

SYSTEM DESIGN PHASE DRAFT REPORT

Trace3 LAMP System

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EXECUTIVE SUMMARY

This report encapsulates our proposal to significantly enhance Trace3's LAMP asset management system's location mapping capabilities. Through meticulous analysis, our team has crafted an innovative geospatial solution aimed at empowering clients to upload detailed building maps, track assets at a granular level, and visualize pertinent asset information such as types and warranty statuses. By allowing filtering based on custom criteria like department ownership, our solution promises to streamline asset management processes.

Key features include the ability to upload indoor site maps, map asset locations to specific rooms, and display visual representations of assets with color-coded warranty statuses. Leveraging cutting-edge web and GIS technologies, we recommend an in-house development approach for optimal implementation. This approach not only ensures customization to Trace3's specific needs but also sets the stage for seamless integration with existing systems.

This report has three main parts: Statement of Work, System Analysis, and System Design.

Summary of Statement of Work/Survey Phase:

During the Survey Phase, our team conducted thorough research on our client and their industry background. Through initial discussions with Trace3, it became evident that the location module of their asset management system, LAMP, required enhancement. Using Wetherbe's PIECES Framework, we systematically identified the problems, opportunities and directives of the current system.

In the existing setup, clients with large campuses faced challenges in locating their assets granularly, as the system's asset tracking feature only mapped to the address level. To address this, our proposed system aimed to improve the location module of Trace3's LAMP platform. This enhancement would allow clients to upload building maps at floor and room number levels for precise asset identification. Additionally, we proposed implementing a dynamic visualization tool to provide information on different types of equipment, along with contract status indicated by color-coding—green for active contracts and red for expired ones. Furthermore, we suggested defining zones or regions within each floor plan to facilitate filtering based on departmental ownership.

Throughout the survey phase, we refined and iterated on the project scope definition through multiple discussions with our client.

Summary of System Analysis Phase

Our main techniques to understand the existing system was through interviewing the client to get clarity on the way the system works (who can edit asset location, who provides warranty and insurance to asset owners) and inspecting the system and running some simulations to see what end users are able to perform and experience.

By doing so, we saw that the LAMP system (as-is) serves the Client, Partner/Vendor, Contract Manager, and System Admin. The two most critical features of LAMP are manage asset location and manage assets and contracts, and their data flow is detailed in the Data Flow Diagrams under System Analysis. The Entity Relationship Diagram which complements the Data Flow Diagram further shows which data is collected from each entity.

After performing System Analysis, we deepened our understanding of the LAMP system and gotten our client's feedback to drill down on only Location Mapping feature as core focus of our project.

Summary of System Design Phase

During the System Design phase, we created Data Flow Diagrams and Entity Relationship Diagram for our proposed solution. To identify the level of access that each entity could have over a process, we present the Synchronized System Models (CRUD Matrix).

We ranked three system solutions (in-house development, outsource, commercial off the shelf packaged software) in our Candidate System Solutions table and the Feasibility Analysis Matrix. The Cost-Benefit Analysis of each of these solutions is performed as well for the client to decide on the best option to proceed.

The Physical Data Flow Diagrams spell out how our proposed solution will be implemented and we provided a mockup of our proposed solution's interface under Input and Output Design.

Finally, we shared our Implementation Plan with timeline and Lessons Learned from the past few months of working on this project.

Conclusions and Recommendations

In conclusion, our rigorous analysis reveals that the commercial off-the-shelf packaged software option presents the highest net benefit (N) for Trace3. Despite the transformative potential of our proposed intuitive map-based interface in reshaping client engagement and decision-making processes, it's crucial to recognize the compelling financial proposition offered by the Software Package Solution.

With a 5-year Net Present Value exceeding \$175,000, the Software Package Solution not only guarantees immediate financial gains but also fortifies Trace3's competitive position in the market. This comprehensive approach perfectly aligns with Trace3's commitment to innovation and excellence, propelling them to the forefront of the industry.

In essence, while both solutions offer unique advantages, the Software Package Solution emerges as the most prudent and advantageous investment for Trace3's long-term success. By combining financial viability with strategic vision, Trace3 can confidently navigate the dynamic landscape of asset intelligence, securing its position as a leader in the field for years to come.

Client Evaluation Letter

To Whom it may concern,

My name is Richard Gau, and I am the Software Development Manager at Trace3. Our company provides IT strategy, solutions, and services to some of the largest companies in the world. Founded in 2002, the company specializes in consulting, integrating, and operating convergent solutions across data, security, and the cloud for business transformation.

UMD Smith approached me about working collaboratively on a project that will add advanced location mapping functionality to Trace3's existing Lifecycle Management Platform (LAMP). Trace3's LAMP is an industry-leading cloud-based service that helps in capturing credits, tracking assets and maintenance contracts, processing RMAs, and updating information with the manufacturer. It also integrates with your IT systems, filling in the process and data gaps between them.

During our initial conversation with the student team via Zoom, they explained the project scope and how it is applicable to our company and explored the several options for this location mapping project. We discussed at length about the internal operations and different phases of this project, such as the Requirement Gathering, Analysis Phase and Design Phase.

The team has also shared several updates on the project like SOW, input and output designs, Analysis Phase Document, and others. We recently held our last call for this semester in which I reviewed the current state of the project, submitted deliverables, and the next steps. Having held several executive-level positions in my career, the work and updates they shared with me were on par with many I have seen. It was very easy to see the work effort that the team has invested to this point.

My biggest takeaways to this point:

- Based on my communications with the team, I am very confident in the validity of the work contained within the project.

- Deliverables for our company will center around the creation of an advanced location mapping for customer assets. This will allow customers to manage asset location at a more micro level; including floor and room.
- The expected deliverables should enable us to become more efficient operationally and enhance the ability to grow our customer base (always a challenge).

I look forward to working further with the team and have told them I will be as available as they need me to be moving forward. I have to say, I am impressed with the overall process to this point. It is nice to be able to work with smart, outgoing, and affable college students like these. I applaud the University for encouraging students to work with small businesses for this project.

Our company benefiting from this is something my team and I are very thankful for. We can always use help to strengthen our business.

Respectfully,

A handwritten signature in black ink, appearing to read "Richard Gau".

Richard Gau

STATEMENT OF WORK

PROJECT SCOPE

Trace3's LAMP tracks asset location and other metadata such as service contracts and warranty certificates for its customers. The asset tracking feature currently maps to the address level but some customers with a vast campus might find it challenging to locate the asset. Hence, more granular tracking is desired for the retrieval of physical assets.

This project will enhance LAMP's existing capabilities by

- Adding a standalone interface/link/site that allows Trace3 to upload a building's map so that its floor levels and room numbers are now identifiable.
- Generating an output to Trace3 to identify an asset's floor level and room numbers.
- Adding a dynamic visualization tool which uses an icon system to visually represent different types of equipment and their statuses.
- Defining zones or regions within the floor plan to allow users to filter based on common attributes, such as departmental ownership.

PROJECT OBJECTIVE

To develop and implement an enhanced asset location mapping feature within LAMP by 12/26, enabling users to accurately track assets in large locations, thereby increasing user satisfaction and platform adoption. Success will be measured by:

- The ability to upload and utilize site maps.
- The accuracy of the asset location tracking.
- User adoption rate within 6 months post-implementation.

HIGH-LEVEL REQUIREMENTS

- Ability to upload indoor site map.
- Ability to create a location mapping system for a site map.
- Ability to map structures with multiple floors.

- Ability to display assets by room or building
- Ability to give assets a primary location and a secondary location.
- The secondary location should allow for the selection of floor and room numbers.
- Ability to search for Assets in both primary and secondary locations
- Visualize the state of assets
- Filter floor maps based on criteria

PROPOSED SOLUTION

Our solution will enable LAMP users to upload a sitemap for a location (similar to how Google indoor maps work) and specify the site layout. Once that process is done, the assets will be mapped to specific locations within a given physical site and additional features such as dynamic visualization and zone filtration will be enabled.

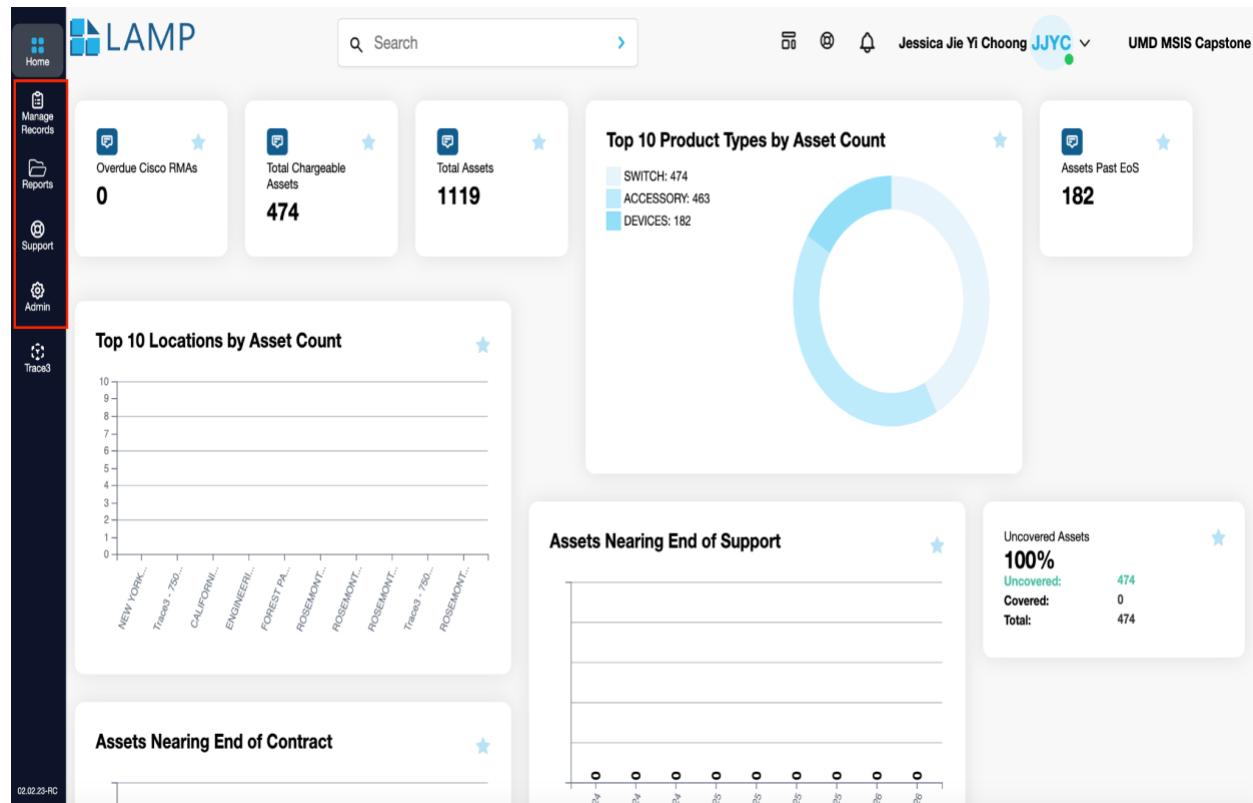
SYSTEM ANALYSIS REPORT

FACT FINDINGS AND INFORMATION GATHERING TECHNIQUES

System Analysis and Simulation

We pored over Trace3's LAMP system (<https://qa.lamp.trace3.com/>) to understand the features, workflows, requirements, input, and output of the as-is system. After a product demo by Trace3, we simulated how customers would interact with each feature of the system by going through each section of the menu and observing the available options and data output displayed.

LAMP - Homepage



The Homepage welcomes users with a customizable dashboard. On the left, users can access four options (in red box) for product features such as Manage Records and Reports, and product support such as Support and Admin.

LAMP - Manage Records

The screenshot shows the LAMP application's Manage Records section. On the left, a dark sidebar contains navigation links: Home, Manage Records (highlighted), Reports, Support, Admin, and Trace3. The main area is titled 'Assets Search' under the 'Assets' tab. It includes a search bar, filter buttons for Asset Status (Active), Chargeable Status (Current), and Special Filters (Exclude D...), and an 'Actions' button. Below is a table with columns: Serial Number, Parent Serial Number, Product Number, Product Description, End Of..., Asset Contr..., Contract, and Physical Location. The table lists 13 entries, all of which are 'C9300 48UN...' with 'C9300 48-port of 5Gbp...' descriptions and 'NEW YORK OFFICE -13...' locations. At the bottom are buttons for Columns, Export, Change Location, Change Contract, and Create New RMA.

Within Manage Records, users now have access to another set of options (in red box). The attributes shown change according to the selected option. For example, under Assets, users can see the Serial Number, Parent Serial Number, Product Number, Product Description, End of Support, Asset Contract End, Contract, and Physical Location.

LAMP - Feature and Actions

This screenshot is similar to the previous one but focuses on the 'Actions' feature. The 'Actions' button is highlighted with a red box, and a dropdown menu is open, showing the 'Add Asset' option. The rest of the interface is identical to the first screenshot, including the sidebar, search bar, filters, and the list of assets in the table.

For each option under Manage Records, there are designated Actions that users can perform. For example, for Assets, users can Add Asset.

