# Data Requirements for Planning of Material Flow Systems

## Description and Explanation


### Summary

This document describes and explains the most important requirements for customer data as planning base for material flow systems.



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Description and Explanation

## 1 Introduction

This document describes and explains the most important requirements for customer data as planning base for material flow systems. Data analysis is a fundamental step in the planning of material flow systems for it translates raw data into understandable and usable information. Different systems can have different requirements with respect to scope and depth of data analyses, yet the general information requirements for planning remain the mostly identical.

The data analysis process can be complex and error prone, and the quality of the resulting planning information is highly dependent on the quality of the available input data. In case of questions about raw data requirements, reach out to us in order to avoid unnecessary iterations of the analysis.

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**Revision History of Document**

| Version | Date | Created by | Comments | Valid |
|---|---|---|---|---|
| 1.2 | 2024-10-10 | Jakob Beer | | **x** |
| 1.1 | 2022-09-22 | Jakob Beer | | |
| 1.0 | 2020-01-11 | Jakob Beer | | |

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# 2 Objective of Data Analysis

The optimal design of material flow systems is closely tailored to the specific requirements of the customer. In addition to a thorough understanding of these process requirements, the analysis of customer data serves as a critical foundation for making informed design decisions. This data-driven approach also informs the system's scaling and capacity planning.

Since data analysis primarily relies on historical data, it is essential to adjust and extrapolate this information based on growth forecasts. However, given the inherent uncertainty in predicting growth, the resulting planning assumptions should be regarded as approximations of future needs..

# 3 Required Data Sets

Different data sets are required as input for the data analysis. Below tables provides an overview. More detailed explanation is provided in the following sub chapters.

| **Data Set** | **Short Explanation** |
|---|---|
| Master Data | A data table containing all relevant products (**S**tock **K**eeping **U**nits, SKUs) and their physical properties, such as dimensions, along with specific storage requirements like temperature and risk classifications. |
| Transaction Data | A data table containing customer orders, ideally with complete timestamps for key process stages, including order receipt, order release, picking, and order completion, if available. |
| Inventory Snapshots | Inventory snapshots are data tables that capture the state of inventory at a specific point in time. These snapshots typically include key details, such as product Stock Keeping Units (SKUs), current stock levels, and location information. |
| Working Hours per Day | The daily working hours available to carry out logistics operations. |
| Growth Expectations and Design Year | The material flow system will be designed to accommodate future business needs. Therefore, it is essential to consider growth projections up to the target *design year*, ensuring that the system remains scalable and capable of supporting evolving operational demands |

## 3.1 Master Data

The master data, or item master file, consists of a table detailing all relevant SKUs along with their physical properties and storage requirements. Relevant SKUs include those that need to be considered in the design of the material flow system.

Experience shows that master data is often incomplete and, even more frequently, inaccurate. While we perform plausibility checks (e.g., identifying items with improbable weights or dimensions), it is clear that higher-quality raw data results in better planning outcomes.

When implausible data is identified, it must be decided how to handle such discrepancies. If only a small number of SKUs are affected, particularly those with low throughput and minimal impact on system design, it may be agreed with the customer to exclude these data sets. However, deleting larger volumes of incorrect data can distort the results of the analysis. In such cases, it may be more appropriate to make reasonable assumptions, such as replacing missing or erroneous dimensions with average values derived from other SKUs.

In any case, a brief discussion about master data quality and how to proceed after initial plausibility checks will be necessary.

### 3.1.1 Data Requirements

| Type of Data | Explanation |
|---|---|
| ***Required Data*** | |
| **Item Number** | The unique identifier of each SKU, typically a numerical or alphanumerical code. |
| **Item Name** | The plain text name of the SKU |
| **Weight** | Weight of the SKU. Make sure that the physical unit used is the same across all SKUs (i.e., always gram OR always kilogram OR always ton). Importantly, the weight needs to refer to the pick (=sales) unit.<br>If you sell individual cans of beans, it is necessary to have the weight of an individual can of beans – not the weight of the full warehouse case containing 12 cans of beans. |
| **Length** | Length of the SKU. Make sure that the physical unit used is the same across all SKUs (e.g., always millimeter).<br>As with weight, make sure the length refers to the length of the actual pick (=sales) unit. |
| **Width** | Width of the SKU. Make sure that the physical unit used is the same across all SKUs (e.g., always millimeter).<br>As with length, make sure the width refers to the width of the actual pick (=sales) unit. |
| **Height** | Height of the SKU. Make sure that the physical unit used is the same across all SKUs (e.g., always millimeter).<br>As with width, make sure the height refers to the height of the actual pick (=sales) unit. |
| **Pick Unit** | Statement about the physical pick unit, e.g., an individual piece, a box (containing several pieces), or a pallet (containing several boxes). |
| **Inventory Level** | An inventory snapshot can be incorporated into the master data, providing a useful reference point. However, it is preferable to receive separate files with inventory |

