SINGAPORE UNIVERSITY OF TECHNOLOGY AND DESIGN

Engineering Systems and Design

40.011 Data and Business Analytics

ADOOH Dashboards

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Company Context and Problem Overview

Digital Content Technologies (DGCT) is a software-centric system integration firm with a focus on embedded systems. Its Adooh platform transforms traditional Digital-Out-Of-Home (DOOH) advertising into a data-driven, IoT-enabled solution, offering real-time insights through distributed sensing devices. However, despite its advanced data capabilities, Adooh lacks a structured operational dashboard. This limits stakeholders' ability to monitor system performance—such as storage activity, bandwidth usage, and file success rates—and impedes timely, data-driven decision-making. As Adooh scales, this gap introduces inefficiencies, increases service costs, and makes performance issues difficult to detect or respond to.

Project Approach and Deliverables

To address these challenges, our team conducted comprehensive data cleaning, analysis, and forecasting based on DGCT's internal logs. We developed a static, interactive dashboard that visualizes key operational metrics such as user behavior, system errors, and resource utilization. This dashboard equips stakeholders with the tools needed to make informed decisions and monitor trends over time.

Key Findings

- Distinct client usage behaviors were observed, including two separate storage usage patterns for the user, monitoring behavior and weekly engagement cycles.
- File size was found to be unrelated to access or download failures; instead, failures clustered around time-based events or system disruptions.
- An ongoing data collection issue—coinciding with a new product launch—risks undermining future analysis.
- A few accounts are rapidly consuming storage at disproportionate rates, signaling potential cost inefficiencies.
- Time series and machine learning models were used to forecast four months of storage growth and access activity to support proactive planning.

Recommendations

1. Resolve the data collection issue to safeguard long-term system insight.
2. Enforce storage management protocols for high-usage accounts.
3. Investigate high-error dates to uncover and address root causes.
4. Leverage predictive models for infrastructure and resource planning.

Conclusion and Value Proposition

The delivered dashboard and analytical insights give DGCT actionable visibility into its operational performance. These tools enhance decision-making, reduce inefficiencies, and prepare the Adooh platform for sustainable growth and scalability through improved monitoring and cost control.

Company introduction

Digital Content Technologies (DGCT) is a distribution and system integration service provider specializing in software-centric system integration for embedded systems. It has developed an Advanced Digital Out-Of-Home platform, ADOOH, designed to provide a centralized, sensor-enabled, data-driven solution for real-time device monitoring, content distribution, and analytics. Through ADOOH, traditional out-of-home advertising becomes a responsive, data-powered marketing channel, connecting outdoor advertising, retail, and smart city systems to maximize campaign impact and audience engagement. ADOOH uses IoT sensing devices, such as cameras, to achieve insights (e.g. dwell time, foot traffic, and number of watchers). It offers an intuitive platform with operational dashboards that cater to various stakeholders, delivering real-time insights into public display performance through custom data visualizations, and helping stakeholders make data-driven decisions. However, a major challenge is the absence of an assurance mechanism that would allow users to verify whether their campaign ran successfully on any of their media players. Users currently have no validation that screens are playing the right campaigns, and visits on-site to verify are unviable for large scale / nationwide campaigns. To combat this, DGCT began a program to integrate an automated display monitoring solution in which a camera takes snapshots of the studio's multiple LED panels at set intervals and securely uploads it to cloud servers. A web interface with simple user experience allows live monitoring of media playback, so users can understand how well the campaign is performing over time and adjust accordingly. Currently, ADOOH operates on internal infrastructure with a low cost, as the project is relatively small, but will then use data from this program to evaluate the performance of the monitoring system and assess whether it should transition to external infrastructure to encourage scalability and long-term sustainability.