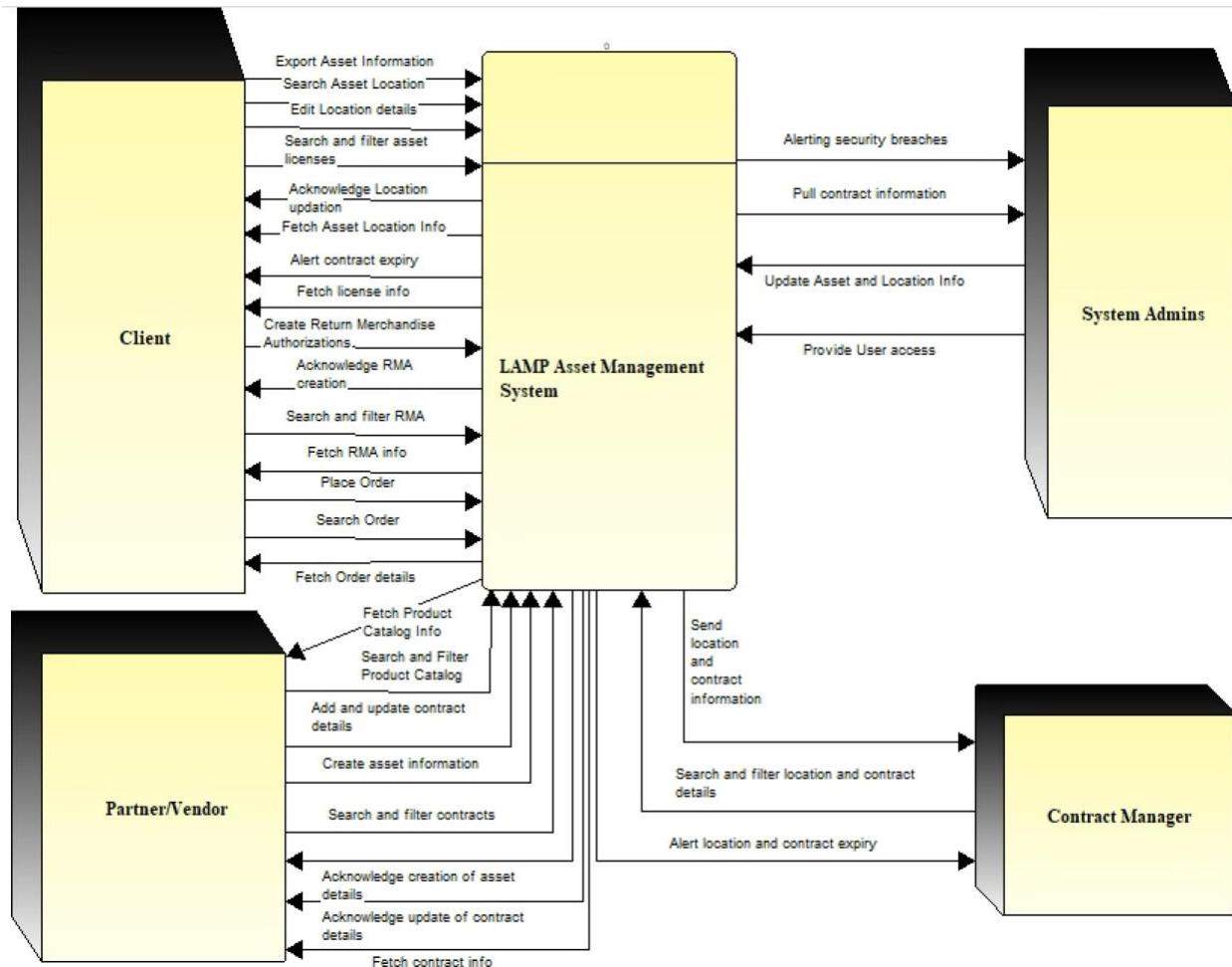
Interview

We talked to Trace3's LAMP development team, namely Richard Gau, Kevin, and Jill, to understand the system and solution requirements. The sessions were all attended by the Trace3 team and Team 7's group members, and most of the time it would take place in a question-and-answer format to clarify our understanding.

DATA FLOW DIAGRAM (DFD)

Visible Analyst Project Name: LAMP_CURR_SYS_DFD

CONTEXT DIAGRAM



In the Context Diagram, there are four external entities in the current system.

External entities are:

Client: This external entity represents any individual or business that requires the management of assets using the LAMP Asset Management System. The client has the capability to perform actions such as searching and filtering assets, acknowledging location updates, and placing orders.

Partner/Vendor: This entity represents any third-party supplier or partner that provides products or services integral to the asset management process. They have functionalities such as acknowledging the creation and updates of asset details and adding and updating contract details. Partner/Vendor manually adds asset locations, and they provide warranty and insurance to clients as well.

System Admins: These are the individuals or teams responsible for maintaining the LAMP Asset Management System. Their responsibilities include updating asset and location information, pulling contract information, and managing user access within the system. Trace3's system admins are responsible for adding vendors.

Contract Manager: This entity is responsible for overseeing contract creation, updates, and expirations. They work within the system to ensure that all contractual obligations are met and are alerted when contracts are due to expire.

System Inputs:

From Client:

- Asset Information Request (the client requests details about the asset's status or location)
- Asset Management Actions (such as acknowledging location updates or alerting contract expiry)
- Return Merchandise Authorization (RMA) Actions (includes creating, searching for, or updating RMA details)
- Order Placement (the client places orders and searches for their details)

From Partner/Vendor:

- Product and Contract Data Exchange (the partner/vendor receives and acknowledges the creation of asset details and contract updates)
- Contract and Asset Information Submission (submission of updated contract details and asset information to the system)

From System Admins:

- System Maintenance Inputs (admin provides updates for asset and location information, processes user access requests, and inputs related to security breach alerts)
- Contact Information Updates (admin updates contract details within the system)

From Contract Manager:

- Contract Management Inputs (includes sending and receiving information related to contract location and expiry alerts)
- Asset and Location Updates (manages updates to asset details and locations as per the contract terms)

System Outputs:**To Client:**

- Asset Information Reports (including locations and statuses of assets)
- Asset Management Confirmations (confirmations of acknowledged location updates, alerts of contract expiry, etc.)
- Return Merchandise Authorization (RMA) Details (responses to created, searched, or updated RMA details)
- Order Confirmations and Details (acknowledgment of placed orders and provision of order details)

To Partner/Vendor:

- Asset and Contract Update Notifications (notifications of asset details creation and contract updates)
- Contract Information Reports (reports and confirmations of updated contract details to partners/vendors)
- Asset Management Action Alerts (alerts to partners/vendors related to asset information changes or requirements)

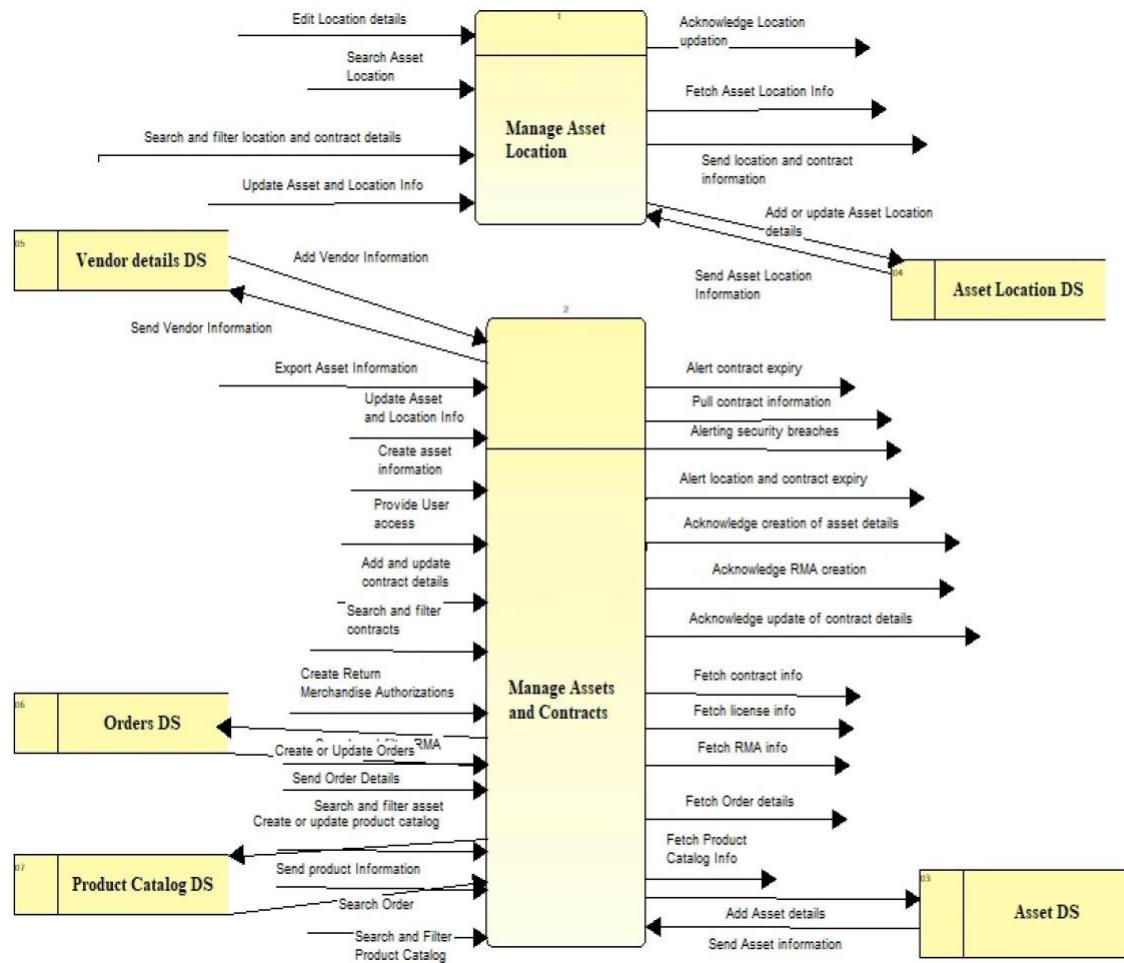
To System Admins:

- System Status Reports (information on the current status and health of the asset management system)
- Security Breach Alerts (notifications and details of any security breaches within the system)
- Contract Information Summaries (summaries of updated contract details for administrative purposes)

To Contract Manager:

- Contract Status Updates (notifications and details of contract creations, updates, and expirations)
- Asset and Location Information Reports (reports detailing the updates to asset information and locations)

LEVEL 0 DIAGRAM



In level zero, we have the same external entities but expand the system into two processes and five data stores.

Data Stores:

Asset Location DS: This data store stores all the information related to asset locations. It is the central repository from which the system retrieves location data to display or update as needed. It receives input from the manage asset location process and then the output is sent back with the information gathered.

Vendor Details DS: This data store maintains all the information regarding the vendors associated. The manage assets and contract process requests sends the vendor information to the data store. It acts as a centralized hub for adding and updating the vendor information.

Orders DS: This data store holds detailed data regarding the orders that include the purchasing and transaction records for the processing of asset orders. It is a central hub that provides order updates.

Product Catalog DS: This data store serves as a centralized repository, housing extensive details of products such as descriptions, categories, and related information. It consolidates new and updated product catalogs, ensuring all product data is current and accessible.

Asset DS: This data store is the primary repository for all the asset information. It acts as a centralized database for storing and retrieving asset details. It acknowledges the creation of new asset information and stores the information.

Processes:

Manage Asset Location: This process is responsible for handling all tasks related to the tracking and updating of asset locations. It involves inputting new location data, updating existing records, and providing users with the ability to visualize asset placements on maps.

Process Inputs:

- Edit location details.
- Search asset location.
- Search and filter contract and location details.
- Update asset and location information.

Process Outputs:

- Acknowledgement of location updates.
- Fetching asset location information.
- Sending over location and contract information.

Manage Assets and Contracts: This process oversees the broader scope of asset management, including vendor relations, contract management, and the orders and products. It ensures that asset information is up to date and that contracts are maintained accurately.

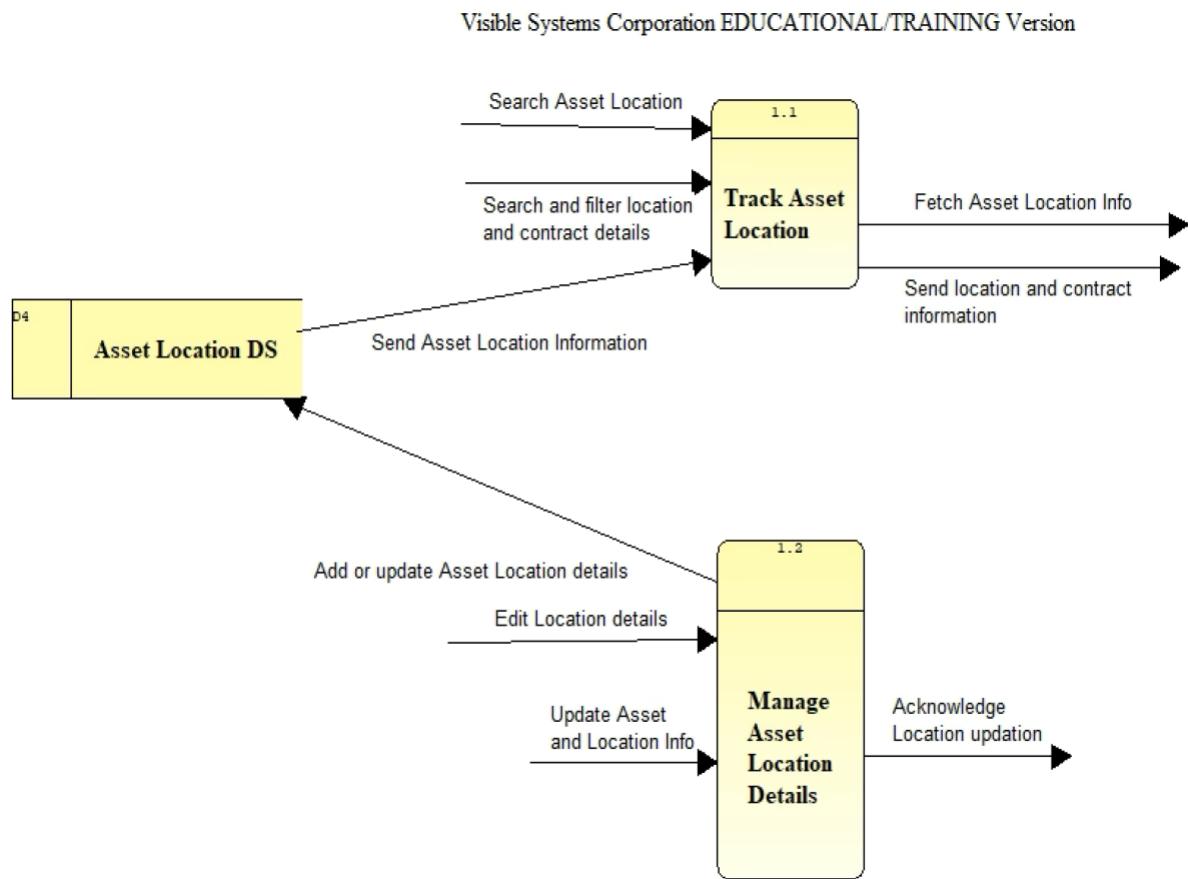
Process Inputs:

- Export asset information.
- Update asset and location information.
- Creating new asset information
- Provide user access.
- Adding and updating of contract details
- Search and filter contracts.
- Create RMAs
- Search and filter asset information.
- Search and filter Product Catalog

Process Outputs:

- Alert contract expiry.
- Retrieve contract information.
- Alerting security breaches.
- Acknowledge the creation of asset details.
- Acknowledge RMA creation.
- Acknowledge updating of contract details.
- Fetch contract information.
- Fetch license information.
- Fetch RMA information.
- Fetch order details.
- Fetch product catalog information.

LEVEL 1 DIAGRAM FOR MANAGE ASSET LOCATION



Data store:

Asset location DS (D4): The Asset Location Data Store receives input from the Manage Asset Location process for adding or updating asset location details. It provides output to the Track Asset Location process, facilitating the retrieval of asset location information.

Processes:

Track Asset Location: The Track Asset Location process is responsible for locating and retrieving the details about an asset's current whereabouts. It receives the search criteria, such as the location and contract information, from the Search Asset Location process. Using this input, the Track Asset Location process accesses the Asset Location DS data store (D4) to fetch the precise location data for the requested asset. Once the asset's location information is retrieved, the

process sends it back to the Search Asset Location process, enabling the user to view the asset's current location.

Process input:

- The Search and filter location and contract details input from the Search Asset Location process.
- The asset location information retrieved from the Asset Location DS data store (D4).

Process outputs:

- The fetched asset location information.
- The location and contract information sent back to the Search Asset Location process.

Process Manage Asset Location Details: The Manage Asset Location Details process allows the user to maintain and update the information related to the organization's asset locations. Users can edit the existing location details, such as the address, contact information, or any other relevant data. When the user makes changes to the asset location, the Manage Asset Location Details process updates the Asset Location DS data store (D4) accordingly. After the location details are updated, the process sends an acknowledgment back to the Search Asset Location process, confirming that the location information has been successfully updated.

