**Freezer Manager Module for Dock Optimizer**

**Concept Overview**

The Freezer Manager Module in Dock Optimizer will help manage, track, and optimize the freezing process of pharmaceutical batches. This system will allow users to input data manually or synchronize data via API connections, such as with Proact Transport, to streamline batch management, ensure inventory readiness for shipment, and maintain traceability across multiple freezers.

**Core Functionalities**

**1. Freezer Model Management**

Monitors capacity, real-time temperature data, and statuses (“active” vs “dormant”).

* **Features** (TBS Understanding):
  + Create and configure freezer models with custom capacity and specifications (default: 44 batches for this implementation but completely flexible by freezer).
  + Connect freezer models via API/webhook to external data sources like Proact Transport.
  + Track information such as temperature data and humidity.
  + Monitor freezer status (Active/Dormant).

TBS Questions:

1. Is Freezers is connected with Facility or Company?
   1. The Freezer would be in the user’s model (our Company), however we’d like to have an Asset Owner field that would allow our user to keep track if it is owned by someone else and on their site.
2. Admin person can Add/Update/View freezer details and can active/deactivate freezer
   1. Yes
3. Which information is required from Proact Transport API? And syncing will be real-time or want to set cron job to sync freezer data?
   1. Temperature, Humidity, and Door Open/Close data
   2. Real time with a RESTful API connection is ideal
4. **Proact Transport API** likely requires **authentication** to ensure secure access. This might involve an **API key**, **OAuth**, or **JWT tokens**
   1. Understood
5. How **Proact Transport API** connect with locally stored freezers with unique GUID or what?
   1. Yes we’d have a unique GUID for freezers in our system that could be connected to a model via API (Proact Transport API in this case)

**Data Model**

* **Freezer Entity:**
  + Id (PK)
  + FreezerId (GUID)
  + Name (VARCHAR)
  + Capacity (INT, Default: 44)
  + Status (ENUM: Active, Dormant)
  + CreatedDate (DATETIME)
  + ModifiedDate (DATETIME)
* **Freezer History Entity:**
  + Id (PK)
  + FreezerId (GUID)
  + TemperatureData (Double)
  + Humidity (Double)
  + CreatedDate (DATETIME)
  + ModifiedDate (DATETIME)

Fields depend on Proact Transport API

**2. Sales Order / Freeze Order Management**

Includes Customer, Desired Pickup Date/Time, Number of Batches, Pre-Shipment Freeze Time, etc.

* **Features** (TBS Understanding)**:**
  + During event booking, provide an option to select "Requires Freezer Storage?" If selected, capture the following details:
    - Customer Name
    - Desired Pickup Date/Time (based on selected slot)
    - Number of Batches Required
    - Inventory Distribution per Batch
    - Pre-Shipment Freeze Time (default 48 hours before pickup date)

**Data Model**

* **SalesOrder/FreezeOrder Entity:**
  + SalesOrderId (PK, GUID)
  + CustomerName (VARCHAR)
  + DesiredPickupDateTime (DATETIME)
  + NumberOfBatches (INT)
  + PreShipmentFreezeTime (INT)
  + CreatedDate (DATETIME)
  + ModifiedDate (DATETIME)

**3. Batch Management**

Tracks which inventory items (bottles) are included, capacity rules (44 max per freezer, in this case but configurable), freeze start/end timestamps.

Batch number is made up of configurable number of bottles (10 in this case)

User would need to scan the bottles as they build the "batch".

Freeze begins when the last Batch is put into the freezer and the door is closed. They would scan the door to start the Freeze Time.

* **Features** (TBS Understanding)**:**
  + Monitor storage time, freeze start, and freeze readiness.
  + Initiate freeze time upon door closure.

TBS Questions:

1. What mean by this line “Tracks which inventory items (bottles) are included”?
   1. That the Batch (an Order) would be made up of Inventory Items (in this case Bottles). The workflow would require the User to scan several Inventory Items (Bottles) to put them together as the Batch.
2. What mean by this line “Batch number is made up of 10 trays of bottles”?
   1. The Batch would be however many bottles (Inventory Items to be as generic as possible) that are required. In this use case 10 bottles generally will make up a batch, but that would like the Batch capacity in the Freezers be configurable.
3. What mean by this line “User would need to scan the bottles as they build the "batch"”?
   1. Our system would prompt staff when starting to Build a Batch to see all of the Inventory Items (bottles in this case) and their required quantity, and be able to scan them individually to mark that Batch is put together. Then the user would scan a barcode on the Freezer door to enter, entering the location within the freezer (of the 44 spaces in this case), and then scan a barcode on the Freezer door to exit starting the freezer timer for the mentioned space in the Freezer. A record would be created, like in Door Manager that spot x (of the 44 in this case) is assigned to the Batch ID. The user can then click to see more about the Batch and the Order that it is a part of.

