1.INTRODUCTION

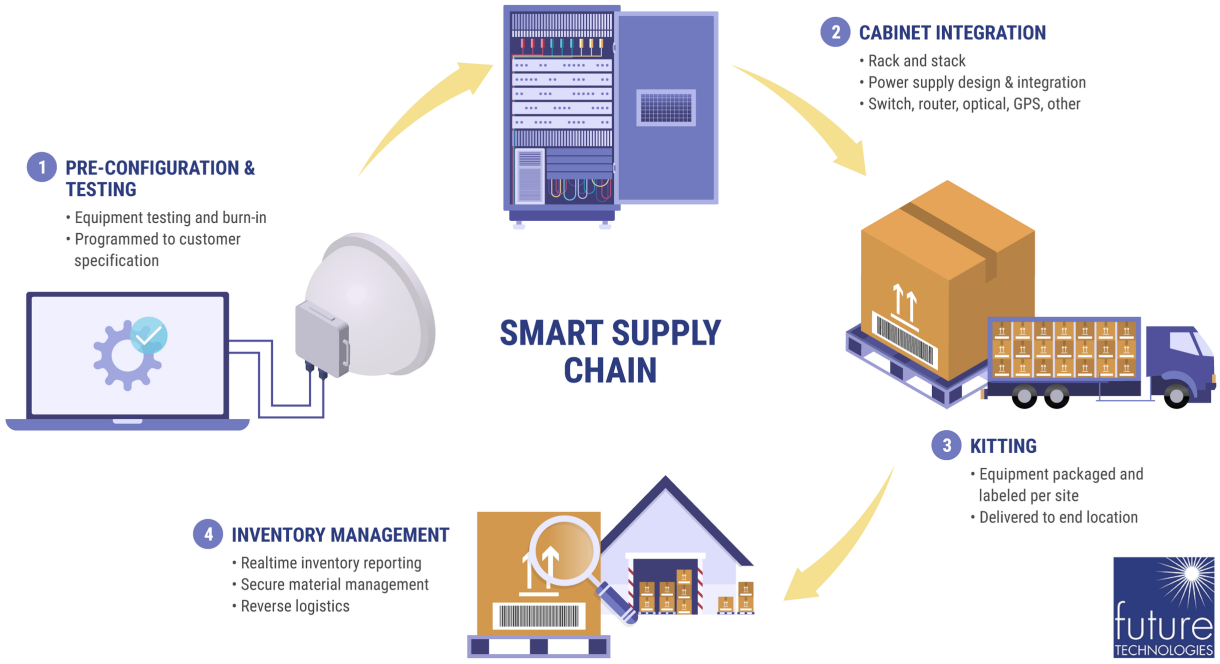
1.1 - OverView:The Smart Supply System is a cutting-edge platform designed to revolutionize supply chain operations by integrating advanced technologies such as IoT (Internet of Things), AI (Artificial Intelligence) and data analytics.This project aims to enhance efficiency, reduce costs, and improve overall supply chain reliability through real-time monitoring, predictive insights, and automation.
The dashboard leverages advanced data visualization techniques to present complex data in an intuitive and interactive manner. It integrates data from multiple sources, offering a holistic perspective that enables stakeholders to make informed decisions. By utilizing data filters and interactive elements, the dashboard allows users to drill down into specific details, uncover hidden patterns, and gain targeted insights.

The primary objectives of the Smart Supply Chain Dashboard are to:

Enhance visibility into sales, inventory, delivery performance, supplier performance, customer insights, and operational efficiency.
Support data-driven decision-making by presenting actionable insights and trends.
Improve overall supply chain performance, including reducing lead times, minimizing stockouts and overstocks, and increasing on-time delivery rates.
Provide a user-friendly interface that enables stakeholders to interact with the data, customize views, and perform detailed analyses.
This introduction sets the stage for a detailed exploration of the dashboard's components, the business problems it addresses, and the specific functionalities it offers to optimize supply chain management. By implementing the Smart Supply Chain Dashboard, organizations can gain a competitive edge through improved efficiency, responsiveness, and strategic planning in their supply chain operations.