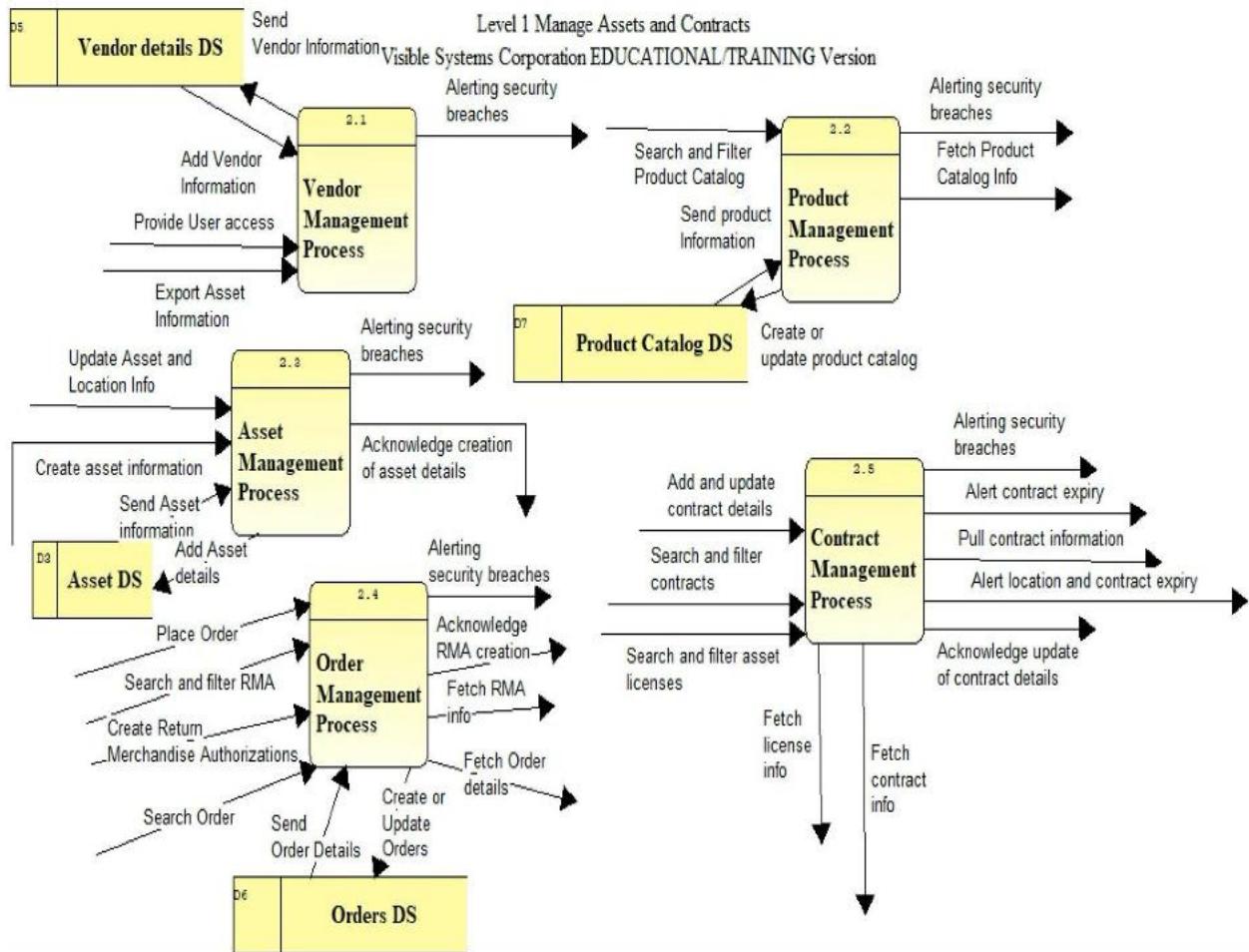
Process input:

- The ability to edit the existing location details.
- The option to update the asset and location information.

Process outputs:

- An acknowledgment of the location update sent to the Search Asset Location process.
- The addition or update of the asset location details in the Asset Location DS data store (D4).

LEVEL 1 DIAGRAM FOR MANAGE ASSETS AND CONTRACTS



Data stores:

Vendor Details DS (D5): The Vendor Details Data Store serves as a repository for comprehensive vendor information vital for efficient Vendor Management. It accumulates data from the Vendor Management process, encompassing details of vendors to be stored or updated. This centralized hub facilitates streamlined vendor oversight and aids in maintaining up-to-date vendor records.

Orders DS (D6): Within the Orders Data Store, intricate details of orders are meticulously recorded, essential for seamless Order Management. Information stored here is pivotal for order processing and alert generation, providing a comprehensive overview of the order lifecycle. Additionally, it serves as a repository for newly created or updated order data received from the Order Management process, ensuring real-time access to order information.

Product Catalog DS (D7): The Product Catalog Data Store acts as a reservoir for product related information, pivotal for product management endeavors. It houses an extensive array of product details, accessible to the Product Management process for various operational needs. Here, newly created or updated product catalogs from the product management process are integrated, fostering a centralized repository for comprehensive product data management.

Asset DS (D8): The Asset Data Store functions as a repository for critical asset information, indispensable for effective Asset Management operations. It serves as a centralized database for storing and accessing asset details, essential for tracking and optimizing asset utilization. Data flows from the Asset Management process to this store, facilitating the acknowledgment of asset creation and ensuring accurate asset record-keeping.

Processes:

Vendor Management Process: The Vendor Management Process efficiently oversees the integration of new vendors, facilitates user access provisioning, and facilitates the extraction of essential asset information. This process seamlessly interacts with the Vendor details DS (D5) data store.

Process input:

- Incorporating Vendor Information
- Provisioning User Access
- Extracting Asset Information (from Vendor details DS)

Process output:

- Prompt notification of security breaches

Asset Management Process: The Asset Management Process meticulously handles all aspects related to asset information management, including the creation of new assets, updating asset and location particulars, and exporting vital asset data. This process interfaces with the Asset DS (D8) data store.

Process input:

- Updating Asset and Location Details
- Creating Asset Information
- Transmitting Asset Information (from Asset DS)

Process output:

- Immediate notification of security breaches
- Confirmation of asset detail creation
- Addition of Asset Details (to Asset DS)

Product Management Process: The Product Management Process adeptly manages tasks concerning the product catalog, such as conducting searches, applying filters, and retrieving comprehensive product catalog details. It seamlessly interfaces with the Product Catalog DS (D7) data store.

Process input:

- Conducting Product Catalog Searches and Filters (from Product Catalog DS)

Process output:

- Timely notification of security breaches
- Retrieval of Product Catalog Information
- Creation or Modification of Product Catalog Entries (to Product Catalog DS)

Order Management Process: The Order Management Process efficiently oversees order-related activities, including order placement, processing return merchandise authorizations (RMAs), generating RMAs, and retrieving order specifics. This process interacts with the Orders DS (D6) data store.

Process input:

- Placing Orders
- Searching and Filtering RMAs
- Generating Return Merchandise Authorizations

- Searching Orders
- Transmitting Order Details (from Orders DS)

Process output:

- Swift notification of security breaches
- Confirmation of RMA creation
- Retrieval of RMA information
- Retrieval of Order details
- Creation or Update of Orders (to Orders DS)

Contract Management Process: The Contract Management Process proficiently handles all contract-related operations, including the addition and updating of contract particulars, searching and filtering contracts and asset licenses, and retrieving contract information.

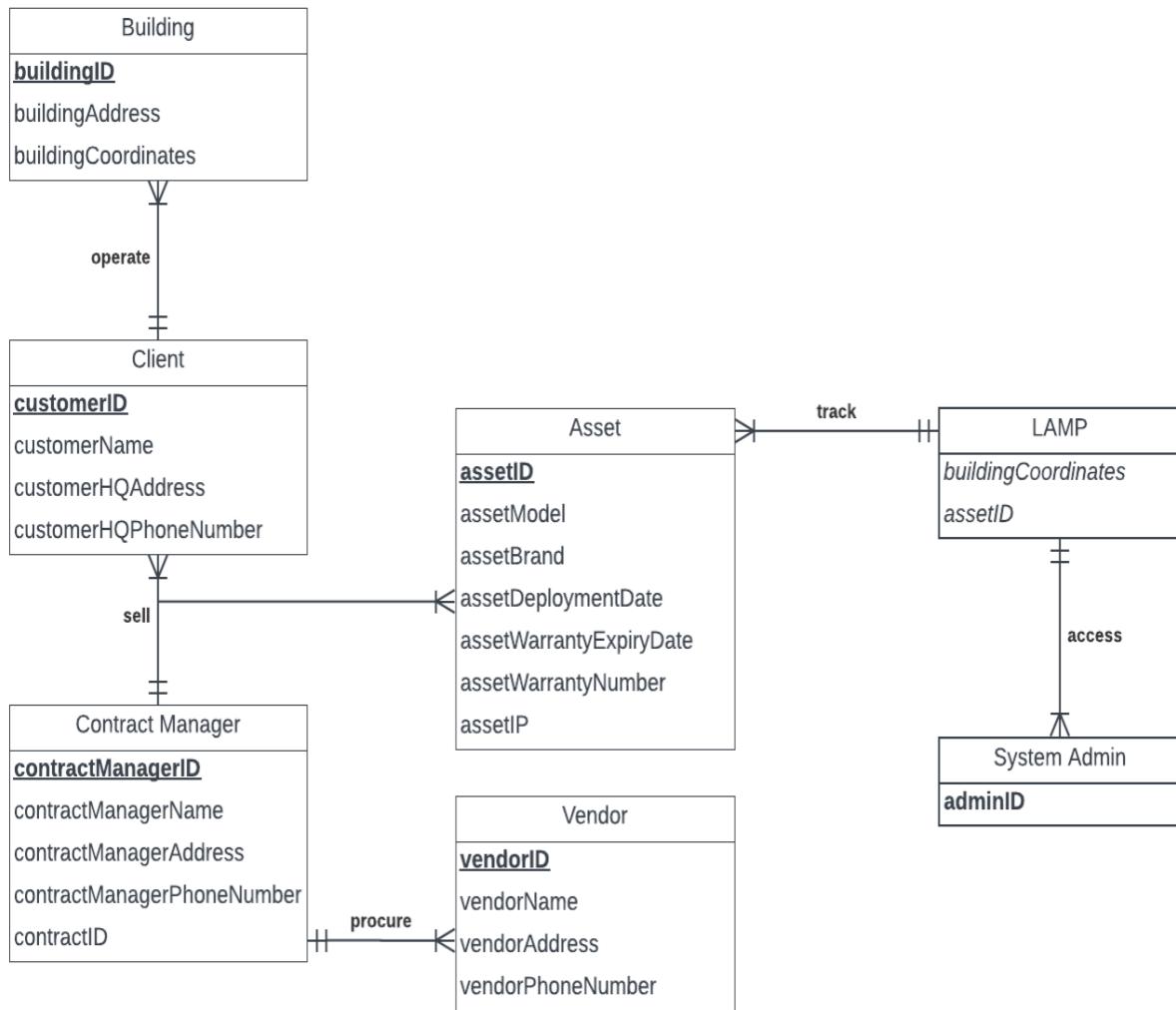
Process input:

- Adding and Updating Contract Details
- Searching and Filtering Contracts
- Searching and Filtering Asset Licenses

Process output:

- Prompt notification of security breaches

ENTITY RELATIONSHIP DIAGRAM (ERD)



This ERD reflects the existing entities and attributes of the LAMP system. Vendor is any third-party vendor or Trace3 that sells hardware products. Contract Manager sells the hardware products, and they serve as the liaison between Client and Vendor. Since a client can have business in one or multiple buildings, Building is added as an entity too.

When a Contract Manager sells Asset to a Client, critical information such as Asset Warranty Number and Asset Warranty Expiry Date are being tracked by LAMP. System Admin can access such information by logging in to the LAMP system.

PROJECT PROPOSAL REPORT

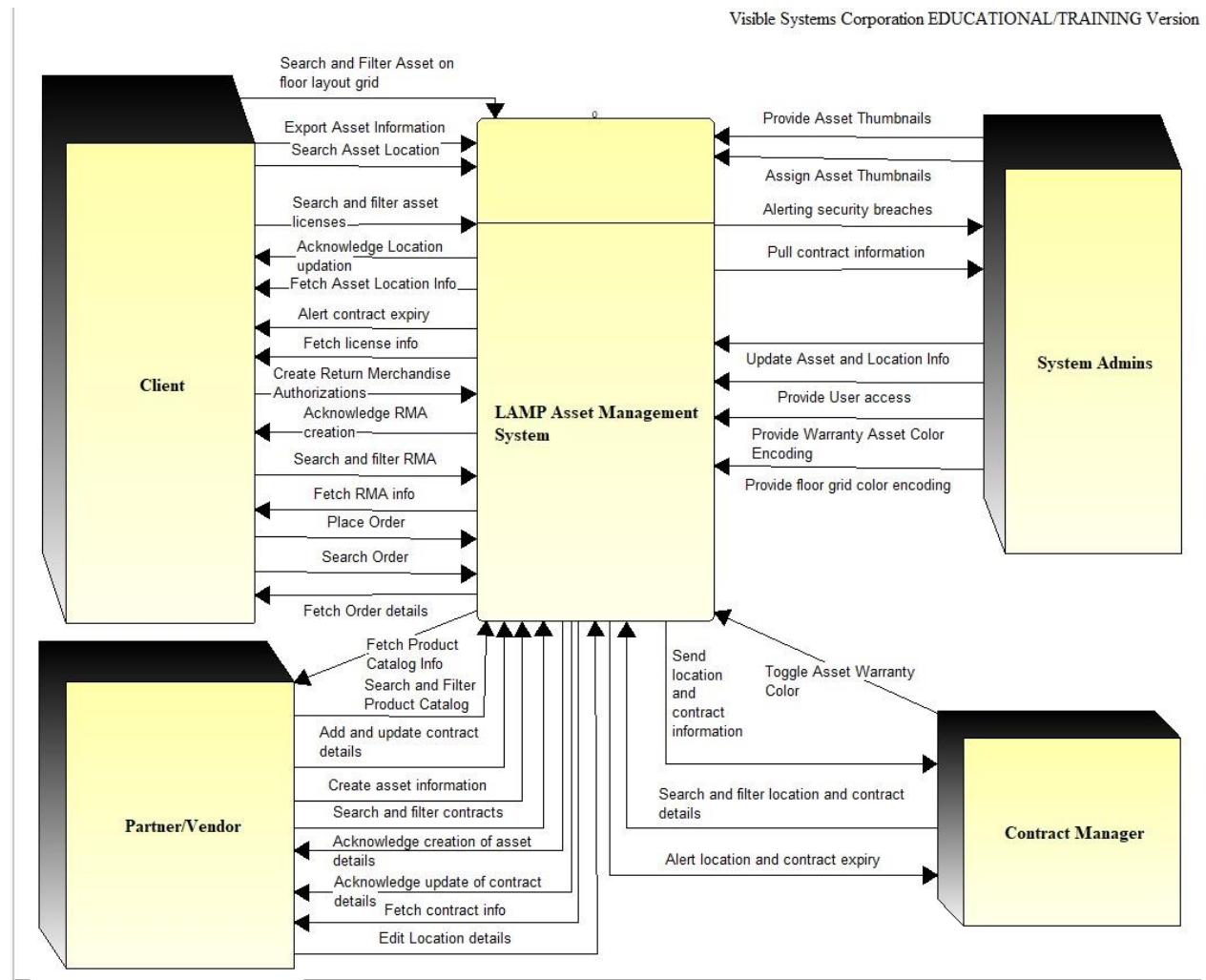
Diagrams and Analysis for the Proposed System

We have designed the following diagrams to depict how our proposed system should work. Analysis follows to see which solution works best for our implementation.

