating and using necessary funds on time without any funding shortage issue.

# Analysis of the Process of Integration of Different Subsystems of ACTS and Their Contribution to Communication Trait of the Satellite

The process that the team of the ACTS project used for integrating multiple subsystems is detailed below along with highlighting respective contributions to the satellite’s capability of communication-

* The OBP (On-board Processing) subsystem was used to manipulate and process the boarded signal before reception. The manipulation process of the subsystem aided in optimizing the adaptability, agility, and efficiency of the overall link of communication.

In order to integrate varieties of subsystems of ACTS, the team of the project used OBP as this enabled it to process and customize the associated signal precisely before the stage of reception which ultimately helped in increasing the agility, efficiency, and adaptability of the communication system.

* The population subsystem was used in the ACTS project to control the satellite for maintaining its respective position in space along with optimizing the link of communication (White & Jean, 2011).

In order to overcome the communication inefficiency-related problem of the ACTS project, the respective team used the feature of the population subsystem as this enabled it to track and maintain the position of the satellite precisely and this ultimately aided in enhancing the competence of the communication link (White & Jean, 2011).

* The deployment of subsystems aided in bringing a greater degree of reliability and stability to the service of communication.

In order to overcome the stability and reliability of the information shared by the communication system of the ACTS project, the team strategically used diversified subsystems across the project which enabled establishing and enhancing the efficiency of communication without any interference issue. The advanced treatment for any signal processing and usage issue enabled in overcoming the stability and reliability issue of the communication service of the ACTS project.

* The link optimization innovation in the ACTS project enabled satellites to communicate with the destination at lower frequencies. The development of low-frequency communication ability surged the power and creativity of space researchers to find a competitive approach to enhance the success trait of satellite projects.

In order to overcome the functionality issue of satellite in case of low-frequency availability, the team of the ACTS project followed the model of cause-and-impact analysis related to the information technology architectural framework which aided in finding optimization innovation practice. The integration of the efficient communication capability within the ACTS project enabled to development of the power of information sharing even at low frequency which ultimately enhanced the success probability of the project.

# Examination of Coordination Essential Among Stakeholders of ACTS

All the stakeholders like the ACTS team, government agencies, and research institutions are necessary to get a collaborative framework as these aid in establishing a real-time communication channel or medium among them. The establishment of a collaborative communication platform helps all the stakeholders of the ACTS project to share information in real-time and this eventually aids in making innovative and informed decisions to get the goal accomplished (White & Jean, 2011). The project progress communication and changes related to coordination and collaboration are necessary among the stakeholders of the ACTS project as these aid in assisting each of them to know the exact progress of the task to take corrective decisions accordingly. The team members associated with the ACTS project are asked to work in a collaborative framework using a cloud infrastructure. The availability of a collaborative working approach enabled the stakeholders to track the changes in the ACTS project on time without any gap in respective communication which eventually aided in taking corrective action to avoid any project or quality gap.

# Technological Innovations Deployed in ACTS and Respective Influence on Augmenting Communication Capabilities of Satellite

The vital innovations applied by the ACTS project in the field of technology are highlighted below along with detailing respective influence in the augmentation of the satellite’s communication capabilities-

* S.B. (Spot Beam) technology was innovated by the ACTS project for focusing respective signals of communication on a targeted demographic area. The innovation aided in augmenting the communication efficiency of the satellite by optimizing and processing bandwidth as well as power (White & Jean, 2011).

In order to overcome the communication inefficiency-related problem possible within the functionality of satellite, the team of ACTS project developed an S.B technology using the backward innovation approach which enabled it to explore the approach for bandwidth optimization and power enhancement. The enhancement in the bandwidth management-related capability within the satellite of the ACTS project helped in enhancing the communication trait of the system.

* ACTS project developed frequency reuse technology for having similar spectrum frequency from different S.B. The innovation helped in augmenting the usage ratio of the assigned spectrum which ultimately augmented the satellite’s capacity.

For enhancing the communication capabilities of satellites, the team of ACTS project explored the functionality of reuse technology which enabled it to encourage the system to find a way to estimate the usage ratio of the allocated spectrum and this ultimately assisted in overcoming the capacity management problem of the system (White & Jean, 2011).

* Usage of collaborative communication innovation has enabled all teams of space research to work on the development of satellites in parallel style.

For overcoming the time shortage and deadline-missing related problems possible in the case of the ACTS project, respective leaders followed the framework of collaborative communication as this empowered all units and related staff to work on satellite features parallelly which ultimately aided in solving the problem of innovation, and time management.

* The development of a parallel working style has contributed to the satellite project’s team to establish and manage effective communication during and after launch.

The following collaborative and parallel working approach enabled the team of the ACTS project to share related information in real-time to avoid any communication gap across the launching and operation of the ACTS project and this ultimately helped overcome innovation and failure problems.

# Scope of Interdisciplinary Team in the Accomplishment of ACTS

The contribution of the interdisciplinary team in the accomplishment of the ACT project is highlighted below-

* The innovative approach aided in collaborating with diversified experts in the designing and development process of the integration system. The collaboration of diversified experts aided in augmenting the innovation and creativity of the satellite and the overall ACTS project.

