Business Case Document for Cockpit Voice Recorder

1. Why is this Project Initiated?

The project is initiated to develop a Cockpit Voice Recorder that can clearly capture and distinguish multiple voices in a noisy environment (like a cocktail party). The goal is to overcome the limitations of traditional voice recorders in scenarios with overlapping speech and background noise.

1. Current Problems
* Poor Audio Clarity: Existing recorders struggle in environments with high background noise.
* Inability to Distinguish Speakers: Traditional systems cannot separate multiple overlapping voices.
* Limited Use Cases: Current recorders are less effective in industries like law enforcement, journalism, and conference management.
1. Problems Solved by the Project
2. Enhanced Voice Clarity: Improved audio capture in noisy settings.
3. Speaker Identification: Ability to distinguish and identify multiple speakers.
4. Extended Use Cases: Suitable for meetings, conferences, law enforcement, and public events.
5. Improved Efficiency: Reduces manual audio processing time.
6. Higher User Satisfaction: Better user experience and confidence in recording.
7. Resources Required
* Human Resources:
* Project Manager
* Business Analyst
* Audio Engineers
* Software Developer
* Quality Assurance Team
* UX/UI Designer
* Technology Resources:
* Advanced Microphones and Sensors
* AI/ML Platforms for voice separation
* Cloud Infrastructure for data processing
* Development and Testing Tools
* Financial Resources: Budget allocation for R&D, hardware procurement, and marketing.
1. Organizational Change Required
* Training: Employees need to be trained in the new system and AI/ML capabilities.
* Process Changes: Implementation of new recording protocols and audio handling workflows.
* Infrastructure Upgrade: Investment in cloud or on-premise infrastructure for processing and storage.
* Stakeholder Buy-In: Ensuring management and operational teams are aligned with the change.
1. Time Frame to Recover ROI
* Estimated Time Frame: 18 TO 24 months, depending on market adoption and initial investment.
* Revenue Streams: Direct sales, licensing the technology to other manufacturers, and service contracts for enterprises.
1. Identifying Stakeholders
* Internal Stakeholders:
* Project Team (Developers, Engineers, QA, etc.)
* Marketing and Sales Teams
* IT Support Staff
* Executive Leadership
* External Stakeholders:
* Customers (Business, Law Enforcement, Journalists)
* Investors and Financial Partners
* Suppliers and Hardware Vendors
* Regulatory Bodies (for compliance with recording).

Stakeholder Identification Methods:

* Workshop and Interviews: Engage various departments to identify internal stakeholders.
* Market Analysis: Identify potential customers and partners.
* Stakeholder Mapping: Categorize based on interest, influence, and impact on the project.

**Business Analyst Approach Strategy for the Cockpit Voice Recorder (CVR) Project:**

1. Initial Planning and Preparation
2. Understand the Project Scope:
* Review the project charter, business case, and aviation industry standards (e.g. FAA, EASA, ICAO regulations).
* Confirm project objectives: Develop a cockpit voice recorder system that meets, enhances safety, and integrates with existing aircraft systems.
1. Identify Stakeholders:
* **Internal**: Project Manager, Engineers, Software Developers, QA Team, Compliance Officers.
* **External:** Airlines, Aircraft Manufactures, Regulatory Authorities (FAA, EASA), Pilots, Maintenance Teams.

1. Stakeholder Analysis and Communication Plan
2. Perform Stakeholder Analysis:
* **RACI Matrix:**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Project Activity** | **Project Manager** | **BA** | **Engineering Team** | **QA Team** | **Regulatory Authority** | **Pilots** | **Airlines** | **Maintenance Team** |
| 1. Requirement Gathering
 | A | R | I | I | C | C | C | I |
| 1. Requirements Documentation
 | A | R | I | I | C | C | C | I |
| 1. Requirements Sign-Off
 | A | R | I | I | R | C | R | I |
| 1. System Designing
 | A | C | R | I | I | I | C | I |
| 1. Design Review and Approval
 | A | C | R | I | C | I | C | I |
| 1. Development
 | A | I | R | I | I | I | I | I |
| 1. Internal Testing
 | A | I | C | R | I | I | I | I |
| 1. Integration Testing
 | A | I | C | R | I | I | I | I |
| 1. Regulatory Compliance Testing
 | A | I | C | R | R | I | I | I |
| 1. UAT
 | A | C | C | R | I | R | C | C |
| 1. Deployment
 | A | I | R | C | I | I | I | R |
| 1. Post Deployment Support
 | A | C | C | R | I | I | C | R |
| 1. Final Approval and Sign-Off
 | A | C | I | I | R | C | R | I |