- Logical DFDs (Data Flow Diagrams)
 - Context level
 - Level 0
 - Level 1
- Entity Relationship Diagram
- CRUD (Create, Read, Update, Delete) Matrix
- Candidate System Solution Analysis
- Feasibility Analysis
- Physical DFDs
- Input/Output Illustrations

SYSTEM MODELS OF THE PROPOSED SYSTEM

DATA FLOW DIAGRAMS (DFDs) – CONTEXT LEVEL



In the Context Diagram, there are four external entities in the proposed system.

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System Admins: These are the individuals or teams responsible for maintaining the LAMP Asset Management System. Their responsibilities include updating asset and location information, pulling contract information, and managing user access within the system. Trace3's system admins are responsible for adding vendors.

Contract Manager: This entity is responsible for overseeing contract creation, updates, and expirations. They work within the system to ensure that all contractual obligations are met and are alerted when contracts are due to expire.

System Inputs:

From Client:

- Asset Information Request (the client requests details about the asset's status or location)
- Asset Management Actions (such as acknowledging location updates or alerting contract expiry)
- Return Merchandise Authorization (RMA) Actions (includes creating, searching for, or updating RMA details)
- Order Placement (the client places orders and searches for their details)

From Partner/Vendor:

- Product and Contract Data Exchange (the partner/vendor receives and acknowledges the creation of asset details and contract updates)
- Contract and Asset Information Submission (submission of updated contract details and asset information to the system)

From System Admins:

- System Maintenance Inputs (admin provides updates for asset and location information, processes user access requests, and inputs related to security breach alerts)
- Contact Information Updates (admin updates contract details within the system)

From Contract Manager:

- Contract Management Inputs (includes sending and receiving information related to contract location and expiry alerts)
- Asset and Location Updates (manages updates to asset details and locations as per the contract terms)

System Outputs:**To Client:**

- Asset Information Reports (including locations and statuses of assets)
- Asset Management Confirmations (confirmations of acknowledged location updates, alerts of contract expiry, etc.)
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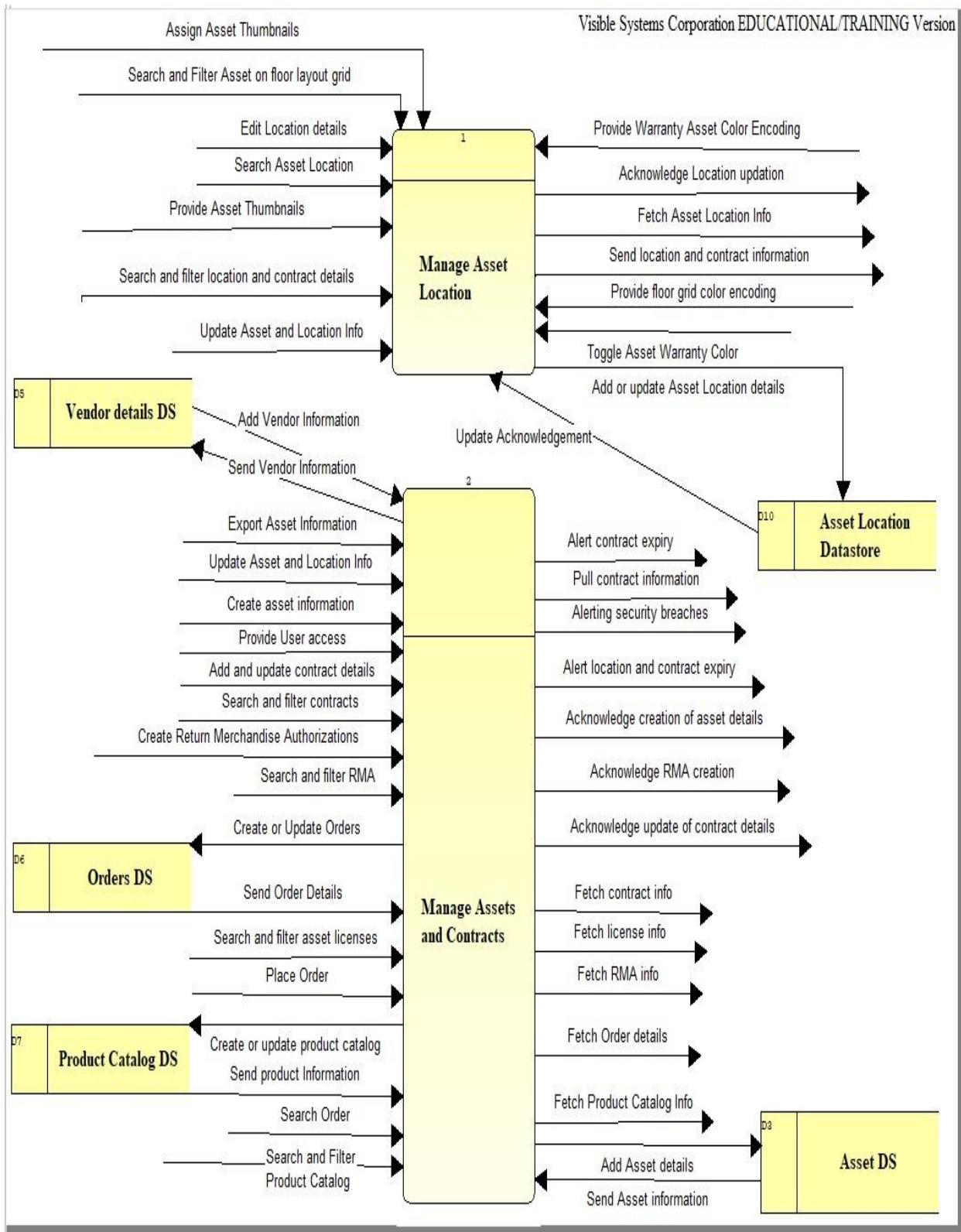
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- System Status Reports (information on the current status and health of the asset management system)
- Security Breach Alerts (notifications and details of any security breaches within the system)
- Contract Information Summaries (summaries of updated contract details for administrative purposes)

To Contract Manager:

- Contract Status Updates (notifications and details of contract creations, updates, and expirations)
- Asset and Location Information Reports (reports detailing the updates to asset information and locations)

DATA FLOW DIAGRAMS (DFDs) – LEVEL 0



Data Stores:

Asset Location Datastore: This data store stores all the information related to asset locations. It is the central repository from which the system retrieves location data to display or update as needed. It receives input from the manage asset location process and then the output is sent back with the information gathered.

Vendor Details DS: This data store maintains all the information regarding the vendors associated. The manage assets and contract process requests sends the vendor information to the data store. It acts as a centralized hub for adding and updating the vendor information.

Orders DS: This data store holds detailed data regarding the orders that include the purchasing and transaction records for the processing of asset orders. It is a central hub that provides order updates.

Product Catalog DS: This data store serves as a centralized repository, housing extensive details of products such as descriptions, categories, and related information. It consolidates new and updated product catalogs, ensuring all product data is current and accessible.

Asset DS: This data store is the primary repository for all the asset information. It acts as a centralized database for storing and retrieving asset details. It acknowledges the creation of new asset information and stores the information.

Processes:

Manage Asset Location: This is the central hub for handling asset location details. It involves assigning thumbnails to assets, searching and filtering asset locations, and managing warranty color encoding for assets.

Process Inputs:

- Search and Filter Asset on Floor Layout Grid: Allows users to locate specific assets on the locations within the grid.
- Provide Asset Thumbnails and Assign Asset Thumbnails: Assigns visual identifiers to assets to aid in their quick identification.

- Provide warranty asset color encoding helps quickly identify whether an asset is under warranty, approaching the end of warranty, or out of warranty.
- Provide floor grid color encoding and toggle asset warranty color: A color code is assigned to different sections of a floor grid within a facility and can toggle the asset warranty colors to gather more information.

Process Outputs:

- Acknowledgement of location updates.
- Fetching asset location information.
- Sending over location and contract information.

Manage Assets and Contracts: This process oversees the broader scope of asset management, including vendor relations, contract management, and the orders and products. It ensures that asset information is up to date and that contracts are maintained accurately.

Process Inputs:

- Export asset information.
- Update asset and location information.
- Creating new asset information.
- Provide user access.
- Adding and updating of contract details.
- Search and filter contracts.
- Create RMAs.
- Search and filter asset information.
- Search and filter Product Catalog.

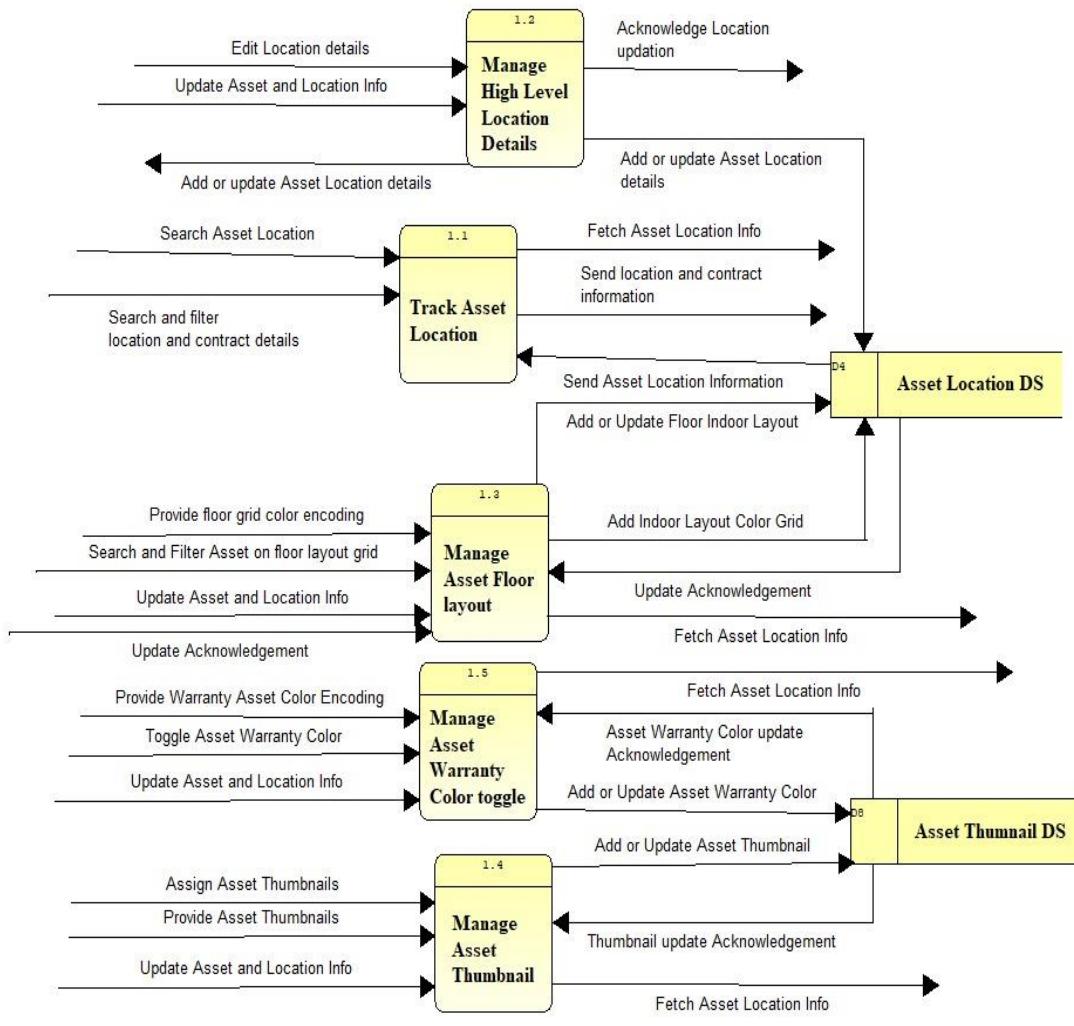
Process Outputs:

- Alert contract expiry.
- Retrieve contract information.
- Alerting security breaches.
- Acknowledge the creation of asset details.
- Acknowledge RMA creation.
- Acknowledge updating of contract details.

- Fetch contract information.
- Fetch license information.
- Fetch RMA information.
- Fetch order details.
- Fetch product catalog information.

DATA FLOW DIAGRAMS (DFDs) – LEVEL 1

Visible Systems Corporation EDUCATIONAL/TRAINING Version



Process 1.1 Track Asset Location: Keeping track of where the assets are to the room level

Process Inputs

- Search Asset Location
- Search and filter location and contract details.
- Send Asset Location Information (from Asset Location Data Store).

Process Outputs

- Send location and contract information.
- Fetch asset location info.

Process 1.2 Manage High-Level Location Details: Mainly to edit and update location info

Process Inputs

- Edit location details.
- Update asset and location info.

Process Outputs

- Acknowledge location update.
- Add or update asset location details (to Asset Location Data Store).

Process 1.3 - Manage Asset Floor Layout: This process allows system admin and users to color encode the floor layout.

Process Inputs

- Search and filter asset on floor layout grid.
- Provide floor grid color encoding.
- Update asset and location info.
- Update acknowledgement.

Process Outputs

- Add Indoor Layout Color Grid (to Asset Location DS).
- Fetch asset location info.

Process 1.4 - Manage Asset Thumbnail: This process allows end users to customize thumbnails for easy recognition.

Process Inputs

- Assign Asset Thumbnails.
- Provide Asset Thumbnails.
- Update asset and location info.
- Thumbnail update acknowledgement (from Asset Thumbnail DS).

Process Outputs

- Add or Update Asset Thumbnail (to Asset Thumbnail DS).
- Fetch asset location info.

Process 1.5 Manage Asset Warranty Color Toggle: This process allows end users to see assets in different colors according to their warranty status.