| | |
|---|---|
| | snapshots from multiple dates. This approach allows for a more comprehensive analysis of inventory trends over time and helps identify fluctuations that may affect the design and scalability of the material flow system. |
| ***Depending on the specific project, the following data may be required:*** | |
| **Number of pick units per transport (replenishment) unit** | The number of pick units per superordinate transport unit – such as the number of individual cans per carton of canned beans – is crucial data, especially when the replenishment process operates with different units than the pick unit. For instance, if the picking zone is replenished with full cartons but pickers are tasked with selecting individual items from these cartons, understanding this unit relationship is essential for accurate planning. |
| **Pallet Ti** | The number of cases (transport units) per layer on a pallet |
| **Pallet Hi** | The number of layers per pallet |
| **Sensitive Item / Crash Class** | In certain projects, it is essential to identify whether SKUs are particularly sensitive or can withstand being dropped during the picking process. This information is critical for performance considerations, storage system design, and the development of efficient picking concepts.<br>In some instances, items may need to be classified into crash classes to establish appropriate picking and packing sequences. Therefore, the crash class designation for each item should be included in the master data to facilitate informed decision-making regarding handling procedures. |
| **Lot Number** | In certain industries, it is crucial to ensure that lot numbers are not mixed. Depending on the storage system and principles applied (e.g., First-In, First-Out or FIFO), this requirement can lead to increased storage needs, as different lot numbers are treated similarly to distinct SKUs. Understanding these requirements is vital for effective inventory management and optimizing storage capacity. |
| **Dangerous Good / Product Group** | In certain projects, it is necessary to flag items as hazardous, flammable, or explosive goods, requiring them to be stored in designated separate areas. When dealing with diverse product groups that have specific storage implications, it is important to document these classifications in the master data. This ensures compliance with safety regulations and facilitates the appropriate design and setup of the storage system. |
| **Temperature Zone** | If SKUs have particular temperature requirements, this information needs to be provided as part of the master data. |
| **Other characteristics** | Any other characteristics, data or information with potential implications for the material flow system design. |

### 3.1.2 Exemplary Extract from Master Data

| Item Number | Item Name | Weight [g] | Length [mm] | Width [mm] | Height [mm] | Pick Unit | Pick Units per Case | Temp Zone |
|---|---|---|---|---|---|---|---|---|
| 295220 | Fusilli Pasta | 500 | 400 | 400 | 20 | Case | 4 | Ambient |
| 223481 | Roll-on Deodorant | 484 | 155 | 104 | 115 | Case | 6 | Ambient |
| 386995 | Milk | 1100 | 90 | 59 | 206 | Piece | 8 | Chilled |

## 3.2 Order Data

The order data encompasses all customer orders relevant to the new material flow system. This data is essential for determining the dynamic performance requirements of the material flow system.

Depending on the project, order data can generate extensive data sets. It is recommended that order data cover at least two full months of customer orders, and it is rarely necessary to exceed one year. Instead of broadening the time horizon, it is more critical that the selected period is representative of the requirements for the material flow system.

When there is a significant disparity between 'average days' and 'peak days' (such as during the Christmas season), it may be beneficial to utilize separate data sets to capture one average period and one peak period. Alternatively and preferably, extending the timeframe to encompass both periods can provide a more comprehensive understanding of the system's performance needs.

### 3.2.1 Data Requirements

| Type of Data | Explanation |
|---|---|
| ***Required Data*** | |
| **Order Number** | The unique identifier of each order, typically a numerical code or alphanumerical code. |
| **Item Number** | The unique identifier of each SKU, typically a numerical or alphanumerical code. |
| **Date** | The order data should include the date of order registration in the system, as well as the dates of picking and shipping. This information is crucial for understanding the order processing timeline.<br>Ideally, both the picking date and shipping date should be represented in separate columns within the order data, especially if there is a significant time difference between them. Moreover, it is important to capture not only the date but also the specific *time* to provide a detailed overview of the order fulfillment process. (See next row). |
| **Timestamp** | It is essential to differentiate between order time, picking time, and shipping time in the order data. The precise timings are particularly important when the load on the material flow system fluctuates throughout the day.<br>Some IT systems capture both the start time and end time of picking activities, which can be valuable for analyzing the congestion levels in picking aisles, should this aspect be of interest. This data can help optimize |