* R - Responsible: Executes the task.
* A – Accountable: Ultimately answerable for the activity.
* C – Consulted: Provides input and feedback.
* I- Informed: Needs to be kept in the loop.
1. Establish Communication Channels:
* Internal: Microsoft Teams, Jira for issue tracking, Slack for quick communication.
* External: Email, Regulatory Review Meetings, and Progress Reports shared bi-weekly.
1. Requirement Elicitation Techniques:
2. Techniques to Use:
* Interviews: With pilots, maintenance teams, and compliance officers.
* Workshops: To gather consensus from airlines and manufacturers.
* Document Analysis: Review current CVR standards and regulations.
* Prototyping: Develop mock-ups of the CVR interface for feedback.
1. Documentation Process
2. Documents to Prepare:
* Business Requirements Document (BRD): Capture high-level requirements such as audio quality, data retention, and compliance needs.
* Functional Requirements (FRS): Detail system functionalities like automatic recording activation, audio compression, and data encryption.
* Non-Functional Requirements(NFRs): Address performance, reliability, and security standards.
* Use Cases/User Stories: E.g. As a pilot, I want the CVR to automatically start recording during take-off to ensure safety compliance.
* Process Flows and Diagrams: Visualize data flow from microphones to storage.
* Change Request Forms(CRF): Document any changes requested by stockholders.
* Traceability Matrix: Map requirements to test cases for compliance tracking.
* UAT Plan: Define testing scenarios including emergency recording scenarios.
* Client Project Acceptance Form: Summarize project deliverables and test results.
1. Document Review & Sign-Off Process
2. Review Cycle:
* Internal: Reviewed by the project team and compliance officers.
* External: Shared with regulatory bodies and airlines for feedback.
1. Feedback Incorporation:

Update documents based on feedback.

1. Approval Process:
* Use e-signature tools (e.g. DocuSign) or obtain written approvals.
* Formal sign-off meetings with all major stakeholders.
1. Handling Change Requests:
2. Change Request Process:
* Document change details, and assess impact on compliance, timeline, and costs.
* Review by the Change Control Board (CCB), including engineering leads and compliance officers.
1. Approval Workflow:
* Gain consensus from key stakeholders.
* Update requirements, technical documents, and communication plans accordingly.
1. Progress Reporting
2. Weekly/Monthly Reports:
* Share progress through Jira dashboards and email reports.
* Highlight key milestones like prototype development, testing phases, and regulatory reviews.
1. Stakeholder Meetings:

Hold bi-weekly stakeholder meetings to review progress and resolve issues.

1. UAT and Client Project Acceptance
2. User Acceptance Testing Table:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Test Case ID | Test Scenario | Test Steps | Expected Result | Actual Result | Status | Comments |
| UAT001 | Automatic Recording Activation | 1. Power on the aircraft.
2. Start engine.
3. Verify CVR starts recording automatically.
 | CVR starts recording automatically when the engine is powered on. |  |  |  |
| UAT002 | Manual Recording Activation | 1. Power on the aircraft.
2. Press the manual recording button.
3. Verify recording starts.
 | CVR beings recording when the manual record button is pressed |  |  |  |
| UAT003 | Audio Quality Check | 1. Record cockpit conversation for 5 minutes.
2. Play back the recorded audio.
 | Clear and distortion-free audio playback is confirmed. |  |  |  |