In order to overcome the innovation-related challenge, the leader of the ACTS project found a way to include multiple-aspect analysis which ultimately enabled in recognizing of the functionality of interdisciplinary teams in augmenting collaboration among different departments.

* The communication system experts aided in developing and innovating technology like frequency reuse and SB along with payload communication. The technical competence aided in augmenting the capacity, efficiency as well as capability of communication to the satellite.

For overcoming the communication enhancement capability of the concerned satellite, the team of ACTS project followed the framework of collaborative working as this enabled the leveraging of the traits and expertise of different disciplines and this ultimately helped in curbing the risk of innovation gap in the challenge fixation (White & Jean, 2011).

* The discipline of cross-department aided in innovating and augmenting the issue-solving capabilities of entire departments. The development of innovation in solution enhancement aided the ACTS project to have a competitive design and system of communication.

In order to overcome the innovative problem solution development-related challenge, the team of the ACTS project followed the cross-collaboration-related approach and culture as this enabled empowering employees and experts of different departments to work together to present their views on different aspects.

# Exploration of Decision-making Process Involved in the Assortment of Components and Technologies of ACTS

The process that the team ACTS project used for deciding on the selection and usage of components and technologies is highlighted below-

* The team of the ACTS project evaluated the final objective of the project and then used a backward analysis process to find efficient components and technologies.

In order to tackle the problem of components and technology assortment within the completion of the ACTS project, the respective leader followed the concept of cause-and-impact evaluation approach as this aided in finding the influence of different sourcing practices which ultimately aided in finding the best solution for the task.

* The backward analysis approach aided the team of the ACTS project in finding the best equipment and technologies in terms of cost and performance.

The incorporation of comparative cost evaluation practice enabled the leaders of the ACTS project to recognize the quality competence of different options which enabled in finalizing the best one (White & Jean, 2011).

* A comparison was made by the team of the ACTS project between all components and technologies in view of metrics like cost, reliability as well as overall performance.

The decision to use the comparative analysis practice was made by the leaders of the ACTS project following the decision-making framework of the i-learn handbook as this aided in finding the competition option or resource in different metrics.

* The evaluation of competence in proportion style aided the ACTS project in finding cost-efficient components over and above technology for success.

The adoption of the comparison-based evaluation framework enabled the team of the ACTS project to explore and use efficient technological and component options for reaching success.

# Highlight the Method Used by NASA for Addressing Potential Risks and Irregularities in the Operation and Development of ACTS

NASA castoff analytics (predictive) to explore the critical uncertainties linked with the ACTS project. The custom of the approach (analytical) assisted the ACTS project in finding the probable risk based on historically related data. This empowered ACTS to take modest action to mitigate the development risk. The ACTS project team cast off a simulation line to address potential uncertainties in its operation. The simulation line enabled the ACTS project team to simulate the possible risk by forming a related scenario. The hypothetical testing aided in mitigating the uncertainties and this occurred because of the competence of the method in finding the probable causes and impact of each practice precisely by developing and testing related environment. The ACTS project team cast a time-series analysis method for projecting how the practices related to the project will work in a different scenario which eventually aided in finding the associated risk in the form of non-economic and financial metrics.

# Long-term Impact of ACTS on the Satellite Communication Field and Role in Paving Future Advancement

The stimulus of the ACTS project is explored below highlighting its contributions to the space program-

* technological growth like SB and reuse of frequency have aided in the assembly of them as benchmarks for future satellites.
* The improvement in the benchmark for the satellite system will help in developing and managing the performance of space communication systems in terms of reliability, performance, and efficiency (White & Jean, 2011).
* The ACTS project has aided in exploring the potential of frequency reuse in augmenting the efficiency of the spectrum. The role of frequency use in enhancing the frequency of spectrum will aid operators of future satellites and respective regulatory bodies to optimize resources of limited spectrum using a similar approach.

# Lesson Learned from ACTS Project

I have learned about the implication of multidisciplinary integration with the support of the ACTS project learning and this has aided in knowing the path for improving the communication system as well as the design of the satellite using informed decisions. I have developed inferences regarding the importance of collaborative teamwork in maximization of efficiency and this trait will be used and prioritized in future projects to make it successful easily (White & Jean, 2011). The accomplishment of the ACTS project has enabled me to learn about the implementation of innovative technologies like S.B. and the usage of frequency in the improvisation of systems or satellites in space. The learning about satellite performance improvement will assist in validating the overall technique of future projects precisely to make them successful by curbing challenges in advance.

# Conclusion

It is summarized that the development and accomplishment of the ACTS project have significantly helped in developing a path for innovation and creative technology in the field of communication systems satellites. The usage of a cost-efficient beam optimization approach within the ACTS project has paved a path for risk-free system designing and communication management in future space programs. It is précised that the usage of S.B and frequency reuse techniques innovated by the ACTS project has paved a path for space researchers in strengthening respective communication systems. The role of technological innovation has made the communication mode of satellite work at low frequency as well which eventually augments respective competence in reaching and communicating targeted destinations.

# References

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