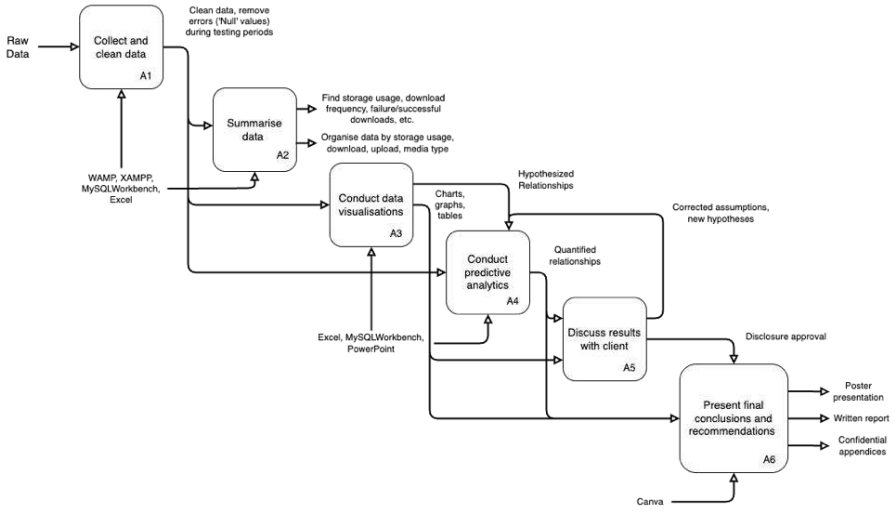
Problem Definition

DGCT's Adooh platform manages and monitors out-of-home media content distribution using video analytics based on AI. However, there is no structured, user-friendly operating dashboard in the current system to aid stakeholders, like the owner, in monitoring device performance, optimizing service costs, and identifying system inefficiencies. Without the right visualization tools, it is challenging to monitor performance metrics such as bandwidth usage, storage, and device success rates.

This raises a critical question: “How might we design simple and effective operational dashboards to enable stakeholders to monitor device performance, lower the cost of service, and enhance operation and service quality within the Adooh platform?”

In order to address the problem that DGCT’s Adooh platform is facing, we analyzed the given data to gain insights into the main objective of our dashboard. First and foremost, we identified bottlenecks in various areas such as upload/download frequencies, bandwidth limitations, and storage constraints based on image quality. Monitoring these parameters will allow us to identify areas of improvement and optimization to enhance overall service efficiency. Secondly, we aim to optimize service costs by analyzing cost-influencing factors such as upload frequency, image quality, refresh rate and storage duration. Last but not least, by analyzing these factors, we will be able to identify at least two areas for potential revenue optimization through service customization of the dashboard.

Methodology and Tools



A1: Receiving the data set from our client in .SQL format, we imported it into MySQL using MySQL Workbench, with WAMP used for Windows and XAMPP for macOS to locally host the database. MySQL Workbench provides visual representations of our data schema. Next, we cleaned the data and created views to target datasets that would offer the most valuable insights.

A2: Once the data is cleaned, we organize the data based on key metrics, storage, download, access and issues. This allowed for more targeted analysis in each section.

A3: Understanding all the summarized data, we use Microsoft Excel to create preliminary charts and graphs for easier visualization of the large volume of data. We then consulted our client and gathered feedback on specific data relationships they wanted represented in the final dashboard.

A4: We conducted a 4-month predictive analysis to estimate future storage requirements and anticipated activity levels, aiding infrastructure planning and efficient server performance.

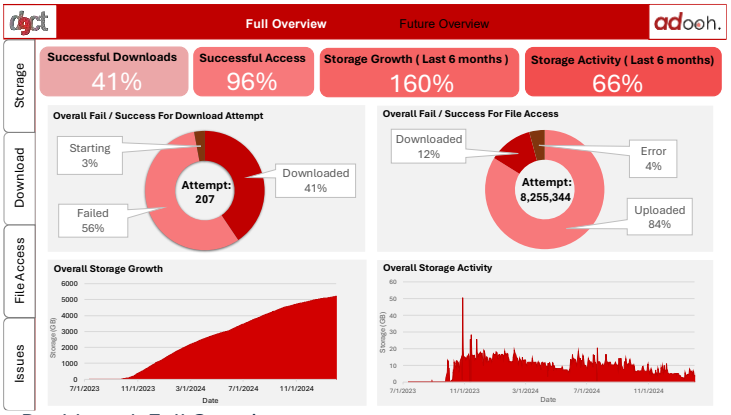
A5: Consolidating all our key findings, we organized them into an interactive dashboard.

A6: The final dashboard is presented to the client, getting feedback and approval before proceeding with the poster, presentation slides and report, documenting our process and findings.