1. Sign-Off on UAT:
* Sign-Off Form: Prepare a UAT Sign-Off Form capturing the following:

|  |
| --- |
| UAT Sign-Off Form for Cockpit Voice Recorder Project |
| Project Name: Cockpit Voice Recorder |
| UAT Start Date:  |
| UAT End Date: |
| UAT Summary: |
| * Total Test Cases:
 |
| * Test Cases Passed:
 |
| * Test Cases Failed
 |
| * Defect Reported
 |
| * Defect resolved
 |
| Outstanding Issues: |
| * Issue Description
 |
| * Stakeholder Approvals
 |

|  |  |  |  |
| --- | --- | --- | --- |
| Role | Name | Signature | Date |
| Project Manager | Jayashree Gosavi |  |  |
| Business Analyst | Nikhil Sherma |  |  |
| Engineering Lead | Rami Patil |  |  |
| QA Lead | Shree Ayar |  |  |
| Regulatory Representative  | SHreayash Mane |  |  |
| Airline Representative | Komal Pardeshi |  |  |
| Maintenance Team Lead | Amol Mengal |  |  |

1. Post -Implementation Review (PIR) for Cockpit Voice Recorder
2. Objectives of the Post-Implementation Review
* Assess Project Success: Evaluate whether the CVR system meets the defined requirements and regulatory compliance.
* Identify Strengths and Weaknesses: Analyse the project’s strengths and weaknesses.
* Document Leassons Learned: Record insights for future projects.
1. PIR Process

Step 1: Review Project Objectives and outcomes

* Compare project deliverables with initial requirements.
* Verify compliance with aviation standards.
* Assess whether key project milestones were achieved on time and budget.

 Step 2: Performance Assessment

* Technical Performance: Evaluate the CVR’s recording quality, data storage reliability, and crush survivability.
* Operational Performance: Validate that the CVR meets all regulatory requirements for data retention, encryption, and temper detection.

 Step 3: Stakeholder Feedback

* Pilots: Feedback on ease of use and audio quality.
* Airlines: Satisfaction with implementation and maintenance processes.
* Regulatory Authorities: Confirmation of compliance with aviation standards.

**Document 3- Functional Specifications**

|  |  |
| --- | --- |
| Project name | Cockpit Voice Recorder |
| Customer name | Jeff Ronaldo |
| Project Version | 0.2 |
| Project Sponsor | Mike Leon |
| Project Manager | Pratik khair |
| Project Initiation date | 10-1-2024 |

**Functional Requirement specifications:**

|  |  |  |  |
| --- | --- | --- | --- |
| Request ID | Request Name | Request Description | Priority (High/Medium/Low) |
| FR-001 | Audio Recording Initiation | The system shall automatically initiate audio recording when the aircraft power is turned off | High |
| FR-002 | Multiple Channel Recording | The recorder shall capture audio from multiple channels, including pilots, co-pilots, and ATC communications. | High |
| FR-003 | Data Encryption | The system shall encrypt all recorded audio data to ensure secure storage and transmission. | High |
| FR-004 | Black Box Integration | The cockpit voice recorder shall integrate with the black box system for synchronized data retrieval.  | High |
| FR-005 | Audio Playback | The system shall allow playback of recorded audio with filters to isolate specific channels. | Medium |
| FR-006 | Storage Capacity Alert | The system shall issue an alert when storage capacity exceeds 90% to prevent data loss. | High |
| FR-007 | Crash Protection | The device shall be crash-protected and water-resistant according to aviation standards. | High |
| FR-008 | Self-Diagnostics | The recorder shall perform regular self-diagnostics and report any malfunctions.  | Medium |
| FR-009 | Voice Activation on Detection | The system shall detect and prioritize a voice activation to reduce non-essential background noise. | Low |
| FR-010 | Data Retention Period | The system shall retain audio recordings for a minimum of 30 days or as specified by regulatory bodies. | Medium |