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|---|---|
| | picking processes and improve overall efficiency in the material flow system. |
| **Quantity** | The number of items picked. Additionally, information about the exact pick unit is necessary (see below). |
| **Pick Unit** | The order data should include a statement about the physical pick unit, such as whether it is an individual piece, a box (containing several pieces), or a pallet (containing multiple boxes). Understanding the physical pick unit is crucial for determining if items are picked and shipped in varying units. For instance, items may occasionally be processed as single pieces, while at other times, they may be picked and shipped as full cartons containing several pieces. This information is essential for effective inventory management and optimizing the material flow system. |
| ***Depending on the specific project, the following data may be required:*** | |
| **Customer Number** | The unique identifier of the customer |
| **Shipping Load Number** | If the analysis needs to include detailed goods-out sortation and similar, it will be necessary to know shipping load numbers so as to be able to understand sortation requirements. |

### 3.2.2 Exemplary Extract from Order Data

The data set should contain all order lines in chronological order, that is every SKU ordered as part of each order for the given time period represents a separate line in the table.

| Order Number | Date of Pick | Time of Pick | Item Number | Pick Quantity | Pick Unit | Customer |
|---|---|---|---|---|---|---|
| FR20201012 | 2020-05-02 | 08:35:45 | 295220 | 1 | Case | JEB6203 |
| FR20201012 | 2020-05-02 | 08:35:59 | 223481 | 2 | Piece | JMB1188 |
| FR20201013 | 2020-05-02 | 08:36:22 | 295229 | 4 | Piece | RAB0687 |
| FR20201014 | 2020-05-02 | 08:36:47 | 293441 | 2 | Pallet | KWH3001 |

## 3.3 Inventory Snapshots

Inventory snapshots are specific records that capture the status of inventory at a particular point in time. These snapshots provide a detailed overview of stock levels, allowing businesses to assess their inventory situation efficiently. They are crucial for various operational activities, including inventory management, supply chain optimization, and financial reporting.

### 3.3.1 Components of an Inventory Snapshot

An effective inventory snapshot typically includes the following components:

- Stock Keeping Units (SKUs): A unique identifier for each product, allowing for easy tracking and management.
- Current Stock Levels: The number of units available for each SKU at the time of the snapshot. This is a critical metric for inventory management and replenishment decisions.
- Location Information: Details about where each SKU is stored within the warehouse or distribution center.
- Lot Numbers: For products that require tracking, including lot numbers can be necessary for the planning process.

- Safety Stock Levels (if applicable): The minimum quantity of inventory that must be maintained.

## 3.4 Working Hours, Growth Expectations and Design Year

In order to understand the performance requirements the material flow system needs to fulfill, it is necessary to know the daily working hours. They should be provided in simple table format.

| Day | Morning Shift | Day Shift | Night Shift |
|---|---|---|---|
| **Monday** | 05:00 – 13:00 | 13:00 – 21:00 | 21:00 – 05:00 |
| **Tuesday** | 05:00 – 13:00 | 13:00 – 21:00 | 21:00 – 05:00 |
| **Wednesday** | 05:00 – 13:00 | 13:00 – 21:00 | 21:00 – 05:00 |
| **Thursday** | 05:00 – 13:00 | 13:00 – 21:00 | 21:00 – 05:00 |
| **Friday** | 05:00 – 13:00 | 13:00 – 21:00 | - |
| **Saturday** | 05:00 – 13:00 | 13:00 – 21:00 | - |
| **Sunday** | 05:00 – 13:00 | - | - |

New systems are seldom designed to accommodate the current status quo; rather, they are intended to meet future requirements. Given that there will be a time lag between the extraction of raw data from IT systems for analysis and the operational launch of the new material flow system, it is crucial to establish a design year along with the anticipated annual growth rates leading up to that year. The performance requirements set for the design year will typically serve as the benchmark for the acceptance testing of the new system

# 4 Requirements for Data Format

The format of the raw data can be flexible, provided it is compatible with commonly used systems and does not require the purchase of proprietary software for accessibility.

Common formats include

- .txt or .csv files
- .xls or .xlsx files (Microsoft Excel)
- .mdb or .accdb files (Microsoft Access)

Receiving the data in formats other than those specified may necessitate additional time and effort for processing. Therefore, please ensure that all columns are appropriately named or documented in a separate file to facilitate easy identification by the data analyst.