1.2 - Purpose:The primary purpose of the Smart Supply System project is to transform and enhance supply chain operations through the integration of advanced technologies, thereby achieving significant improvements in efficiency, cost reduction, reliability, and customer satisfaction.
Real-Time Monitoring: Implement IoT sensors to continuously track inventory levels, environmental conditions, and shipment statuses, enabling proactive management and reducing delays.
Automation: Streamline and automate routine processes such as order processing, inventory management, and logistics operations to reduce manual intervention, errors, and processing times.

1.3-Technical Architecture:



2. DEFINE PROBLEM/PROBLEM UNDERSTANDING

2.1 - Specify the Business Problem :The modern supply chain is complex and requires meticulous coordination and real-time responsiveness to ensure operational efficiency, cost-effectiveness, and customer satisfaction.

1. Lack of Real-Time Visibility
2. Inefficient Inventory Management
3. Manual and Error-Prone Processes
4. Poor Demand Forecasting

Business Problems:

Inventory Management Issues

Stockouts and Overstocks: Balancing inventory levels is a constant challenge. Stockouts can lead to lost sales and dissatisfied customers, while overstocks tie up capital and increase storage costs.

Inventory Turnover: Inefficient inventory turnover rates can indicate problems in demand forecasting and inventory replenishment strategies.

Delivery Performance Challenges

On-Time Delivery: Meeting delivery deadlines is crucial for customer satisfaction. Delays in delivery can result in customer dissatisfaction, loss of business, and damage to the company's reputation.

Delivery Duration Variability: Inconsistent delivery times can create uncertainty and affect planning and resource allocation.
Supplier Performance Issues

Supplier Reliability: Dependence on suppliers with inconsistent performance can lead to disruptions in the supply chain.
Lead Times: Long and unpredictable lead times from suppliers can affect production schedules and inventory levels.
Sales and Demand Forecasting

Sales Trends and Patterns: Identifying and analyzing sales trends is essential for accurate demand forecasting and inventory planning.
Seasonal Variations: Failing to account for seasonal variations can lead to inventory imbalances and lost sales opportunities.

2.2 - Business Requirements :To ensure the successful implementation and operation of the Smart Supply System, several business requirements must be defined. These requirements encompass functional, technical, and operational aspects that align with the overall objectives of the project.

1. Real-Time Inventory Tracking
2. Demand Forecasting
3. Shipment Tracking
4. Cost Management

1. Data Integration
Requirement: Integrate data from multiple sources such as ERP systems, inventory management systems, CRM systems, and supplier databases.
Purpose: Ensure a holistic view of the supply chain by consolidating data from various systems into a single platform.
2. Real-Time Data Updates
Requirement: Enable real-time or near-real-time data updates to ensure the dashboard displays the most current information.
Purpose: Provide stakeholders with up-to-date insights for timely decision-making and proactive management of supply chain issues.
3. User-Friendly Interface
Requirement: Design an intuitive and easy-to-navigate interface that accommodates users with varying levels of technical expertise.

Purpose: Ensure that all users, including executives, managers, and operational staff, can easily access and interpret the data.
4. Interactive Data Filters
Requirement: Include interactive filters such as date range selectors, product category filters, customer segment filters, supplier filters, and region selectors.
Purpose: Allow users to customize their views and drill down into specific details to perform targeted analysis.
5. Key Performance Indicators (KPIs)
Requirement: Define and display relevant KPIs such as total sales, on-time delivery rate, average delivery duration, return rate, inventory turnover ratio, and supplier lead times.
Purpose: Provide a quick overview of critical supply chain metrics to monitor performance and identify areas for improvement.
2.3 - Literature Survey : The development and implementation of a Smart Supply System require a thorough understanding of the existing research and advancements in the field of supply chain management, IoT, AI, and data analytics. This literature survey reviews key studies and findings relevant to the Smart Supply System project.
IoT in Supply Chain Management : This study explores the transformative potential of IoT in supply chain management. The authors discuss how IoT devices provide real-time visibility into various supply chain operations, from inventory tracking to shipment monitoring.
AI and Machine Learning in Demand Forecasting : The authors investigate the application of machine learning techniques to improve demand forecasting in supply chains. The study demonstrates that machine learning models, particularly those using historical sales data and external factors such as market trends, can significantly enhance the accuracy of demand forecasts.

1. Supply Chain Management (SCM)
Supply chain management involves the coordination and management of complex networks of activities, processes, and entities involved in producing and delivering goods and services to customers. The primary goal of SCM is to maximize efficiency, reduce costs, and ensure customer satisfaction. Key components include procurement, production, distribution, and logistics.