**Data Model**

* **Batch Entity:**
  + BatchId (PK, GUID)
  + SalesOrderId (FK, GUID)
  + InventoryItems (JSON)
  + Capacity (INT, Default: 44)
  + FreezeStartTime (DATETIME)
  + FreezeEndTime (DATETIME)
  + CreatedDate (DATETIME)
  + ModifiedDate (DATETIME)

**Freezer Utilization**

Give Option “Utilize Freezer” in listing page when admin clicks Utilize button popup will appear and ask details like SalesOrderId, Number of batches, Timestamp, FreezingType(Start/End) etc..

BalanceCapacity will be calculate automatically based on the history of In/Out Data.

* **Freezer Utilization Entity:**
* FreezerID (PK, GUID)
* SalesOrderId (FK, GUID)
* BatchUtilized (INT)
* BalanceCapacity (INT)
* Timestamp (DATETIME)
* FreezingType (START/END)
* CreatedDate (DATETIME)
* ModifiedDate (DATETIME)

**4. Freezer Monitoring**

* **Features** (TBS Understanding)**:**
  + Monitor real-time status, batch readiness, and capacity utilization.
  + Track freeze start/end timestamps and batch statuses.

TBS Question:

1. What mean by this line “10 freezers with orders, 2 freezers with dormant orders. 44 batches per freezer, 440 batches at any given time”?
   1. We’d have to have a model of Active Freezers, Dormant Freezers, and Inactive Freezers

**5. Integration with Proact Transport**

Proact Transport - this is where the Freezer data is aggregated.

Get inventory logs, with barcodes, to be ingested into our inventory database.

* **Features** (TBS Understanding)**:**

**Communication Methods:**

There are two main methods to communicate with Proact Transport:

1. **Real-time API Calls**:
   * Dock Optimizer can make **synchronous API calls** to Proact Transport to get the latest freezer data (e.g., temperature, humidity).
   * This method is typically used when data needs to be updated frequently and immediately when requested.
2. **Scheduled Data Pulls**:
   * **Periodic (asynchronous) requests**: Dock Optimizer can set up a scheduled job to pull data at defined intervals (e.g., every hour or daily) from the Proact Transport API.
   * This is useful if you don't need real-time data and want to reduce the load on the system by fetching data in batches.

TBS Question:

1. What mean by this line “Get inventory logs, with barcodes, to be ingested into our inventory database.”?
   1. We’d build a simple Inventory management system with product name, product manufacturer, temperature (not climate controlled, climate controlled, frozen required), product ID (internal to our system), barcode (internal to our system and exportable to label printer).
2. With the help of Proact Transport API which other information we may required? Temperature, Humidity any anything else?
   1. Temperature, Humidity, Open/Close door data
3. **Proact Transport API** likely requires **authentication** to ensure secure access. This might involve an **API key**, **OAuth**, or **JWT tokens**

**6. Data Visualization & Dashboard**

* **Features:**
  + Capacity dashboards for freezer status tracking.
  + Alerts for freeze readiness, capacity breaches, and order pickup schedules.
  + Maintain history of batch allocation/deallocation.

**Technical Architecture**

**Data Model Design**

* **SalesOrder/FreezeOrder Entity:** Customer, Desired Pickup Date/Time, Number of Batches, Pre-Shipment Freeze Time, Order Status.
* **Batch Entity:** Inventory Items, Freeze Start/End Timestamps, Batch Status (Ready/Not Ready), Batch Number.
* **Freezer Entity:** Capacity, Real-Time Status (Active/Dormant), Associated Batches.

**Integration Architecture**

* **API/Webhook Connections:** Connect with Proact Transport for freezer data aggregation.
* **Barcode Sync:** Direct scan-to-server sync or offline mode with periodic synchronization.

**Front-End vs. Back-End Responsibilities**

**Front-End (Dock Optimizer UI)**

* Create and configure freezer models.
* Input and track sales orders.
* Scan barcodes for batch building.
* Monitor freezer statuses and dashboards.

**Back-End (.NET 6)**

* Manage freezer models and order data storage.
* Compute freeze readiness and manage capacity rules.
* Handle API integration with Proact Transport.
* Ensure data integrity for batch management.

**Development Requirements**

**Use Cursor AI**

1. **Freezer Manager Module:**
   * Admin can add/edit/delete multiple freezers based on requirements.
2. **Event Booking Integration:**
   * Allow users to choose "Requires Freezer Storage?" If selected, capture additional details like type of item and required temperature.
3. **Admin Notifications:**
   * Notify dock admin personnel about events requiring freezer storage.
   * Allow dock admin to assign freezers and input manual data.

**Benefits**

**For Customers**

* **Enhanced Traceability:**
  + Maintain full traceability and compliance with regulatory requirements.
* **Faster Order Fulfillment:**
  + Reduce shipment delays with proper batch scheduling.
* **Inventory Tracking:**
  + Ensure accurate batch tracking from storage to pickup.

**For Dock Personnel**

* **Efficient Freezer Management:**
  + Allocate batches optimally based on freezer capacity.
* **Streamlined Workflow:**
  + Automate batch creation and freeze initiation using barcode scanning.
* **Real-Time Monitoring:**
  + Maintain visibility into freezer statuses and batch readiness.