**Document 4- Requirement Traceability Matrix**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Request ID | Request Name | Request Description | Design | D1 | T1 | D2 | T2 | UAT |
| FR001 | Audio Recording Initiation | The system shall automatically initiate audio recording when the aircraft power is turned off | Yes | Yes | No | Yes | Yes | Yes |
| FR002 | Multiple Channel Recording | The recorder shall capture audio from multiple channels, including pilots, co-pilots, and ATC communications. | Yes | Yes | No | Yes | Yes | Yes |
| FR003 | Data Encryption | The system shall encrypt all recorded audio data to ensure secure storage and transmission. | Yes | Yes | No | Yes | Yes | Yes |
| FR004 | Black Box Integration | The cockpit voice recorder shall integrate with the black box system for synchronized data retrieval. | Yes | Yes | No | Yes | Yes | Yes |
| FR005 | Audio Playback | The system shall allow playback of recorded audio with filters to isolate specific channels. | Yes | Yes | No | Yes | Yes | Yes |
| FR006 | Storage Capacity Alert | The system shall issue an alert when storage capacity exceeds 90% to prevent data loss. | Yes | Yes | No | Yes | Yes | Yes |
| FR007 | Crash Protection | The device shall be crash-protected and water-resistant according to aviation standards. | Yes | Yes | No | Yes | Yes | Yes |
| FR008 | Self-Diagnostics | The recorder shall perform regular self-diagnostics and report any malfunctions. | Yes | Yes | No | Yes | Yes | Yes |
| FR009 | Voice Activation on Detection | The system shall detect and prioritize a voice activation to reduce non-essential background noise. | Yes | Yes | No | Yes | Yes | Yes |
| FR010 | Data Retention Period | The system shall retain audio recordings for a minimum of 30 days or as specified by regulatory bodies. | Yes | Yes | No | Yes | Yes | Yes |

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Cockpit Voice Recorder

CVR-001-2024

V2.2024

Komal Pardeshi

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1. Document Revisions

|  |  |  |
| --- | --- | --- |
| Date | Version Number | Document Changes |
| 05/02/2024 | 0.1 | Initial Draft |
| 29/11/2024 | 0.2 | Digital CVR |

1. Approval

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Role | Name | Title | Signature | Date |
| Project Sponsor | **Mr. John Smith** | Approval of project funding and strategic alignment |  |  |
| Business Owner | **Ms. Anita Kapoor** | Approval of business requirements and objectives |  |  |
| Project Manager | **Mr. Rajesh Lyer** | Approval of project plan, timeline, and resource allocation |  |  |
| System Architect | **Mr. Alex Johnson** | Approval of system design and architecture  |  |  |
| Development Lead | **Ms. Priya Menon** | Approval of development framework and coding standards |  |  |
| User Experience Lead | **Mr. David Lee** | Approval of user interface and experience design |  |  |
| Quality Lead | **Ms. Sara Tan** | Approval of testing plans and quality assurance processes |  |  |
| Content Lead | **Mr. Rohan Gupta** | Approval of documentation and content strategy |  |  |

1. RACI Chart

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Name | Position | \* | R | A | S | C | I |
| Mr. John Smith | Senior Voice President |  |  | x |  |  | x |
| Ms. Anita Kapoor | Director of Business Operation |  |  | x |  |  | x |
| Mr. Rajesh Lyer | Project Manager |  | x |  |  |  |  |
| Mr. Alex Johnson | Chief System Architect |  |  |  | x | x |  |
| Ms. Priya Menon | Lead Developer, Software Engineer |  |  |  |  | x |  |
| Mr. David Lee | UX Designer |  |  |  |  | x | x |
| Ms. Sara Tan | Quality Assurance Lead |  |  |  |  |  | x |
| Mr. Rohan Gupta | Content Strategy Lead |  |  |  |  |  | x |