Key References:

Chopra, S., & Meindl, P. (2016). Supply Chain Management: Strategy, Planning, and

Operation. This book provides a comprehensive overview of supply chain management principles and practices, emphasizing the importance of integrated and coordinated approaches.
Mentzer, J. T., DeWitt, W., Keebler, J. S., Min, S., Nix, N. W., Smith, C. D., & Zacharia, Z. G. (2001). "Defining Supply Chain Management." Journal of Business Logistics, 22(2), 1-25. This article discusses the definition and scope of supply chain management, highlighting the critical role of information sharing and collaboration.
2. Role of Data in SCM
Effective supply chain management relies heavily on accurate and timely data. Data-driven decision-making enables organizations to optimize their operations, forecast demand, manage inventory, and improve supplier and customer relationships. The integration of data from various sources is crucial for a comprehensive view of the supply chain.

Key References:

Wamba, S. F., Akter, S., Edwards, A., Chopin, G., & Gnanzou, D. (2015). "How 'big data' can make big impact: Findings from a systematic review and a longitudinal case study." International Journal of Production Economics, 165, 234-246. This study examines the impact of big data on supply chain management, emphasizing the importance of data analytics for improving efficiency and performance.
Schoenherr, T., & Speier-Pero, C. (2015). "Data science, predictive analytics, and big data in supply chain management: Current state and future potential." Journal of Business Logistics, 36(1), 120-132. This article explores the role of data science and predictive analytics in supply chain management, highlighting the potential for data-driven insights to enhance decision-making.
3. Data Visualization in SCM
Data visualization plays a crucial role in transforming complex data into understandable and actionable insights. By presenting data visually, organizations can quickly identify trends, patterns, and anomalies, facilitating more effective analysis and decision-making.

Key References:

Few, S. (2006). Information Dashboard Design: The Effective Visual Communication of Data. This book provides guidelines and best practices for designing effective dashboards, emphasizing the importance of clear and intuitive data visualization.

Kelleher, C., & Wagener, T. (2011). "Ten guidelines for effective data visualization in scientific publications." Environmental Modelling & Software, 26(6), 822-827. This article outlines best practices for data visualization, highlighting the importance of simplicity, clarity, and context in presenting data.

3.DATA COLLECTION

3.1 - Collect the Dataset - The dataset that we have collected is from Kaggle.A DataSet of Supply Chains used by the company DataCo Global was used for the analysis. Dataset of Supply Chain , which allows the use of Machine Learning Algorithms and R Software.

Dataset Link - https://www.kaggle.com/datasets/shashwatwork/dataco-smart-supply-chain-for-big-data-analysis

Identify Data Sources

The dataset can come from multiple sources including ERP systems, inventory management systems, CRM systems, and supplier databases.

Ensure that the data sources are reliable and provide accurate and up-to-date information.

Dataset Components

Sales Data: Includes order information such as order ID, product ID, order date, quantity, unit price, total price, customer ID, and customer location.

Inventory Data: Includes information on product ID, product name, category, current inventory level, restock dates, stockout instances, and overstock instances.

Delivery Data: Includes details on order ID, ship date, delivery date, expected delivery date, on-time delivery indicator, and delivery duration.

Supplier Data: Includes supplier ID, supplier name, supplier location, lead time, on-time delivery rate, and performance metrics.

Customer Data: Includes customer ID, customer name, customer location, order frequency, customer lifetime value, satisfaction scores, and return rate.

Operational Data: Includes metrics like order fulfillment cycle time, return rate, and operational efficiency metrics.

Data Extraction

Extract data from the identified sources using APIs, database queries, or data export functionalities.

Ensure the data extraction process is automated to enable regular updates.
Data Cleaning

Check for missing values, duplicates, and inconsistencies in the data.
Standardize data formats (e.g., date formats, currency formats).
Validate data accuracy by cross-referencing with source systems.
Data Transformation

Transform the data into a format suitable for analysis and visualization.
Aggregate data as needed (e.g., monthly sales totals, average delivery durations).
Create calculated fields (e.g., total sales = quantity * unit price, on-time delivery rate).
Data Integration

Integrate data from different sources to create a unified dataset.
Ensure that data joins (e.g., linking sales data with customer data) are correctly implemented.
Data Loading

Load the prepared dataset into a data warehouse or a business intelligence tool like Qlik.
Ensure the dataset is accessible to the dashboard for visualization and analysis.