Main Result (Dashboard)

Dashboard Overview

The dashboard is split into two parts:

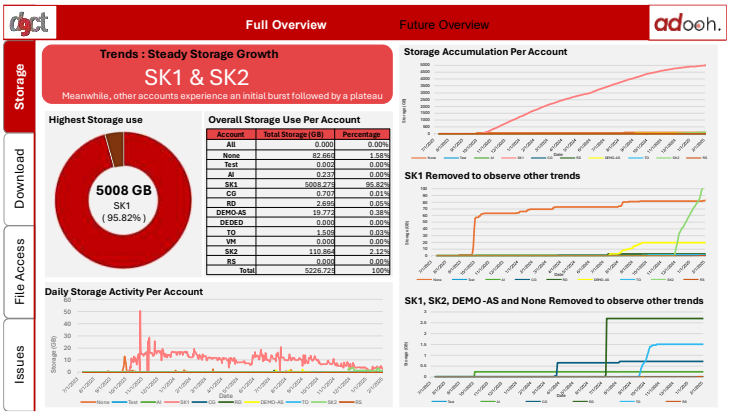


Dashboard: Full Overview

Full Overview and Future Overview. The Full Overview contains four subsections—Storage, Download, File Access, and Issues—each presenting targeted analysis of Adooh system performance. These analyses aim to assess Adooh system performance, identify causes of failure, validate client hypotheses, and track user behavior using our six pages interactable static dashboards.

Storage Analysis

We analyzed storage usage per account using SQL to extract storage log data. The account SK1 was identified as the primary contributor to total storage.

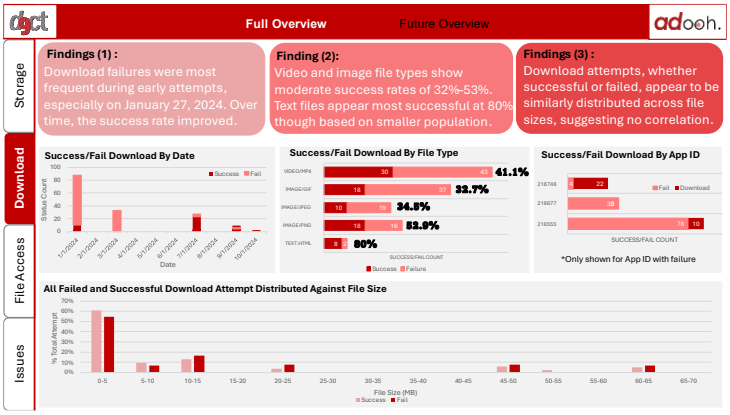


Dashboard: Storage

Time-series graphs show daily activity and accumulation per user accounts. These visuals are filterable, allowing stakeholders to isolate specific accounts, see when they became active, and track growth over time. This supports informed decisions on storage control, clean-up, and cost optimization. The storage accumulation graph also points out a pattern of storage growth for all user accounts excluding SK1 and SK2 where they experience an initial burst follow by a plateau. This raised the concern to put measures in limiting SK1 and SK2 storage growth.

File Download Analysis

Using log data from file download attempts, we aimed to identify the key factors contributing to failure in download. By visualizing success and failure rates over time using stacked bar charts, we could clearly pinpoint when failures occur and assess their proportion relative to total attempts. The data revealed that most failures were concentrated during the initial system trials. We then compared success and failure rates across different file types. The results suggest that file type is not a strong predictor of download success, with most file types exhibiting success rates within the 32%–53% range. Although text files showed an 80% success rate, the sample size was too small to support definitive conclusions.



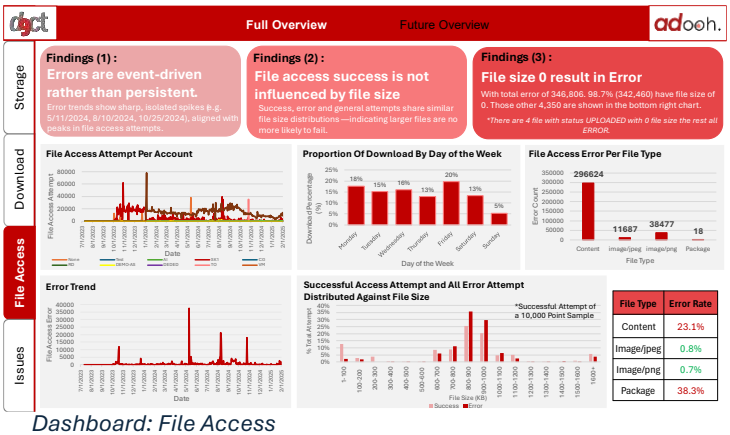
Dashboard: Download

A client hypothesis suggested that larger file sizes were more likely to fail. To test this, we plotted success and failure distributions by file size and found no meaningful correlation—the distributions were largely identical across both outcomes. In addition, most of the failure attempts happened in the lower file size range.