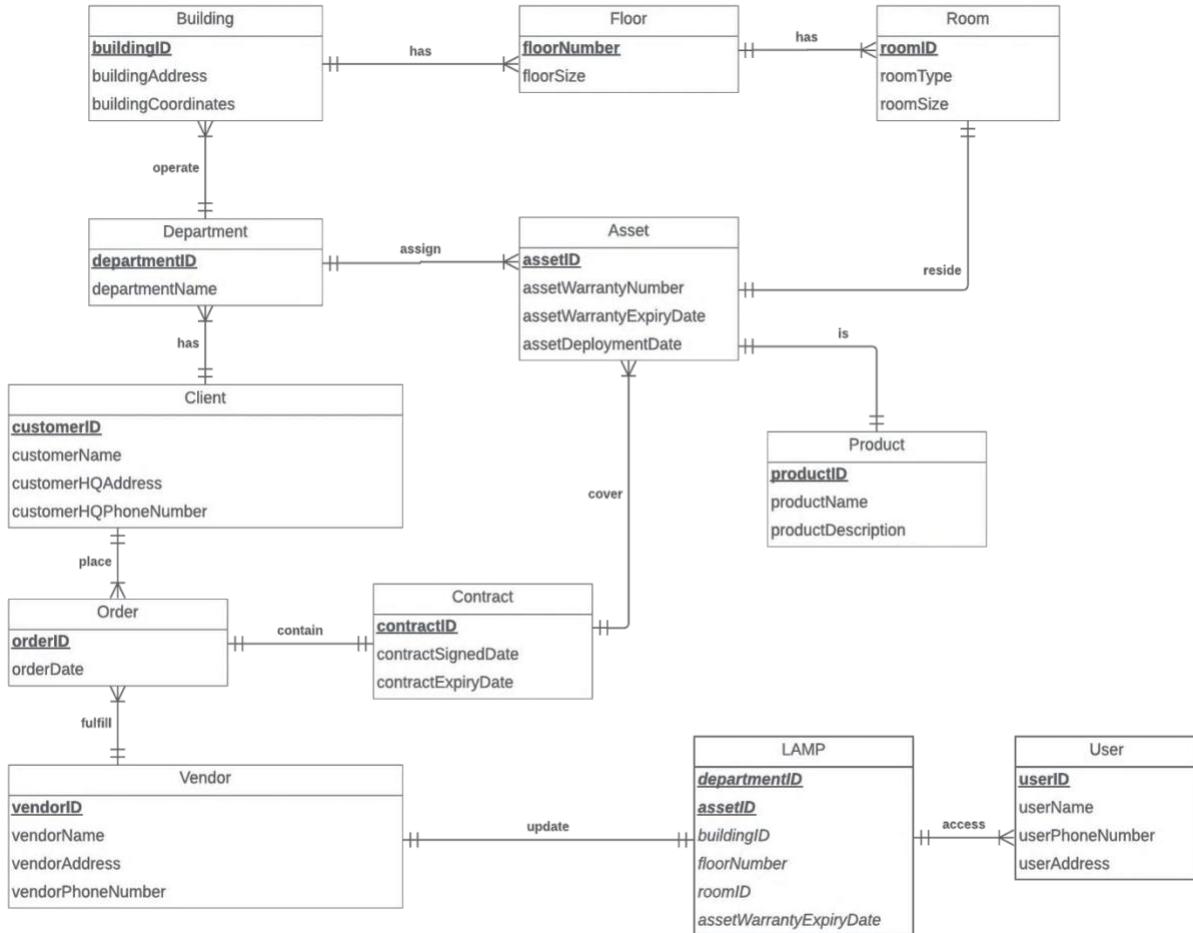
Process Inputs

- Provide Warranty Asset Color Encoding.
- Toggle Asset Warranty Color.
- Update asset and location info.
- Asset warranty color update acknowledgement (from Asset Thumbnail DS).

Process Outputs

- Add or Update Asset Warranty Color (to Asset Thumbnail Data Store).
- Fetch asset location info..

ENTITY RELATIONSHIP DIAGRAM (ERD)



After further meetings with Trace3, we have edited our ERD to reflect its current workings more accurately. When a client places an Order, the Vendor fulfills it. A Contract is created as a by-product of this transaction, and the Contract covers the Asset and its Warranty. Once a Product is sold to a client, it is known as an Asset in the system.

The Vendor updates the LAMP system on Assets that are deployed with details such as Asset Warranty Expiry Date and the location of the Asset (Building ID, Floor Number, Room ID). This information is accessible by the User through the LAMP system.

What makes this system different from the LAMP as-is system is Floor and Room. These will be the additional features which our solution offers.

SYNCHRONIZED SYSTEM MODELS (CRUD MATRIX)

The diagram illustrates the correlation between the entity relationship diagram and the data flow diagrams, depicting the synchronization of operations on data elements by various processes. It outlines which processes are responsible for creating, reading, updating, or deleting each data element.

Entity, Attribute	Manage Asset Location	Manage Assets and Contracts	Manage high level location details	Track Asset Location	Manage Asset Floor Layout	Manage Asset Warranty Color toggle	Manage Asset Thumbnail	Vendor Management Process	Product Management Process	Asset Management Process	Order Management Process	Contract Management Process
User		CUD									CUD	
.userId		CUD									CUD	
.userName		CUD									CUD	
.userPhoneNumber		CUD									CUD	
.userAddress		CUD									CUD	
Vendor	CRU	CUD	CRU					CUD				
.vendorId	CRU	CUD	CRU					CUD				
.vendorName	CRU	CUD	CRU					CUD				
.vendorAddress	CRU	CUD	CRU					CUD				
.vendorPhoneNumber	CRU	CUD	CRU					CUD				
Client		CUD									CUD	
.customerId		CUD									CUD	
.customerName		CUD									CUD	
.customerHQAddress		CUD									CUD	
.customerHQPhoneNumber		CUD									CUD	
Asset	R	CUD	R	R	R	R	R			CUD		
.assetId	R	CUD	R	R	R	R	R			R		
.assetModel	R	CUD	R	R	R	R	R			R		
.assetBrand	R	CUD	R	R	R	R	R			R		
.assetDeploymentDate	R	CUD	R	R	R	R	R			R		
.assetWarrantyExpiryDate	R	CUD	R	R	R	R	R			CUD		
.assetWarrantyNumber	R	CUD	R	R	R	R	R			CUD		
Contract	CU	CUD	R	CU	R	R	R				CUD	
.contractId	CU	CUD	R	CU	R	R	R				CUD	
.contractSignedDate	CU	CUD	R	CU	R	R	R				CUD	
.contractExpiryDate	CU	CUD	R	CU	R	R	R				CUD	

Entity, Attribute	Manage Asset Location	Manage Assets and Contracts	Manage high level location details			Track Asset Location	Manage Asset Floor Layout	Manage Asset Warranty Color toggle	Manage Asset Thumbnail	Vendor Management Process	Product Management Process	Asset Management Process	Order Management Process	Contract Management Process
Department	CRUD		CRUD	R	R	R	R							
.departmentId	CRUD		CRUD	R	R	R	R							
.departmentName	CRUD		CRUD	R	R	R	R							
Floor	CRUD		R	R	CRUD	R	R							
.floorNumber	CRUD		R	R	CRUD	R	R							
.floorSize	CRUD		R	R	CRUD	R	R							
Room	CRUD		R	R	R	R	R	CRUD						
.roomID	CRUD		R	R	R	R	R	CRUD						
.roomType	CRUD		R	R	R	R	R	CRUD						
.roomSize	CRUD		R	R	R	R	R	CRUD						
LAMP	CRUD		CRUD	R	CRUD	R	CRUD							
.departmentId	CRUD		CRUD	R	R	R	R	R						
.assetId	CRUD		CRUD	R	R	R	R	R						
.buildingId	CRUD		CRUD	R	R	R	R	R						
.floorNumber	CRUD		R	R	CRUD	R	R							
.roomId	CRUD		R	R	R	R	R	CRUD						
.assetWarrantyExpiryDate	CRUD		CRUD	R	R	R	R	R						
Building	CRUD		CRUD	R	R	R	R	R						
.buildingId	CRUD		CRUD	R	R	R	R	R						
.buildingAddress	CRUD		CRUD	R	R	R	R	R						
.buildingCoordinates	CRUD		CRUD	R	R	R	R	R						
Order											CUD			
.orderDate											CUD			
Product										CUD				
.productID										CUD				
.productName										CUD				
.productDescription										CUD				

PHYSICAL SYSTEM DESIGN

CANDIDATE SYSTEM SOLUTIONS TABLE

Characteristics	Candidate 1: In-House Development	Candidate 2: Purchase Packaged Software	Candidate 3: Outsourcing
Technology <i>The technologies that are required for the candidate</i>	Custom web technologies.	Commercial Software such as Azure Maps.	External vendor technology.
Portion of System Computerized <i>Specific part of the organization's operations that will be computerized by the candidate solution.</i>	Asset mapping and tracking system.	Asset mapping module integrated with Azure Maps.	Complete asset management system.
Brief Description <i>A brief description of the candidate solution proposed</i>	Custom platform for real-time asset location tracking on detailed indoor maps.	Existing software adapted to include asset tracking and mapping features.	Comprehensive asset management solution including tracking, maintenance, and analytics.
Benefits <i>Business benefits expected from implementing each solution</i>	Tailored solution, perfect fit to exact needs, seamless integration with existing systems.	Faster implementation, proven stability, community support, leverages Azure Maps for advanced geospatial capabilities.	Expert handling, lower internal management overhead, potentially innovative solutions.

Servers and workstations <i>The hardware requirements necessary to support the implementation and daily operation of each candidate solution.</i>	High-performance servers to support intensive data processing and real-time asset tracking functionalities, Developer workstations Quad-core processors (Intel Xeon or AMD equivalent), 32GB RAM minimum, 1TB SSD for rapid data access and storage. Optimized for high data throughput and minimal latency to support GIS processing and large-scale data management.	Standard servers compatible with the software integration and other asset management software components, user workstations for admin and operational staff Dual-core processors, 16GB RAM, and 500GB SSD storage to handle the less intensive processing needs of packaged software but capable of cloud connectivity and data synchronization.	The specifics of servers and workstations will be defined and managed by the outsourcing service provider, tailored to the scope of the outsourced asset management system.
Software Tools <i>The software development tools, platforms, and environments needed to create or customize the solution.</i>	React, Node.js, PostgreSQL, MongoDB, GIS, development, and testing tools	Software customization tools, integration middleware.	Handled by external vendor.

Application Software <i>The main software programs that will be either developed in-house, bought as a packaged solution, or provided by an outsourcing vendor.</i>	Custom-developed application.	Software, plus additional asset tracking modules.	Vendor-specific asset management software.
Data Processing method <i>How data will be processed within the system, which could be in real-time, batch, or a combination.</i>	Real-time and batch processing.	Mostly real-time with some batch processing for updates. .	Defined by vendor, likely a mix of real-time and batch.
Output devices. <i>The hardware required to output data and information from the system.</i>	High-resolution monitors, mobile devices for real-time tracking.	Standard monitors, printed reports.	Depends on vendor's system, typically includes web and mobile outputs.
Input devices. <i>The devices and methods used to input data into the system, and any special considerations such as mobile compatibility or the need for barcode scanners.</i>	Keyboards, scanners, mobile input apps.	Standard input devices like keyboards and possibly tablets.	Vendor-specific, potentially customized input devices.

Storage devices <i>Details about the data storage requirements, including type, capacity, and data organization method, plus considerations for future scalability.</i>	High-capacity, scalable storage solutions, cloud integration.	Standard data storage solutions, possibly cloud-based options.	Typically cloud-based storage managed by vendor.
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FEASIBILITY ANALYSIS MATRIX

Feasibility Criteria <i>(Rationale for Weight)</i>	Weight	Candidate 1 (In-House Development)	Candidate 2 (Purchase Packaged Software)	Candidate 3 (Outsourcing)
Operational Feasibility <i>(This criterion assesses how well each solution integrates with current business operations, which is fundamental for any system implementation. The main objective of a new system is to enhance operational efficiency without disrupting existing processes, and we weighted this the highest because this is the number one priority of our project, that our solution's implementation should not interfere with LAMP's current system, and it must have a smooth and seamless integration with the LAMP system for end-users' best experience.)</i>	35%	This solution provides tailored performance to meet the requirements of this project.	This option will handle the operation well due to the quality of the software.	Hard to measure how well the performance would be under outsourcing.
Technical Feasibility <i>(Checking whether the current technological</i>		It can provide a high flexibility to meet the	Mature technical skill set, but seems to be	Carrying difficulty to adopt any

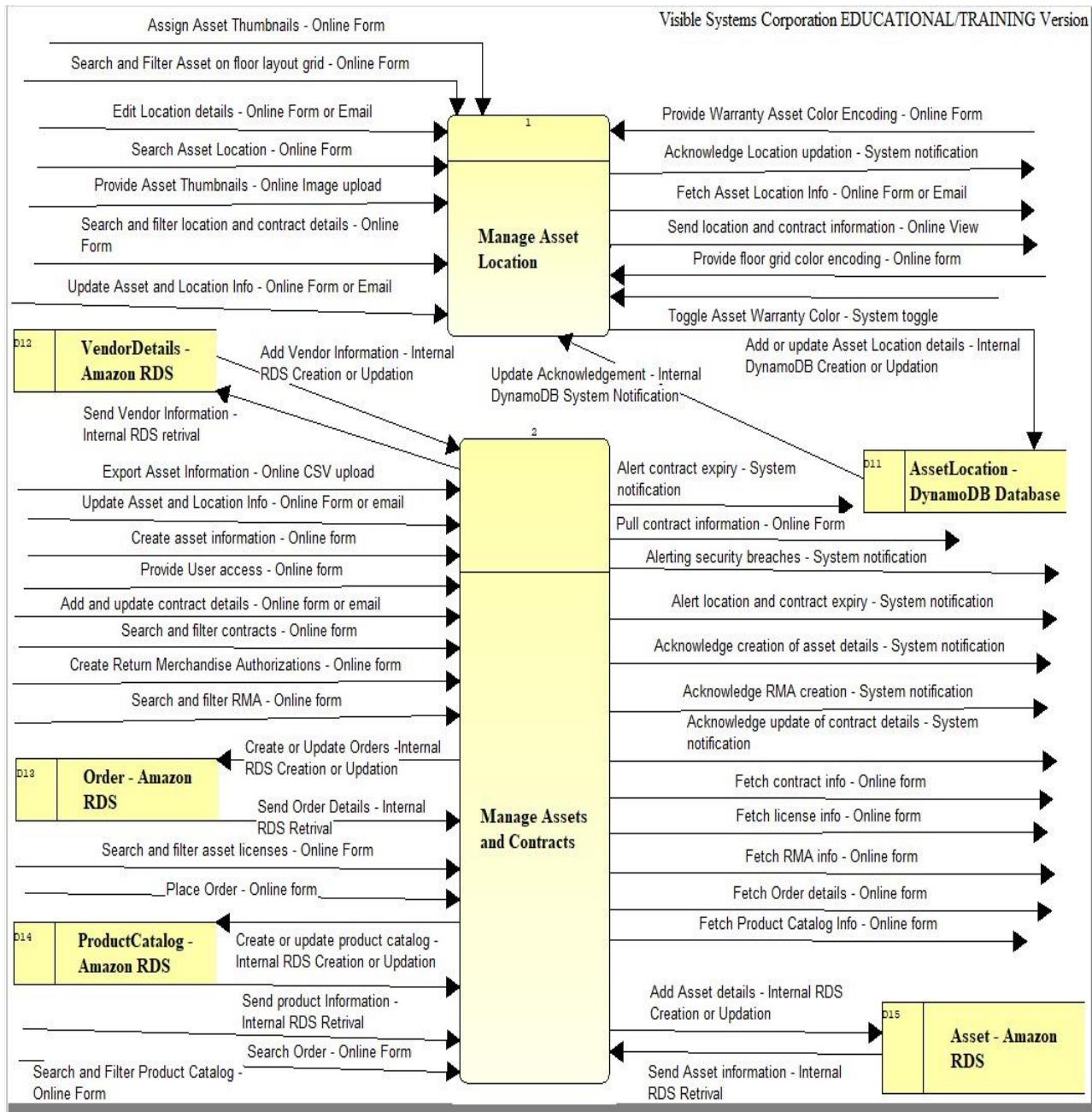
<p><i>infrastructure can support the new system, and what upgrades or new technologies are required. Another component is an assessment of the technical expertise needed to develop, operate, and maintain the candidate system.</i></p> <p><i>This is given the second highest prioritization because the technical backbone must be robust enough to support the system, ensuring scalability and adaptability to future needs. This is tied with Economic Feasibility because both aspects are interrelated.)</i></p>	25%	<p>requirement of any technique problem, also available for future improvements.</p>	<p>difficult of any upgrade request due to the inflexible</p>	<p>technical request.</p>
<p>Economic Feasibility</p> <p><i>(This involves evaluating the cost implications of each solution, including initial investments and ongoing expenses. It also considers the return on investment and the payback period. Given the</i></p>	25%	<p>Cost: \$240.00 Payback: 1 year NPV: \$116,540.87</p>	<p>Cost: \$9,000.00 Payback: 1 Year NPV: \$157,344.52</p>	<p>Cost: \$7,360.00 Payback: 1 Year NPV: \$108,985.12</p>