3.2 - Connect data with Qlik Sense - Qlik is a powerful data visualization and business intelligence tool that allows you to connect, transform, and visualize your data from various sources.

1. Prepare Your Dataset
2. Open Qlik Sense Desktop or Qlik Cloud
3. Add Data to Your App
4. Start Preprocessing and Visualisation of data

Step 1: Prepare Your Data
Ensure that your data is clean and well-structured. Qlik Sense can connect to a variety of data sources, including:

Excel files
CSV files
Databases (SQL, Oracle, etc.)

Web files (JSON, XML)
Cloud services (Google Analytics, Salesforce, etc.)

Step 2: Open Qlik Sense
Open Qlik Sense: Launch Qlik Sense Desktop or log in to Qlik Sense Enterprise.

Step 3: Create a New App
Create a New App: In Qlik Sense, click on the “Create new app” button.
Name Your App: Give your app a name and click “Create.”
Open the App: Click on the app to open it.

Step 4: Add Data to Your App
Data Manager or Data Load Editor: You can add data using either the Data Manager for a more guided experience or the Data Load Editor for more control and flexibility.

Data Manager:

Click on “Add data” in the Data Manager.
Select your data source (e.g., an Excel file, a database, etc.).
Follow the prompts to connect to your data source. For example, if connecting to an Excel file, browse to the file location and select it.
Data Load Editor:

Click on “Data load editor” from the menu.
Click on “Create new connection” and choose your data source.
Fill in the necessary details for your connection (e.g., server name, database name, credentials for a database connection).
Click “Test Connection” to ensure the connection is successful.
Click “Create” to save the connection.

4.DATA PREPARATION
4.1 - Prepare the Data for Visualisation - The process of preparing data for visualization involves several critical steps to ensure the data is clean, accurate, and structured appropriately for analysis and visualization tools such as Qlik. Proper data preparation

enables effective and meaningful insights from the data, supporting better decision-making. This document outlines the theoretical approach to preparing the DataCo Supply Chain dataset for visualization.

1. Understand Your Data Sources
Identify all the data sources you plan to use. These can include:

Structured Data: Databases (SQL, Oracle, etc.), Excel files, CSV files.
Unstructured Data: Text files, JSON files, XML files.
External Data: APIs, web services, cloud services (Google Analytics, Salesforce, etc.).

2. Clean the Data
Clean data is essential for accurate analysis. Steps include:

Remove Duplicates: Ensure that there are no duplicate records.
Handle Missing Values: Decide how to handle missing values (e.g., imputation, removal).
Correct Inaccuracies: Fix any incorrect data entries.
Standardize Formats: Ensure consistency in data formats (e.g., dates, currency).

3. Structure the Data
Data structure should facilitate analysis:
Normalize Data: For relational databases, ensure tables are normalized to reduce redundancy.
Flatten Data: For easier analysis in Qlik Sense, consider flattening complex hierarchical data structures.
Data Types: Ensure that all data fields are of the correct data type (e.g., integer, string, date).

4. Enrich the Data
Enhance your data by adding additional context or derived fields:
Calculated Fields: Add fields that are derived from existing data (e.g., total sales = quantity * price).
External Data: Integrate external data sources to provide additional insights.

Geo-enrichment: Add geographic information if relevant.

5. Document the Data
Document your data sources and any transformations you apply:

Metadata: Include metadata for each data field (e.g., description, data type).
Data Lineage: Track the origin and transformations of your data.
Assumptions and Business Rules: Clearly document any assumptions or business rules applied during data preparation.

5.DATA VISUALISATION
5.1 - Visualisations - Effective data visualization helps in uncovering patterns, trends, and insights that can drive strategic decisions. Here are several types of visualizations that can be created using the DataCo Supply Chain dataset in Qlik.
Types of Visualisations we can perform:

1. Total Sales Over Time
2. Sales by Product Category
3. Sales by Region
4. Delivery Performance by Region
5. Return Rate by Product Category

Step 1: Load Your Data
Before creating visualizations, ensure that your data is loaded into Qlik Sense. If you haven't done this yet, refer to the steps in the previous response on connecting data with Qlik Sense.

Step 2: Open a Sheet
Open Your App: Go to the Qlik Sense hub and open the app you want to work with.
Add a Sheet: If there are no sheets yet, create a new one by clicking "Add new sheet." Give it a name and click "Create."