Lastly, we identified a specific client account (App ID 218555) that disproportionately experienced download failures. This anomaly is clearly highlighted in the dashboard and warrants further investigation.

File Access Analysis

First examined file access attempts per account over the entire data duration. This provides valuable insights for the client, allowing them to assess the activity level of individual customer accounts across time.



Dashboard: File Access

Next, we isolated access errors and visualized them in a time-series graph. This revealed four distinct spikes with minimal ongoing errors, suggesting that these failures were time-specific events rather than persistent issues.

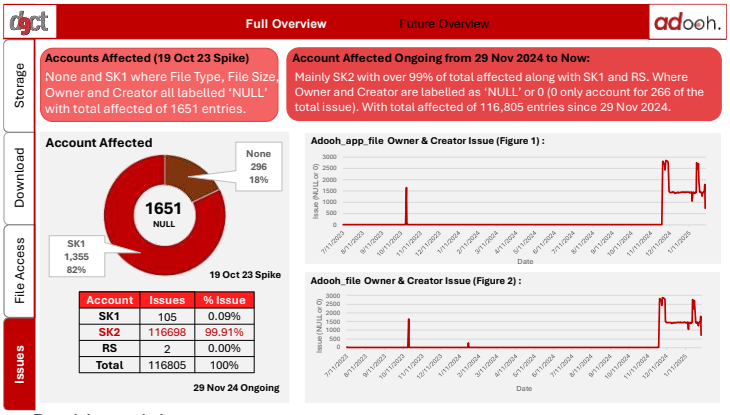
In the context of the access logs, a successful download indicates the moment customers are actively monitoring their Adooh system. In response to client requests, we create a bar chart of access traffic by day of the week to better understand customer behavior.

The client hypothesized that larger file sizes might lead to more access errors. To test this, we excluded logs with file size zero (which inherently indicate failure) to focus on errors of file size more than zero. We then compared their size distribution against a random sample of 10,000 successful access attempts, drawn from over 8 million entries. To ensure reliability, we repeated the sampling and confirmed distribution consistency. The results showed no clear relationship between file size and error rate, disproving the hypothesis.

Conversely, file type was found to be a strong indicator of success. Image files demonstrated exceptionally high success rates, while content and package files were responsible for the majority of access errors.

Issue Analysis

Through our investigation of storage and file-related logs, we identified two primary instances of user data collection errors**.**



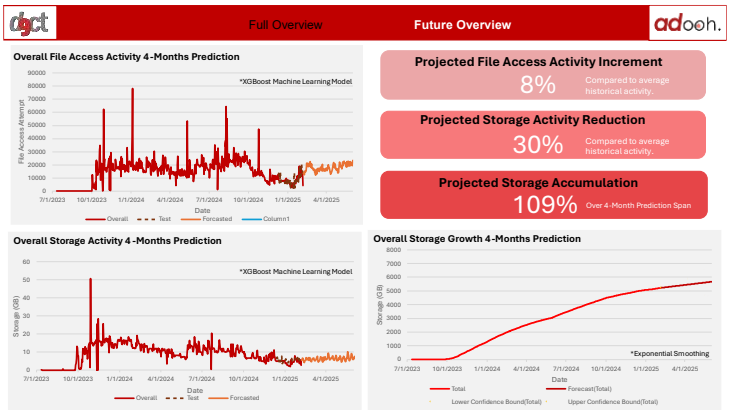
Dashboard: Issue

The first occurred on 19 October 2023, when a spike in the data disrupted all records collected on that day across both user, file size and file type, likely a server issue.

The second is ongoing. The issue began on 29 November 2024, coincided with the launch of Adooh's new product. If unaddressed, it could compromise future user behavior analysis.

Forecasting

Using XGBoost and exponential smoothing, we forecasted file access activity, storage activity, and storage growth. These predictions were then condensed into percentages for clarity.



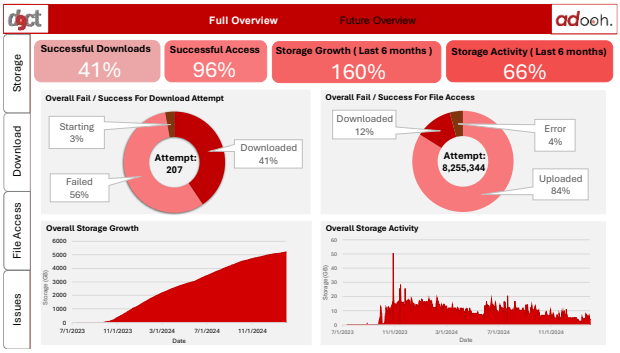
Dashboard: Future Overview

The forecasts help our client anticipate future server demands and assess the scalability of the Adooh system. For example, projected trends suggest a decrease in server load—a potentially positive indicator of lower operating costs. However, this may also signal reduced client engagement, which should be monitored closely.