<i>financial implications of system implementation, this criterion is critically important and thus holds substantial weight)</i>		Score: 85	Score: 100	Score: 85
Schedule Feasibility <i>(This criterion estimates the time required to implement each solution and its impact on business operations. While important, it is weighted slightly less because, once a solution is determined operationally, technically, and economically feasible, the time to implement becomes a secondary (though still significant) consideration)</i>	15%	This takes the longest time to develop and testing for integration.	Not much time needed for development, but there will be substantial amount of time needed for customization and testing.	Not much time needed for development, just to learn the new system.
Ranking	100%	Score: 70	Score: 85	Score: 80

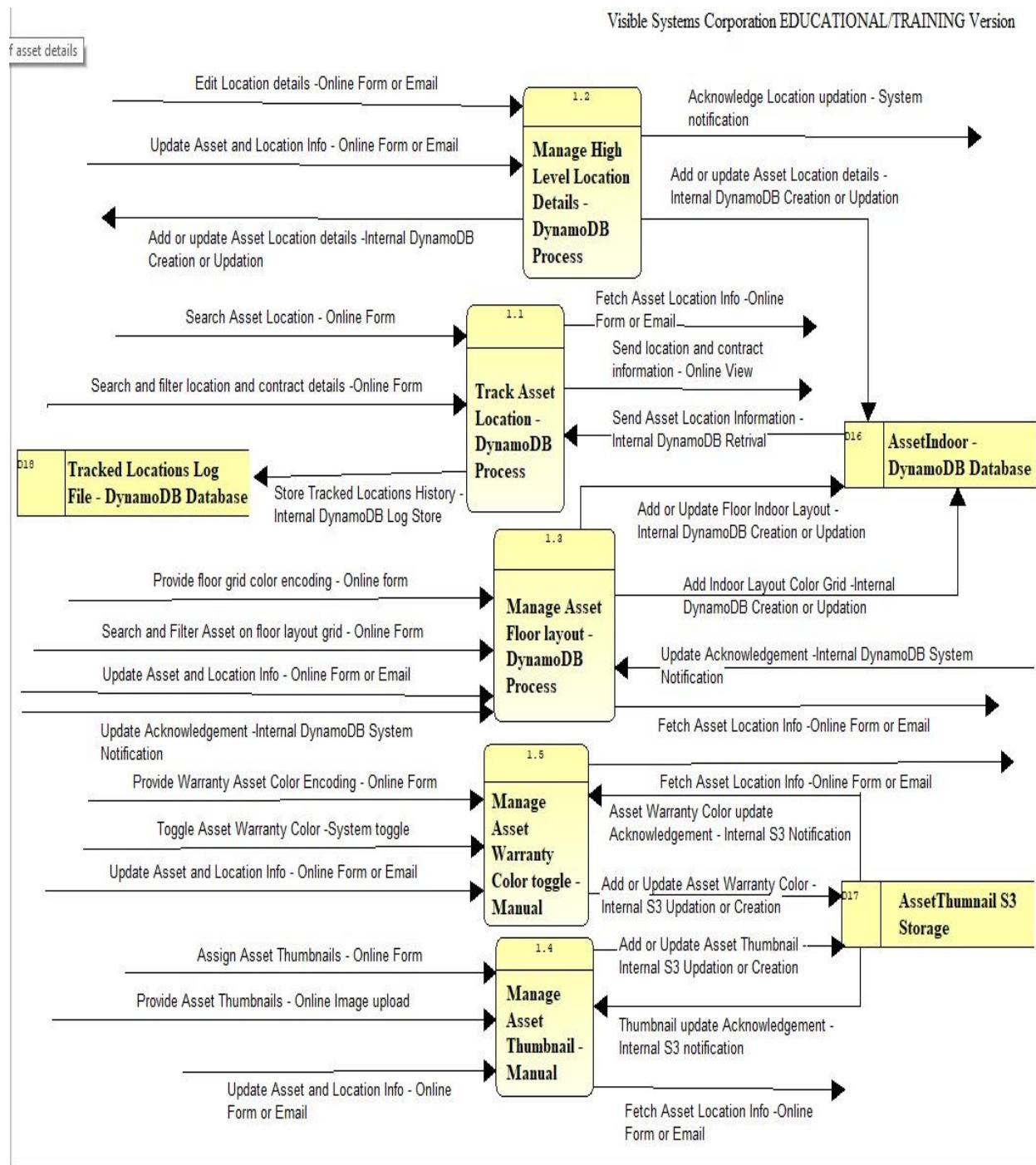
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Physical DFDS

LEVEL 0 DFD



LEVEL 1 DFD



INPUT AND OUTPUT DESIGN

INPUT DESIGN - SAMPLE INTERFACE SCREENS

- Building Map Upload

The screenshot shows the LAMP application's 'Add Building Map' screen. On the left is a vertical sidebar with icons for Home, Manage Records, Reports, Support, Admin, and Trace3. The main area has two columns. The left column contains fields for 'Building Name', 'Number of Floor(s)', and 'Department(s)' (with 'Department Name' repeated). It also has a 'Copy from Address' button and a 'Google' map interface. The right column contains fields for 'Address Line 1-3', 'City', 'County', 'State', 'Postal Code', and 'Country/Region'. At the bottom are 'Cancel' and 'Upload' buttons.

The screenshot shows a 'File Upload' interface. It has a large dashed rectangular area for dragging files. Inside this area are three icons representing different file types: a document, a grid, and a person. Below the dashed area is a blue button labeled 'Select files from device'. At the bottom, text specifies 'Supported File Types: DWG, PDF, DOCX, PNG, GIF, JPG' and 'Max File Size: 20 MB'.

LAMP

Add Asset

Actions : X

Details

Serial Number
Asset Tag
Vendor Instance Number
Host Name
Parent Asset
Asset Status
Organizational Unit
Quantity*

Location

Building Name
Floor
Room
Effective Date

Contract

Contract
Start Date
End Date

Vendor

Vendor*
Product Number
Product Description
Product Category
Product Type
Units

Custom Fields

Customer HW PO
Customer Maint PO
Lease Plus Serial Number
Meraki License Key
Meraki Order Number
Product SO
Ship Date
Maintenance PO
PAK

Cancel Save and Add Another Save and View

LAMP

Asset / AST388FACE73B5A

EDIT

Details

Serial Number
Vendor
Asset Code
Asset Status
Quantity
Product Number
Description
Product Type
Units
Chargeable Status
Do Not Cover/Renew

Location

There were no locations found.

Tickets

TKTLMSC7R02
New

Cisco RMA

There are no Cisco RMA cases.

Cisco TAC Cases

There are no Cisco TAC cases.

Add Physical Location

Location

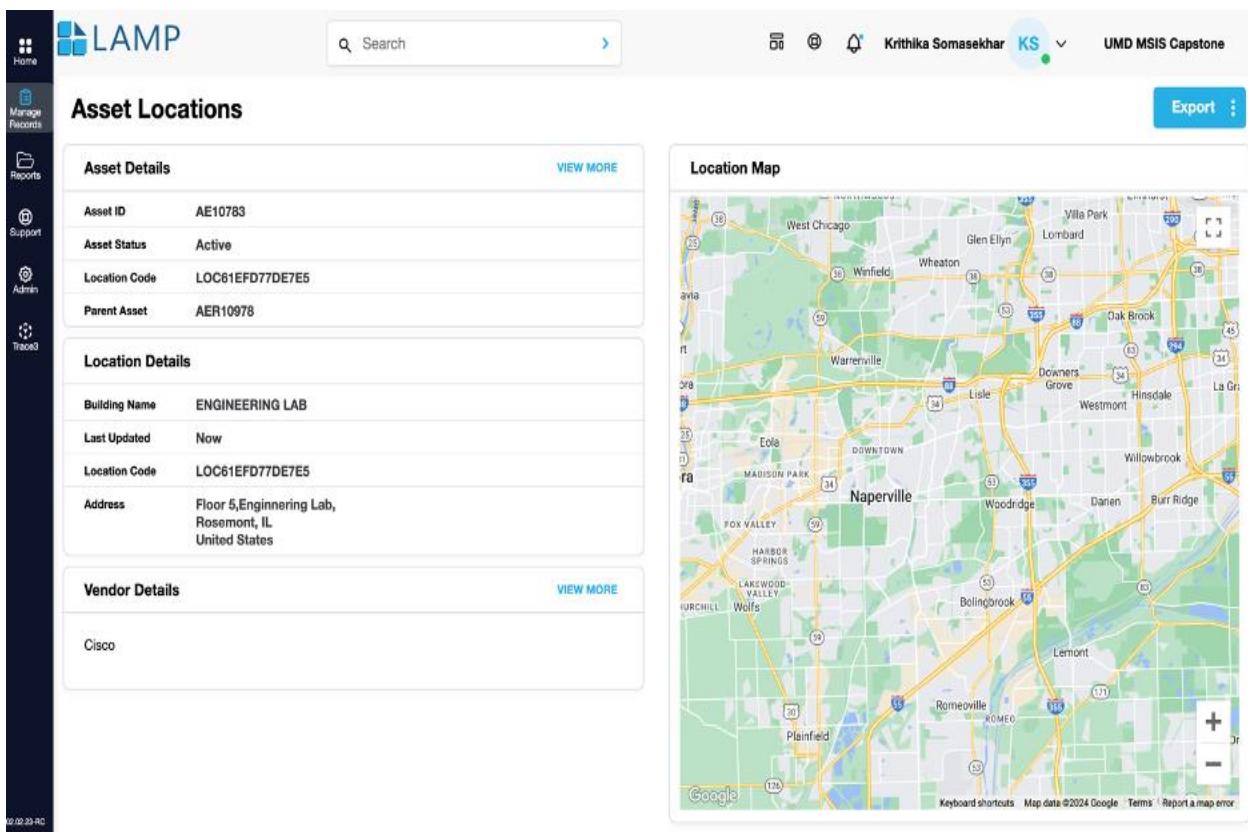
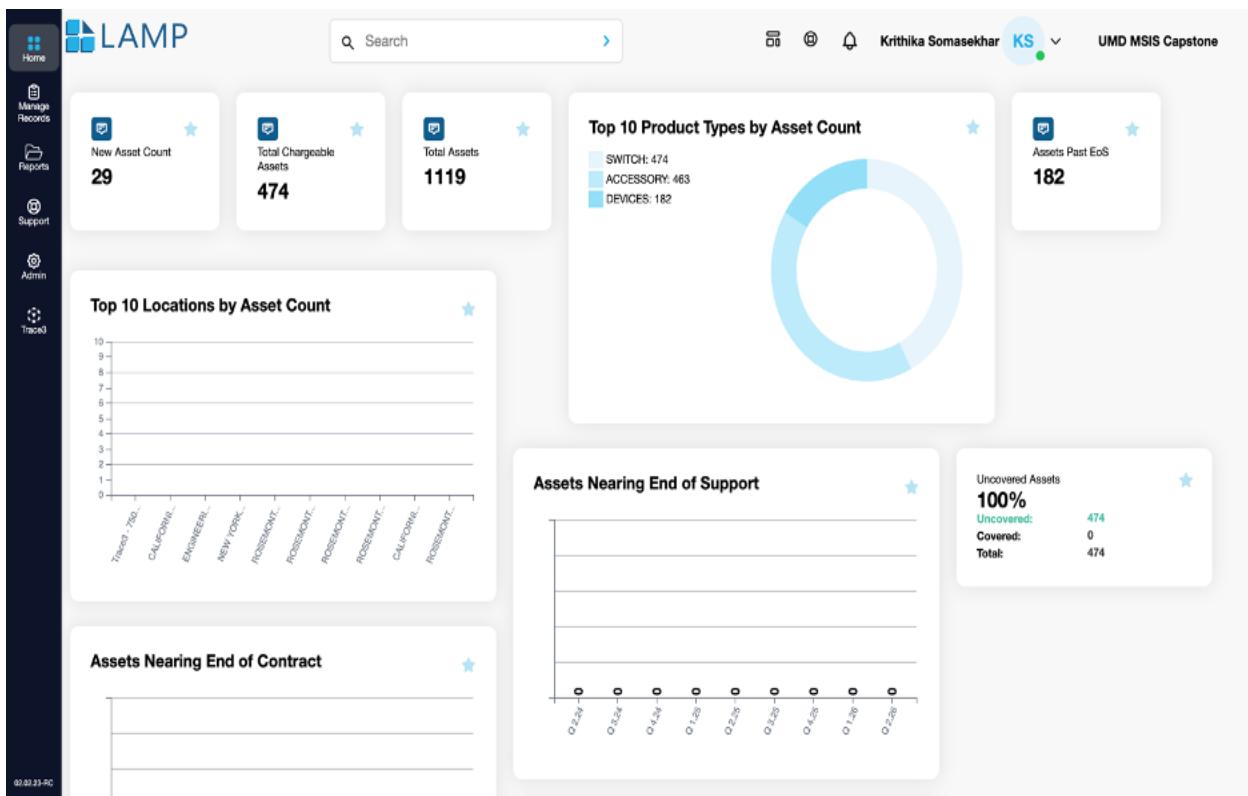
Building*
Floor*
Room*
Effective Date