1. Introduction
2. Business Goals
3. **Organizational Goals:**
* **Enhance Aviation Safety:** Improve post-incident investigation accuracy to reduce future accidents by capturing high-quality cockpit audio.
* **Regulatory Compliance:** Ensure the CVR system complies with international aviation standards (e.g. ICAO, FAA, EASA).
* **Market Leadership:** Position the organization as a leader in aviation safety technology by offering innovative CVR solutions.
* **Revenue Growth:** Drive new business opportunities by expanding the customer base among airlines and aircraft manufacturers.
1. **Organizational Needs:**
* **Data Accuracy and Reliability:** Ensure that the CVR provides clear and precise audio data to aid investigations.
* **Cost Efficiency:** Develop a cost-effective solution that balances affordability with top-tier performance for clients.
* **Seamless Integration:** Design a CVR that integrates easily into existing cockpit systems, reducing installation time and cost.
1. Business Objectives
2. **To Provide IT Solutions:**
* Develop a comprehensive suite of IT solutions to enhance the management, analysis, and accessibility of cockpit voice recordings.
* Integrate modern software functionalities that streamline aviation safety operations and facilitate efficient data handling across multiple platforms.

 **Functionalities to be Developed in Software:**

1. **Mobile Application for Android and Ios:**
* **Real-time Notification System:** Alert authorities about flight incidents for immediate action.
* **Secure Data Access:** Enable authorized personnel to access CVR data remotely via encrypted channels.
* **Voice Playback and Analysis Tools:** Allow audio playback, keyword search, and voice analysis.
* **Incident Reporting:** Generate and submit detailed incident reports directly from the app.
1. **E-Learning Management System (LMS):**
* **Training Modules on Aviation Safety:**

Provide e-learning modules on using CVR data for safety improvements.

* **Simulation Tools:** Include flight incident simulation tools to train investigators.
* **Certification Management:** Track and issue certification for users completing safety training.
* **Certification Management:** Track and issue certification for users completing safety trainings.
1. **Human Resource Management System (HRMS):**
* **Training and Certification Tracking:**

Manage personal training, qualifications, and certifications related to CVR operations.

* **Incident Responses Team Management:**

Assign, track, and manage the availability of the response team.

* **Employee Performance Analytics:**

Track investigator performance based on incident handling efficiency.

1. Business Rules
2. **Organization Policies:**
* **Data Privacy Policy:** All CVR data must be encrypted and stored securely, accessible only to authorized personnel.
* **Incident Response Policy:** CVR data must be made available to the investigation team within 24 hours of the reported incident.
1. **Procedures**
* **Data Retrieval Procedure:**
* Authorized personnel initiate data retrieval through a secure request system.
* Two-factor authentication is required to access the data.
* **Data Analysis Procedure:**
* Audio data is processed using approved analytical tools to ensure accuracy.
* Analysts must document findings in standardized investigation reports.
1. **Rules and Regulations:**
* **Retention Rules:** CVR data must be retained for a minimum of 30 days unless required for an ongoing investigation, in which case it should be stored securely until the investigation is concluded.
* **Access Control Rule:** Only certified Investigators, regulatory authorities, and authorized personnel may access CVR data.
1. Background

**History and Origin of the Project:**

The concept of cockpit voice recording dates back to the 1950s when early aviation accidents highlighted the need for better incident investigation tools. Initial CVRs were basic, using analog tape to record pilot communications.

**Business Issues/Problems Identified:**

1. **Limited Recording Capacity:**

Traditional CVRs only recorded the last two hours of cockpit audio, missing key pre-flight and early-flight conversations in long-haul incidents.

1. **Data Retrieval Delays:** Manual data extraction and analysis processes delayed critical investigations, impacting safety recommendations.
2. **Data Security Risks:** Increasing cyber threads posed risks to the integrity and confidentially of CVR data.

**Expected Benefits of Implementing the Project:**

1. **Enhanced Aviation Safety:** By capturing high-quality, long-duration audio, investigators can gain comprehensive insights into incidents, improving accident prevention.
2. **Faster Incident Resolution:** Automated data retrieval and analysis will reduce investigation time, allowing for quicker safety recommendations.
3. **Regulatory Compliance:** Meeting and exceeding international safety standards will ensure compliance and build trust with aviation authorities.
4. Project Objective

**Overall Goal:**

The primary objective of the Cockpit Voice Recorder (CVR) project is to develop an advanced, secure, and reliable voice recording system that enhances aviation safety by providing clear, long-duration audio recordings of cockpit communications.