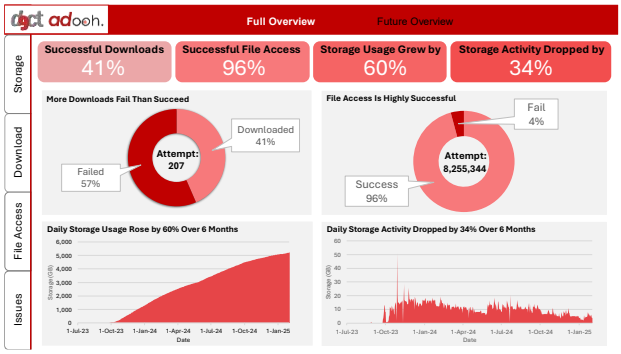
From this the client can proactively plan infrastructure needs, optimize cost-efficiency, and improve service delivery strategies.

Assumptions

Dashboard Versions - The dashboard used in the report differs from the poster version. This change assumes that a simplified version would be clearer for audiences unfamiliar with the Adooh system, while the full version supports client-specific analysis needs.

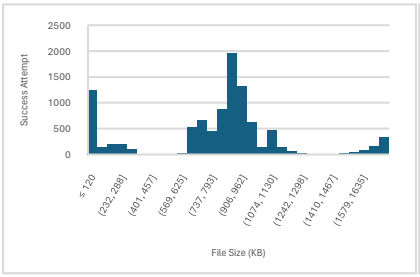


Client Dashboard Full Overview

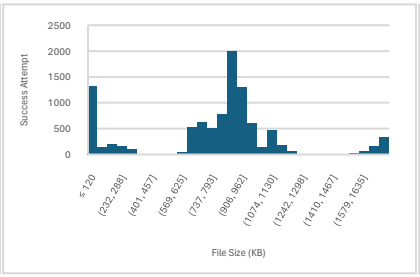


Poster Dashboard Full Overview

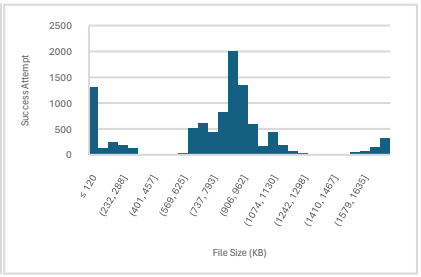
Sampling Method - We used a random sample of 10,000 entries from the file access dataset of over 8 million access logs. To validate its representativeness, we repeated the sampling three times and observed consistent file size distributions across all samples.



1st Sample File Size Distribution



2nt Sample File Size Distribution



3rd Sample File Size Distribution

Issue Definition - Entries with NULL or zero values in file size, file type, user ids were labeled as issue, based on their absence in the primary key table.

Forecasting Models - We assumed XGBoost, and exponential smoothing were suitable for forecasting, given identifiable trends and patterns in historical access and storage data.

Limitation

Insufficient Data - Some findings are limited by limited data in file download and access logs for file types like 'package' and 'text'. Thus, weaken the strength of those conclusions.

Forecasting Method - Forecasting accuracy may be impacted by irregular, event-driven error spikes, which have occurred intermittently throughout the data collection period.

Analysis Method – A visual histogram comparisons were used instead of formal statistical tests (e.g., regression) when analyzing error predictors. This was deemed sufficient due to clear visual patterns and no client request for deeper statistical validation.

Contribution

This project delivers a comprehensive dashboard that empowers DGCT's Adooh platform with actionable insights for performance monitoring and strategic decision-making. Through our analysis of storage and file access logs, we uncovered key trends in service usage—identifying SK accounts as the primary contributors and highlighting consistent access patterns. We disproved the assumption that file size affects access failure, concluding instead that most errors are time-based, and event driven. A major issue in user data collection was also identified, aligning with the launch of a new product and requiring urgent investigation. Forecasting models projects a need for at least 5.6 TB of storage over the next four months. These insights guide stakeholders to prioritize storage cleanup, resolve ongoing data issues, and prepare for future growth while reducing operational costs and improving service scalability.