Cancel Save

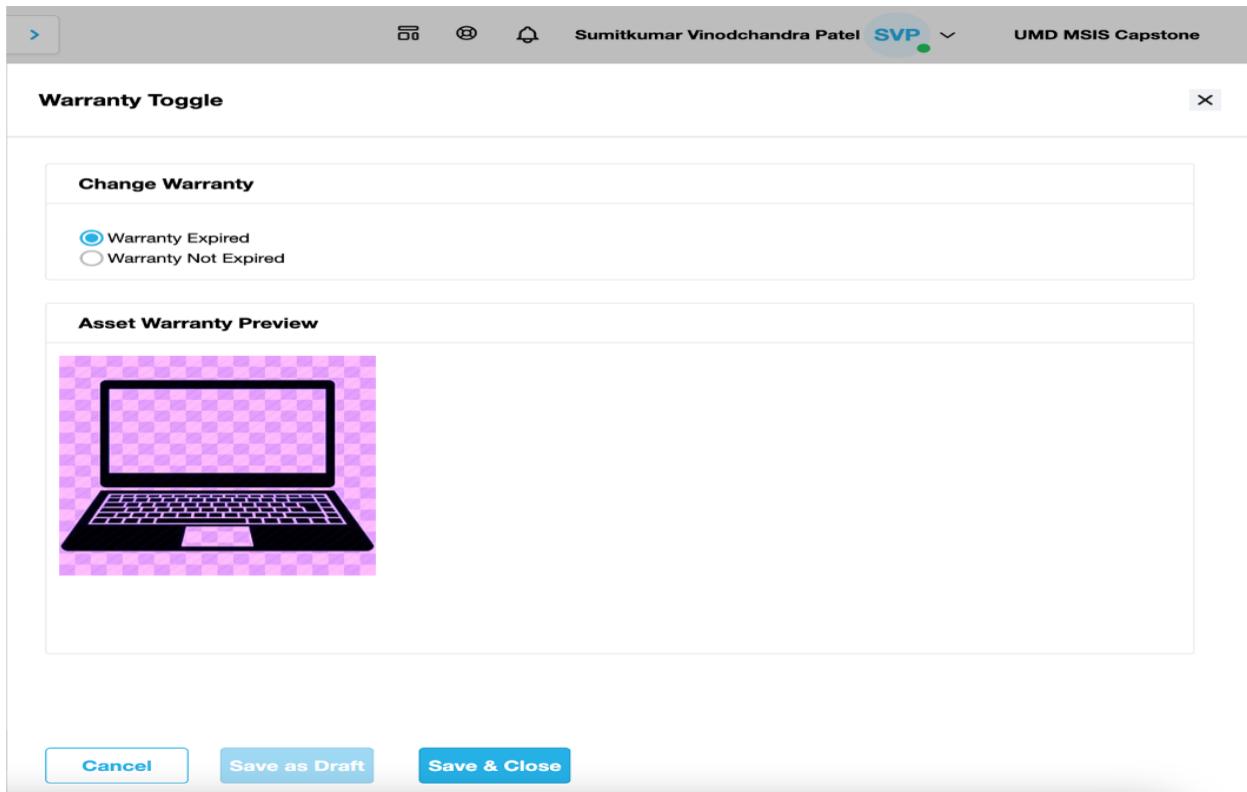
- Output Design

The screenshot shows the LAMP Asset Management System interface. At the top, there's a navigation bar with icons for Home, Manage Records, Reports, Support, Admin, and Tickets. The main title is "Asset / AST3CBF57CE909C". Below the title, there are several sections: "Asset Details" (Serial Number: Test102, Vendor: Cisco, Asset Code: AST3CBF57CE909C, Asset Status: Active, Quantity: 2, Product Number: C9300-48UN-1E, Description: C9300 48-port of 5Gbps, Network Essentials, 1yr offering, Product Category: Hardware, Product Type: SWITCH, Chargeable Status: Currently Chargeable, Do Not Cover/Renew: No); "Location" (Map showing a location with coordinates 41.8781, -74.0441, with options to Map Data, Terms, Report a map error); "Notes" (Empty, with a "VIEW" link); "Recent Updates" (Empty, with a message "New Location found"); "Tickets" (List of one ticket: TKTL5MBEHNS38QU Asset Added, New, Assigned to Richard Gau, Created On 02/14/2024); "Cisco RMA(s)" (Empty); and "Cisco TAC Case(s)" (Empty). A blue "Export Details" button is located in the top right corner.

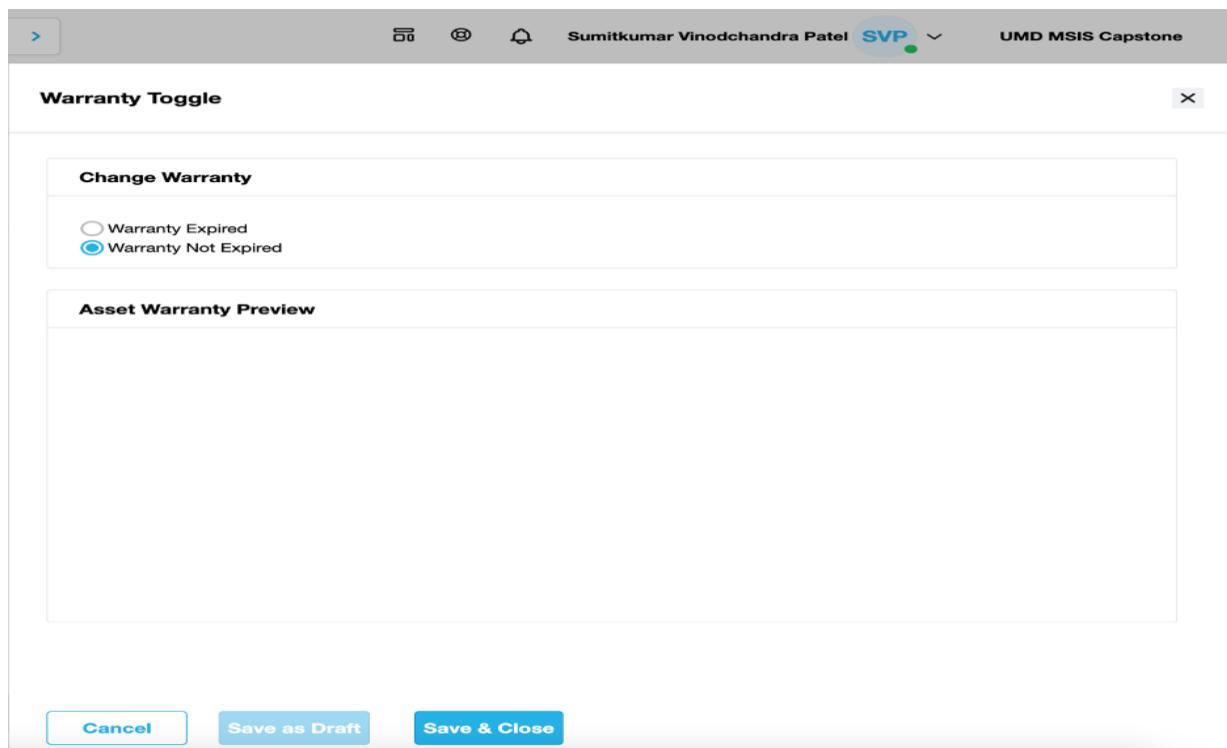
This screenshot shows a configuration tool for selecting columns. It has two main sections: "Selected Columns" on the left and "Available Columns" on the right. The "Selected Columns" section contains the following fields with blue star icons: Asset ID, Serial Number, Product Number, Product Description, Physical Location, Contract Location, and Asset Tag. The "Available Columns" section includes sections for "ASSET CUSTOM FIELDS" (Customer HW PO (A), Customer Maint PO (A), Lease Plus Serial Number (A), Meraki License Key (A), Meraki Order Number (A), Product SO (A), Ship Date (A), Maintenance PO (A), PAK (A)) and "ASSETS" (Asset Tag). A large blue "Export" button is at the bottom. A note at the bottom right says: "Click the add icon in the right column to add columns. Click the remove icon in the left column to remove columns. Drag and drop the columns in the left column to rearrange the order of active columns."



- Input/Output for Contract/Warranty Expired



- Warranty Not Expired



- Add/Update assets thumbnail

LAMP

ADD/UPDATE ASSETS THUMBNAIL

Details

Thumbnail Upload*

Choose File

No file chosen

Search Assets*

Laptop

Thumbnail Preview

Cancel Save

- Change contract status Not expired.

Contract Toggle

Change Contract Status

Contract Expired

Contract Not Expired

Asset Contract Preview

Cancel Save as Draft Save & Close

- Change contract status expired!

The screenshot shows a user interface for changing a contract status. At the top, there is a navigation bar with icons for back, forward, search, and notifications, followed by the user's name "Sumitkumar Vinodchandra Patel" and a profile picture labeled "SVP". To the right of the user info is the text "UMD MSIS Capstone". Below the navigation bar is a title "Contract Toggle" with a close button "X". The main content area has a header "Change Contract Status". Inside this header, there are two radio buttons: one selected (blue outline) labeled "Contract Expired" and one unselected (grey outline) labeled "Contract Not Expired". Below the header is a large red square containing a black silhouette of a laptop computer. At the bottom of the dialog are three buttons: "Cancel", "Save as Draft", and "Save & Close".

- Input/Output for Zoning

LAMP

Search

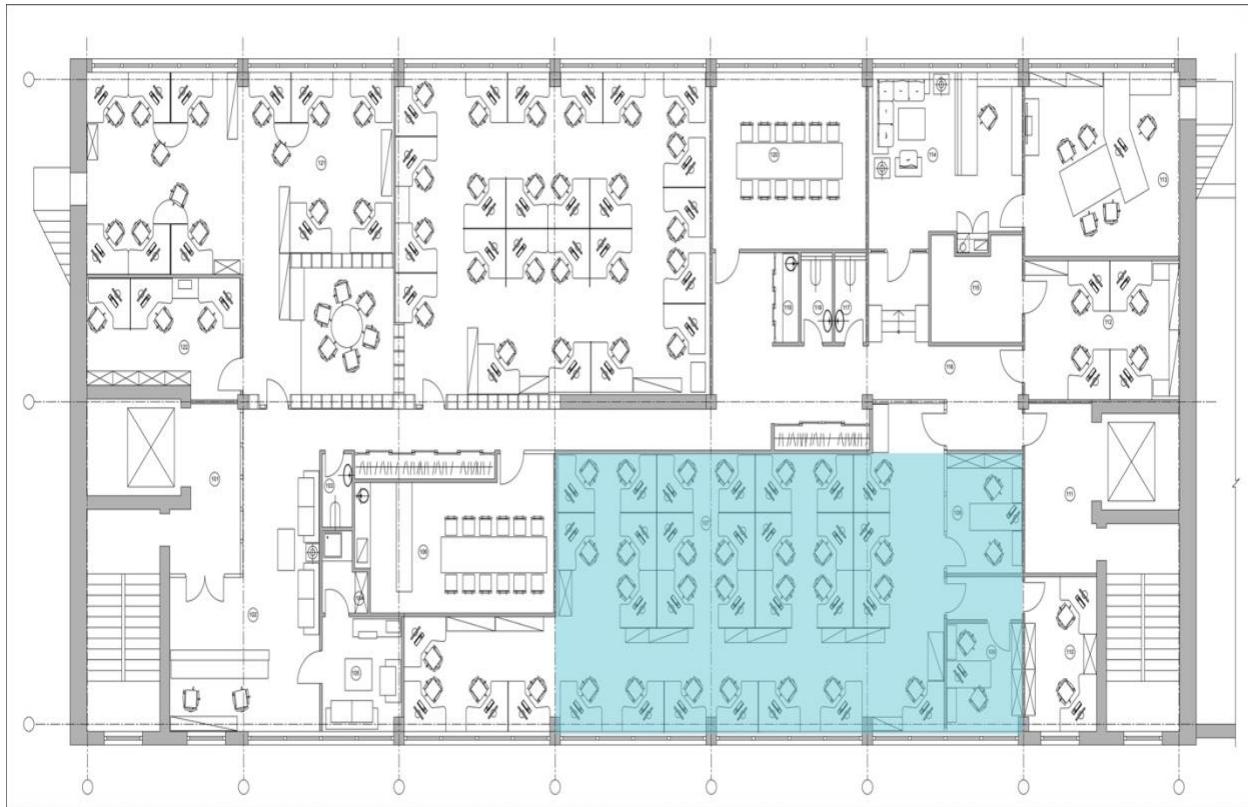
Jessica Jie Yi Choong JJYC UMD MSIS Capstone

Asset Report
License Report
Location Report
End Of Support Report
Cisco RMA Returns Report
Assets By Contract Report
Assets By Organizational Unit Report
Assets By Department Report
Asset Report With Most Recent Contract Data
RMA Report
Tickets Report
Cisco Refresh Report
LAMP Lookup
Estimates

Assets By Department Report

Physical Location Departm. PI Parent Serial Number Serial Number Product Num. Product Descriptio. Proc. C. Proc. Type. Pr. L. Cor. Nur. Serv. Level Assr. C... Latest Con...

NEW YORK...	Finance	NY	Test1	C9300...	C9300 48-p...	H...	SWI...	\$...
ROSEMON...	Finance	IL	Test986	10017...	POWER SU...	DEV...		



IMPLEMENTATION PLAN

Implementation plan for the proposed asset location mapping feature in the LAMP system:

The implementation of the enhanced asset location mapping features will follow an abrupt cutover strategy. Since the proposed solution is an extension of the existing LAMP system with advanced capabilities, rather than a complete system overhaul, an abrupt cutover approach minimizes disruption and simplifies the transition process. Given the low risk of data loss during the cutover and the similarities between the current and new system, halting the old system and immediately switching to the new one is a logical plan.

The recommended implementation steps are as follows: First, the new system components, including the site map upload interface, location mapping functionality, visualization tools, and database changes, will be thoroughly developed, tested, and integrated with the LAMP system in a staging environment. Concurrently, comprehensive user training and documentation will be prepared to ensure a smooth adoption. Once the system is stable and ready for production, a precise cutover window will be scheduled, during which the old system will be taken offline, and the new system with enhanced location mapping features will be deployed to production. Since the solution is a commercial package, no additional system construction is required. Proper communication, data validation, and support procedures will be established to ensure a seamless cutover and minimize any potential disruptions to operation.



Phase 1: Project Planning and Initiation (3 weeks → 25th Aug to 14th Sep 2024)

- Kickoff meeting with project stakeholders and team.
- Define project scope, objectives, and success criteria.
- Identify project risks and mitigation strategies.

- Create a detailed project schedule and assign tasks/responsibilities.
- Procure necessary hardware, software, and development tools.

Phase 2: Design and Architecture (4 weeks → 15th Sep 2024 to 13th Oct 2024)

- Design database schema for storing site maps, location mappings, and asset details.
- Define data structures and interfaces for site map upload and management.
- Design user interface mockups for map visualization, filtering, and asset tracking.
- Determine system integration points with existing LAMP components.

Phase 3: Development (4 weeks → 14th Oct 2024 to 11th Nov 2024)

- Set up development, testing, and staging environments.
- Implement database changes to support new location mapping features.
- Develop site map upload and manage interfaces.
- Build map visualization module with icon representation and filtering.
- Integrate primary/secondary location mapping for assets.
- Enhance asset search to include location parameters.
- Conduct unit testing and bug fixing iterations.