Step 3: Add Visualizations
Edit the Sheet: Open the sheet and click on "Edit" to enter the editing mode.
Select a Visualization: From the left-hand panel, drag and drop a visualization type onto the sheet. Qlik Sense offers various visualization types.

Dimensions: Drag a field from the data panel to the “Dimensions” section. Dimensions are typically categorical fields like names, dates, or categories.
Measures: Drag a field to the “Measures” section. Measures are typically numerical fields that you want to aggregate, such as sums, averages, or counts.
Properties Panel: Use the properties panel on the right to configure the visualization further:

Appearance: Customize the appearance, including colors, labels, and styles.
Sorting: Define how the data should be sorted.
Data Handling: Configure how missing or null values should be handled.

6.DASHBOARD
6.1 - Responsive and Design of Dashboard - A supply chain dashboard is a visual representation of key performance indicators (KPIs), metrics, and insights related to the performance and operations of a supply chain. It provides stakeholders with a centralized view of critical information, enabling them to monitor, analyze, and optimize various aspects of the supply chain. Here's the theoretical design of a Supply Chain Dashboard.

Step 1: Define the Purpose and Audience
Identify the Purpose: Understand the main objective of the dashboard. Is it for monitoring KPIs, exploring data trends, or providing a detailed report?
Know Your Audience: Tailor the dashboard to the needs of its users. Executives may need high-level overviews, while analysts may require detailed, drill-down capabilities.

Step 2: Plan the Layout
Sketch the Layout: Before you start in Qlik Sense, sketch the layout on paper or using a design tool. Decide where each visualization will be placed.
Group Related Items: Place related visualizations close to each other. Grouping helps users understand the data context more easily.
Logical Flow: Arrange visualizations in a logical order that guides users through the data. Consider using a top-to-bottom or left-to-right flow.

Step 3: Choose the Right Visualizations
Select Visualization Types: Choose visualizations that best represent your data. For example, use bar charts for comparisons, line charts for trends, and pie charts for proportions.
Keep it Simple: Avoid clutter. Use the simplest visualization that effectively communicates the data.

Step 4: Create Visualizations
Open Qlik Sense: Open the app and create a new sheet for your dashboard.
Add Visualizations: Drag and drop visualizations onto the sheet. Configure each visualization with the appropriate dimensions and measures.
Customize Visualizations: Use the properties panel to customize each visualization's appearance, sorting, and data handling.

7.REPORT
7.1 - Report Creation -
Smart Supply Chain Dashboard Report
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8.PERFORMANCE TESTING
8.1 - Amount of Data Rendered - The amount of data rendered for the Smart Supply Chain Dashboard includes all relevant and necessary datasets and data points from the DataCo Supply Chain dataset. To ensure the dashboard provides comprehensive insights and actionable information, the following types and volumes of data are

typically rendered.

1. Data Aggregation
Aggregate Data: Instead of displaying granular data, aggregate it to a higher level. For example, show daily sales totals instead of individual transactions.
Pre-Aggregation: Perform aggregations during the data loading process to reduce the amount of data processed during visualization rendering.

2. Data Reduction
Filters: Use filters to limit the amount of data displayed. Allow users to select specific time periods, regions, or categories to focus on relevant data.
Calculated Fields: Create calculated fields to pre-compute metrics that can be used directly in visualizations, reducing the need for on-the-fly calculations.

3. Incremental Data Loading
Incremental Load: Implement incremental data loading to update only the new or changed data rather than reloading the entire dataset.
Partitioned Loading: Load data in partitions (e.g., by date) to manage large datasets more efficiently.

4. Data Modeling
Optimized Data Model: Design an optimized data model with appropriate indexing and relationships to improve performance.
Star Schema: Use a star schema or snowflake schema for your data model to simplify queries and improve performance.

8.2 - Utilization of Data Filters - Data filters are essential components of a dashboard that allow users to interact with the data dynamically. They provide flexibility in viewing and analyzing the data from various perspectives, making the dashboard more user-friendly and insightful. In the Smart Supply Chain Dashboard, data filters help stakeholders drill down into specific details, uncover hidden patterns, and gain targeted insights.

1. Adding Filter Panes
Filter panes allow users to select specific values to filter the data displayed in the visualizations.