**High-Level Description of the Product:**

* **Audio Recording and Storage:**

Capture high-quality, multi-channel audio from cockpit communications, including pilots, co-pilots, and air traffic control.

* **Extended Recording Duration:**

Provides up to 25 hours of continuous recording to ensure comprehensive coverage of all flight phases.

 **Alignment with Business Objectives:**

* **Enhancing Aviation Safety:** The CVR system will improve incident investigation accuracy and contribute to proactive safety measures, aligning with the business objective.

 **Requirements for Interaction with Other Systems:**

1. **Mobile Applications (Android/iOS):** Secure real-time access t CVR data for authorized personnel.
2. **E-learning Management System:** Training modules on CVR usage and incident investigations.
3. **Aviation Safety Databases:** Integration for automated incident reporting and data sharing with aviation authorities.
4. Project Scope

The project will focus on developing a modern, feature-rich Cockpit Voice Recorder system that ensures aviation safety, operational efficiency, and regulatory complienece.

1. **Cockpit Voice Recorder System Development:**
* **Audio Recording and Storage:**
* Multi-channel audio recording of cockpit communication including pilots, co-pilots and air traffic control interactions.
* Continuous recording for up to 25 hours.
* **High-Quality Audio Processing:**
* Noise reduction and audio enhancement for clear voice.
* Real-time audio monitoring for flight crew.
1. In-Scope Functionality:
* Audio Recording and Storage:

Capture high-quality, multi-channel audio from cockpit communications, including pilots, co-pilots, and air traffic control.

* Extended Recording Duration:

Provides up to 25 hours of continuous recording to ensure comprehensive coverage of all flight phases.

1. Out Scope Functionality
* Hardware Development
* Custom Integration with Specific Aircrafts.
* Non-Standard Regulatory Compliance
* Real-Time Data Streaming
1. Assumptions
2. **Compliance with International standards**
3. **Availability of Technical Infrastructure**
4. **Regulatory Approval**
5. **Data Security and Privacy**
6. Constraints
7. Regulatory Compliance
8. Budget Limitation
9. Time Constraints
10. Integration with Existing System
11. Risks
* **Avoid:**
* Plan the budget with a buffer for unexpected costs and continuously monitor expenditures to keep within limits
* **Mitigate:**
* Prioritize critical features and postpone non-initial functionalities if necessary to stay with budget
* **Transfer:**
* Consider transferring the risk to cybersecurity vendor who can provide specialized expertise and manage ongoing security risks.
* **Accept:**
* If minor integration challenges arises, address them as they occur.

Technological Risks

Skills Risks

Political Risks:

 N/A

Business Risks:

 N/A

Requirements Risks

 N/A

Other Risks

1. Business Process Overview
2. Legacy System (AS-IS)
* Hardware and Audio
* Data Storage retrieval
1. Proposed Recommendations (TO-BE)
* Transition to Digital and High-Capacity Storage Solutions
* Real-time Data Steaming and Remote Access
1. Business Requirements:

1. **Cockpit Voice Recorder System Development:**

* **Audio Recording and Storage:**
* Multi-channel audio recording of cockpit communication including pilots, co-pilots and air traffic control interactions.
* Continuous recording for up to 25 hours.
* **High-Quality Audio Processing:**
* Noise reduction and audio enhancement for clear voice.
* Real-time audio monitoring for flight crew.
1. Appendices
2. List of Acronyms
3. **CVR:** Cockpit Voice Recorder
4. **LMS:** Learning Management
5. **HRMS:** Human Resources Management Sytem
6. Glossary of Terms

 N/A

1. Related Documents

1. **ICAO Annex 6**
2. **FAA Advisory Circulation**
3. **EASA CS 25**
4. **Data Retention Guidelines**