Phase 4: System Integration and Testing (2 weeks → 12th Nov 2024 to 26th Nov 2024)

- Integrate new location mapping features with LAMP system.
- Perform integration, system, performance, and security testing.
- User acceptance testing with selected customer pilot group.
- Bug fixing and stabilization.

Phase 5: User Training and Documentation (2 weeks → 17th Nov 2024 to 26th Nov 2024)

- Develop user guides, training materials, and documentation.
- Conduct training sessions for administrators and end-users.

Phase 6: Deployment (1 weeks → 26th Nov 2024 to 3rd Dec 2024)

- Deploy changes to a staging environment for final testing.
- Execute communication plan to inform users about the new release.
- Go-live with the new location mapping features in production.

Phase 7: Monitoring and Support (4 weeks → 4th Dec 2024 to 31st Dec 2024)

- Monitor system performance and user feedback.
- Provide technical support and address issues.
- Plan for future enhancements and improvements based on user feedback.

COST-BENEFIT ANALYSIS

SOLUTION 1

IN HOUSE DEVELOPMENT SOLUTION:

Development Costs:

- **Hardware and Software Costs (Cloud Implementation):**
 - Hosting and Storage Costs in AWS (\$313/month): \$3756
- **Personnel Information:**
 - Development Timeframe: 3 months
 - Total Working days: 21 days * 3 months = 63 days
- **Personnel Costs:**
 - Training cost for employees (16\$/hour for 15 hours) = \$240
 - Total Initial Cost = \$240
- **Projected Annual Operating Costs:**
 - Expert assistance (80 hours at \$50/hour) = \$4000
 - Cloud support and maintenance (85 hours at \$65/hour) = \$5525
 - Total Projected Annual Operating Costs = \$9525
- **Note:**
 - Cloud support and maintenance Costs are 15% the implementation efforts which is 85 hours.
 - Expert assistance is defects fixing and enhancements done to the developed module yearly.
- **Total Annual Operating Costs**
 - Year Cloud Infrastructure Costs + Total Projected Annual Operating Costs
 - \$3756 + \$9525 = \$13281
- **Trace3 Information**
 - Current Trace3 clients – 3500
 - Expected increase in clients through new feature – 100 per year.
 - Annual Client Growth % - 2.9 %

- **Revenue:**
 - Average asset tracking system cost per client - \$40/month
 - Total revenue = \$40/month * 12 months * 3500 clients = \$1,680,000

Benefits:

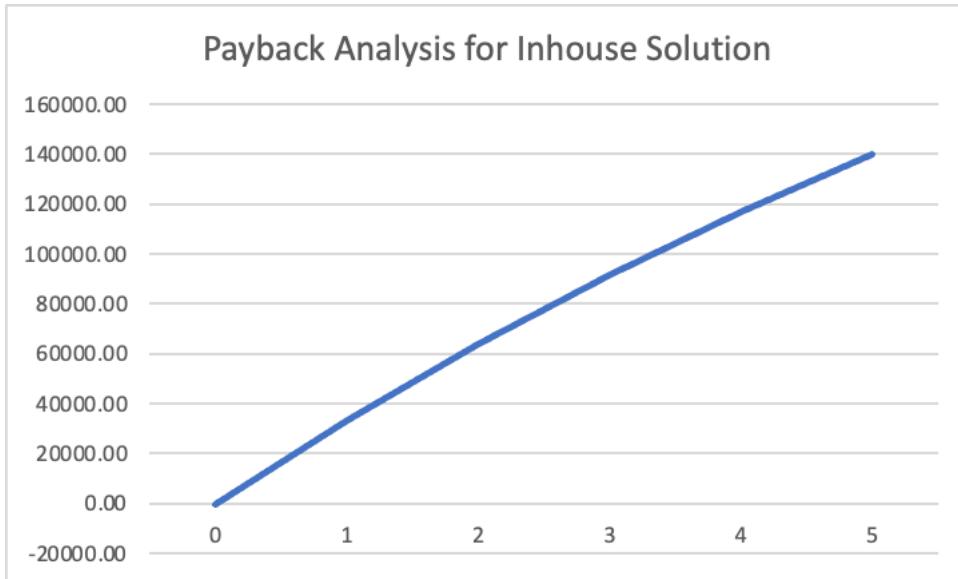
- **Cost Savings:**
 - Efficiency gains in asset tracking and management = \$1500
- **Revenue Growth:**
 - Sales growth (at 2.9% per year) = \$48,720

Total Benefits per year

○ = \$48720 + \$1500 = \$50220

PAYBACK ANALYSIS: (Considering the Rate of return to be 10%)

Cash Flow Description	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Development Cost	-240					
Annual Costs		-13281	-13281	-13281	-13281	-13281
Time Adjusted Costs	-240	-12073	-10976	-9978	-9071	-8246
Cumulative Adjusted Costs	-240	-12313	-23289	-33267	-42338	-50585
Benefits Derived from New System	0	50220	50220	50220	50220	50220
Time Adjusted Benefits	0	45654	41504	37731	34300	31182
Cumulative Adjusted Benefits	0	45654	87158	124889	159190	190373
	0	1	2	3	4	5
Net Present Value	-240	33340	63869	91621	116851	139787



NPV ANALYSIS:

NPV Analysis	
Total Present Value of Lifetime Costs	-50585
Total Present Value of Lifetime Benefits	190373
Net Present Value of this Alternative	139787

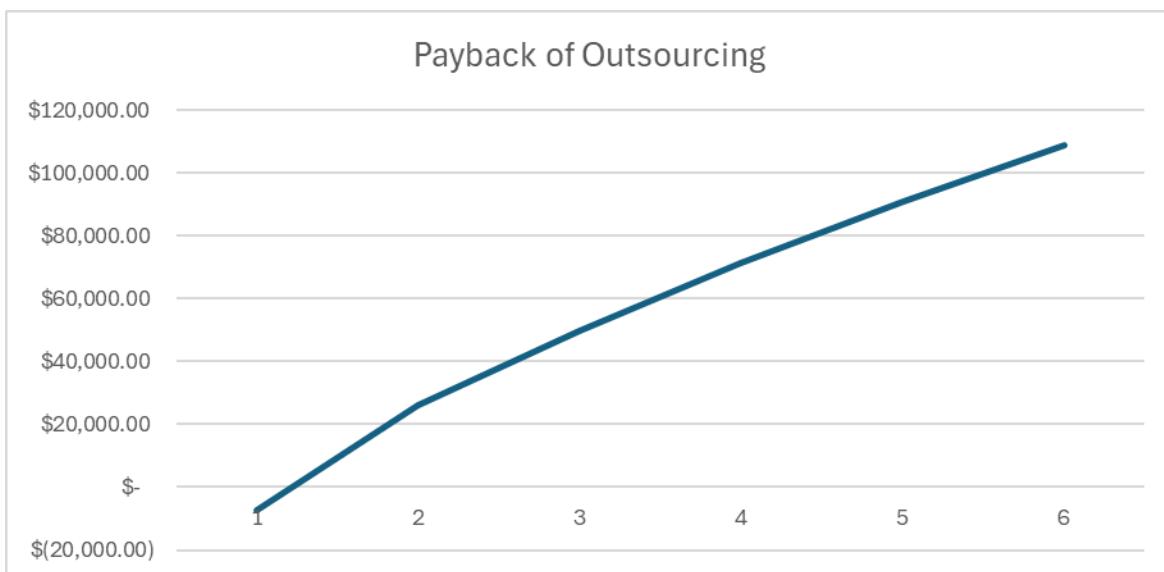
The Net Present Value of this Alternative (In House Development) is **\$139788**.

SOLUTION 2

OUTSOURCING COST/BENEFIT ANALYSIS

Development Costs	
Hardware and Software Costs	
Vendor Monthly Membership:	\$1500.00
Vendor Equipment	\$2,000.00
Merchant Service for Web:	\$60.00
Total Hardware and Software Costs:	\$3,560.00
Personnel Costs	
Software Expert (100 hrs at \$35/hr)	\$3500.00
Employee Training (20 hrs at \$15/hr)	\$300.00
Total Personnel Costs:	\$3800.00
Total Development Costs:	\$7,360.00
Projected Annual Operating Costs	
Expenses: (30hrs at \$45/hr)	\$1,350.00
Monthly Service Fee (\$100/mo)	\$1,200.00
Backup Storage (\$100/mo)	\$1,200.00
Maintenance Fee	\$1,000.00
Total Projected Annual Costs:	\$4,750.00
Cost Saving	
Management Efficiency	\$7,500.00
Innovative Solutions	\$3,500.00
Reduced Operational Errors	\$2,500.00
Total Annual Cost Savings:	\$13,500.00
Increased Sales:	\$20,000.00

Cashflow Description	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Development Cost	\$7,360					
Annual Cost		\$4,750	\$4,750	\$4,750	\$4,750	\$4,750
Time Adjusted Cost	\$7,360	\$4,318	\$3,925	\$3,568	\$3,244	\$2,949
Cumulative Adjusted Cost	\$7,360	\$4,318	\$8,243	\$11,812	\$15,056	\$18,006
Benefit	\$0.00	\$33,500	\$33,500	\$33,500	\$33,500	\$33,500
Adjusted Benefit	\$0.00	\$30,454	\$27,685	\$25,169	\$22,880	\$20,800
Cumulative Adjusted Benefit	\$0.00	\$30,454	\$58,140	\$83,309	\$106,190	\$126,991
Net Benefit	\$(7,360)					
Net Present Value	\$(7,360)	\$26,136	\$49,896	\$71,496	\$91,133	\$108,985



SOFTWARE PACKAGE SOLUTION:

Costs:

Development Costs:

- **Hardware and Software Costs (Cloud Implementation):**
 - Hosting and Storage Costs in Amazon Web Services (AWS): \$1000.00
 - Vendor Machines: \$2000.00
 - Web Services: \$1000.00

Personnel Information:

- **Development Timeframe:** 9 months
 - Total Working Days: 5 days/week * 9 months = 45 weeks * 5 days/week = 225 days.

Personnel Costs:

- Training Cost for Employees: \$5000 (for training materials and workshops)
- Total Initial Cost: \$4,000.00 + \$5,000.00 = \$9,000.00

Projected Annual Operating Costs:

- Expert Assistance:
 - Expert Assistance (80 hours at \$200/hour): \$16,000.00

Cloud Support and Maintenance:

- Cloud Support and Maintenance (150 hours at \$100/hour): \$15,000
- Backup Assistance (100hrs at \$100/hr): \$10,000.00
- Monthly Service Fee (\$200/Mo): \$2,400.00

Total Projected Annual Operating Costs:

- $\$16,000.00 + \$15,000 + \$10,000.00 + \$2,400.00 = \$43,400.00$

Revenue:

Average Subscription Cost per Client:

- \$2000/month (for medium to large construction companies)

Expected Number of Clients:

- Initial clients: 5
- Expected increase in benefit: 10%

Total Revenue:

- Year 1: \$72,000.00
- Year 2: \$79,200.00
- Year 3: \$87,912.00

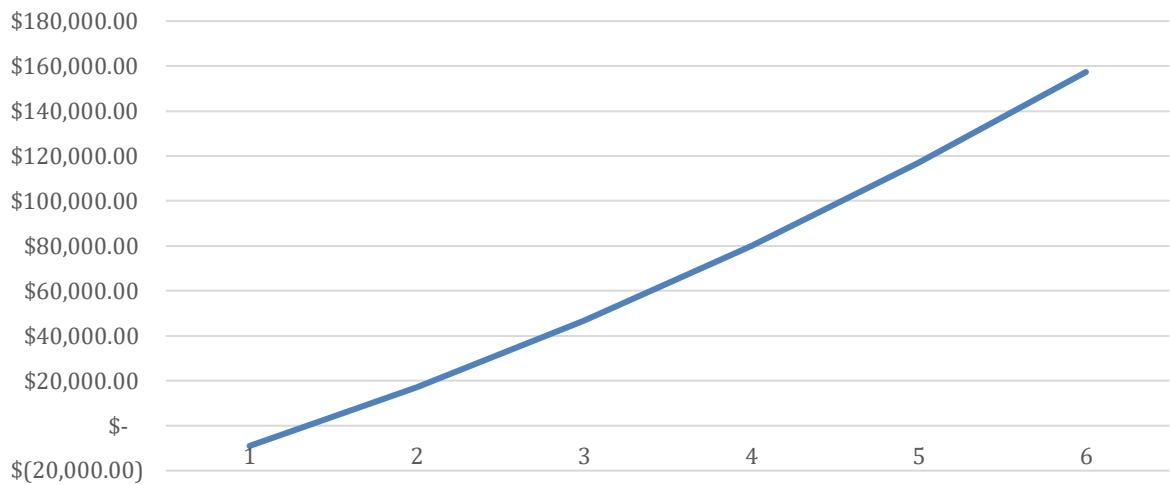
- Year 4: \$97,582.32
- Year 5: \$108,316.38

Benefit of Software Package Solution

Cost Saving:	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Cost from Clients						
Average Initial	\$2,000	\$72,000	\$79,200	\$87,912	\$97,582	\$108,316
Total Annual Cost Savings:						
		\$72,000	\$79,200	\$87,912	\$97,582	\$108,316
Assuming 10%						
Development Cost	\$9,000					
Annual Cost		\$43,400	\$43,400	\$43,400	\$43,400	\$43,400
Time Adjusted Cost	\$9,000	\$39,454	\$35,867	\$32,607	\$29,642	\$26,947
Cumulative Adjusted Cost	\$9,000	\$48,454	\$84,322	\$116,929	\$146,572	\$173,520
<hr/>						
Benefit From the Option	\$	\$72,000	\$79,200	\$87,912	\$97,582	\$108,316
Time Adjusted Benefit	\$	\$65,454	\$65,454	\$66,049	\$66,650	\$67,255
Cumulative Adjusted Benefit	\$	\$65,454	\$130,909	\$196,958	\$263,608	\$330,864
Net Benefit	\$(9,000)					
Net Present Value	\$(9,000)	\$17,000	\$46,586	\$80,029	\$117,036	\$157,344

Assuming a 10% discount rate, this cash flow analysis projects development costs and annual expenses over five years, with a net present value starting negative but turning positive by the end, indicating a profitable outcome.

Software Package Solution Cost Analysis



Among the three total cost analyses, this stands out as the best solution, demonstrating a pathway to profitability over time.

LESSONS LEARNED

This project with Trace3 started with our understanding of the requirement – that we will design and plan for building-floor-room level of asset tracking. Knowing that Trace3's LAMP system currently tracks to address level, we were at first taken aback as to how to actualize the vision to track to room level. Our first lesson was to **prioritize requirements and system understanding over technology selection**. By following the process, from coming up with our statement of work, to system analysis, to system design, each step gives us greater clarity on the project requirement and possible solutions.

As we progressed through the steps, we uncovered some information that was basic yet profound. How did we miss it? The second lesson was to always **connect with the client and have as many questions and reiterations as possible**. Had we not worked through the system analysis phase and came up with a list of questions to check with our client, we would not have realized that the client is also a device and warranty provider.