Steps to Add Filter Panes:

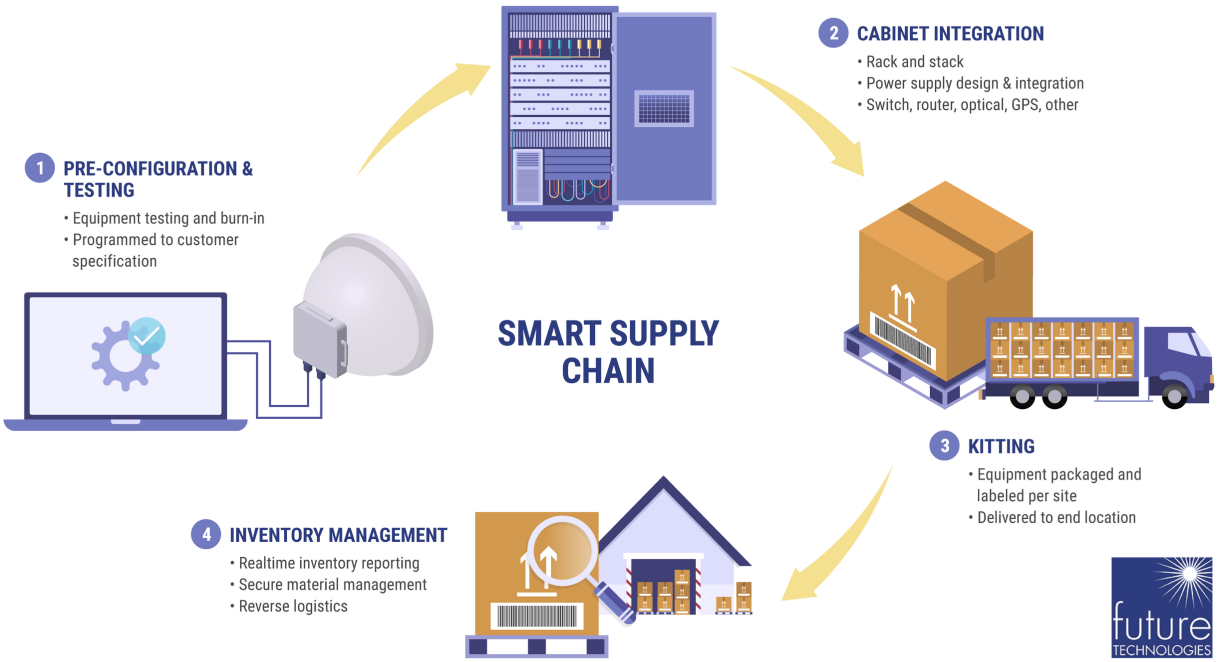
Open Your App: Open the Qlik Sense app where you want to add the filters.
Edit the Sheet: Navigate to the sheet where you want to add the filter pane and click on "Edit."
Drag and Drop Filter Pane: From the left-hand side panel, drag the "Filter Pane" object to the desired location on the sheet.
Add Fields to Filter: Select the fields you want to use as filters. For example, drag the "Region," "Product Category," or "Date" fields into the filter pane.
2. Configuring Filter Panes
You can configure filter panes to enhance their functionality and appearance.

Steps to Configure Filter Panes:

Properties Panel: With the filter pane selected, use the properties panel on the right to customize it.
Sorting and Selection Options: Configure how the filter values are sorted and displayed.
Appearance: Adjust the appearance settings, such as label display, item height, and multi-select options.
3. Using Filter Panes for User Interactivity
Filter panes provide powerful interactivity in your dashboard.

Interactive Filtering:

Single or Multi-Select: Users can select single or multiple values from the filter pane to filter the data.
Search in Filter Pane: Users can search for specific values within the filter pane, which is particularly useful for fields with many distinct values.
Clear Selections: Users can easily clear their selections to reset the filter.


1 PRE-CONFIGURATION & TESTING
• Equipment testing and burn-in
• Programmed to customer specification
2 CABINET INTEGRATION
• Rack and stack
• Power supply design & integration
• Switch, router, optical, GPS, other
SMART SUPPLY CHAIN
3 KITTING
• Equipment packaged and labeled per site
• Delivered to end location
4 INVENTORY MANAGEMENT
• Realtime inventory reporting
• Secure material management
• Reverse logistics
future TECHNOLOGIES