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Functional Design Specification

of the

Warehouse Control System

for

Toll Enterprise
Prestons, NSW

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Document Roles and Responsibilities

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Related Documents

Document Title	Version[1]	Company
Project Enterprise Business Requirements Document	2.01	Toll
System Specification	A3	Dematic
WCS Host Interface Specification	1.0	DAI
WCS-PLC Interface Specification	A3	Dematic

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[1] Relevant version at time of release of this document

DEMATIC

CONTENTS

DEMATIC

Glossary of Terms

Bin	A section of a GOH trolley containing stock of a single SKU
Brand	Any of the names under which a client markets its stores and stock
Carton	A container into which stock is transferred in the DC for despatch
Case	A container in which stock of a single SKU is delivered to the DC
Click To Collect	A type of order delivered to a store for a specific customer
Client	Any of the businesses for which Toll provides use of the DC
Customer	An individual who purchases stock from a brand
DC	Distribution Centre (a generic name for this Toll facility)
Despatch Unit	A WCS data record holding common details on the contents of a single despatch TM.
DU	See 'Despatch Unit'
FDS	Functional Design Specification. A detailed functional design description of a high-level system to be supplied by Dematic (this document).
Flat	Any stock that is not hanging
GOH	Garments On Hangers
GTP	Goods-to-person. Relates to processes whereby the system automatically delivers stock to an operator for a manual action. The primary use of the GTP stations is for the picking of the majority of SKUs. Section 12.
HLOP	High Level Order Picker
Hold	Stock state maintained by WCS (Section 4.4.4)
Host	A generic name referring to Toll's Red Prairie system, the system above WCS in the hierarchy
iAT	Inter-Aisle Transfer. The ability to transfer a tote on the same level between adjacent multishuttle aisles via a special rack location
Line	See 'Order Line'
LOI	"Local Operator Interface". A screen, typically fixed position, with a dedicated operational role (e.g. goods-to-person station).
LP	License Plate. A label providing a unique barcode ID to a particular TM. No other information is contained within a license plate ID – it is effectively a random unique identity that is used to cross-reference a database containing other details such as contents and routing information.
LSS	Long Span Shelving
Manual	Any area of the DC other than GTP and GOH
MI	"Management Information"
MIS	"Management Information Server" (the server providing WCS MI functions)
Module	A group of 4 adjacent multishuttle aisles between which iAT is possible

MOI	"Mobile Operator Interface". On this project is a hand-held, wrist-wearable or vehicle-mounted RF Terminal.
Multishuttle	Storage and retrieval system for totes and cartons
OM	Operations Management – browser-based screens software
OMW	Operations Management Workstation – a workstation with OM facilities
Order Line	An order line is a single-SKU part of an order. WCS represents a line as one or more pick records.
Pick record	A WCS data record holding details of a single pick requirement (i.e. quantity of a single SKU). Initially one pick record represents one order line received from the Host, though a line may get broken down into multiple pick records during WCS order processing. Section 9.2.1.
PLC	"Programmable Logic Controller". Low-level controller for automated material flow.
QA	"Quality Assurance"
RF	"Radio Frequency"
Sector	A group of 8 adjacent GTP stations, served by the same order buffer multishuttle
SKU	"Stock Keeping Unit". Defines a particular article/material type (Section 4.2)
SSCC	"Serial Shipping Container Code". An international standard used to identify despatch TMs
Stock record	A WCS data record holding details of a quantity of stock (same SKU)
Store	A building used by a client to which stock is despatched from the DC
Style	An attribute of a SKU. Typically several different SKUs of the same brand belong to the same brand
SWAP	"Scan, Weigh And Profile", as in SWAP Station – see Section 5.1
TM	"Transport Module". A generic term referring to any type of container handled by the system – see Section 4.3
Train	A group of bins that an operator is handling at a time
Tramming	The process whereby an individual uses a vehicle to manually transport stock around the DC
Trolley	A TM holding GOH stock. Split into uniquely-identified bins. In the manual area, a vehicle holding one or more other TMs
UID	User ID
VNA	"Very Narrow Aisle" – an attribute of an aisle in the manual area
WCS	Warehouse Control System. The system described in this document.

DEMATIC

1   INTRODUCTION

1.1   This Document

This Functional Design Specification provides a description of functions provided by the Warehouse Control System (WCS) to be supplied by Dematic for Toll's distribution facility in Prestons, New South Wales.

1.1.1   Embedded Comments & Questions

Particular versions of the FDS (particularly during its initial development) may contains a number of embedded questions and open points designed to prompt particular areas of discussion. These are highlighted in a particular font *[like this].* Such comments should be disregarded with respect to any formal review or signoff.

1.1.2   Greyed Out Sections

Some parts of the FDS may be greyed out *[like this]*. This indicates that the text is not relevant to this project but is retained as an aid to understanding or against the possibility of future use. This typically applies where a feature that is standard in the Dematic application is not being used on this project. Such sections should be disregarded with respect to any formal review or signoff.

1.1.3   Non-WCS Logic

While the purpose of this FDS is to define the logic to be implemented on WCS, in places it may describe functionality that is not within its domain (e.g. Host or PLC logic). This is done for the following reasons:-

- To define the assumptions made in designing the WCS functionality
- To provide the reader with a more complete description of a process involving more than one system

The descriptions are based on our understanding at the time of writing, and we expect that understanding to be checked by the appropriate parties involved in the formal FDS signoff.

If the non-WCS logic is implemented differently to our understanding, this might impact on the functionality of WCS and will require an assessment of any implications on the WCS design and engineering.

1.2 Position of WCS in Systems Hierarchy
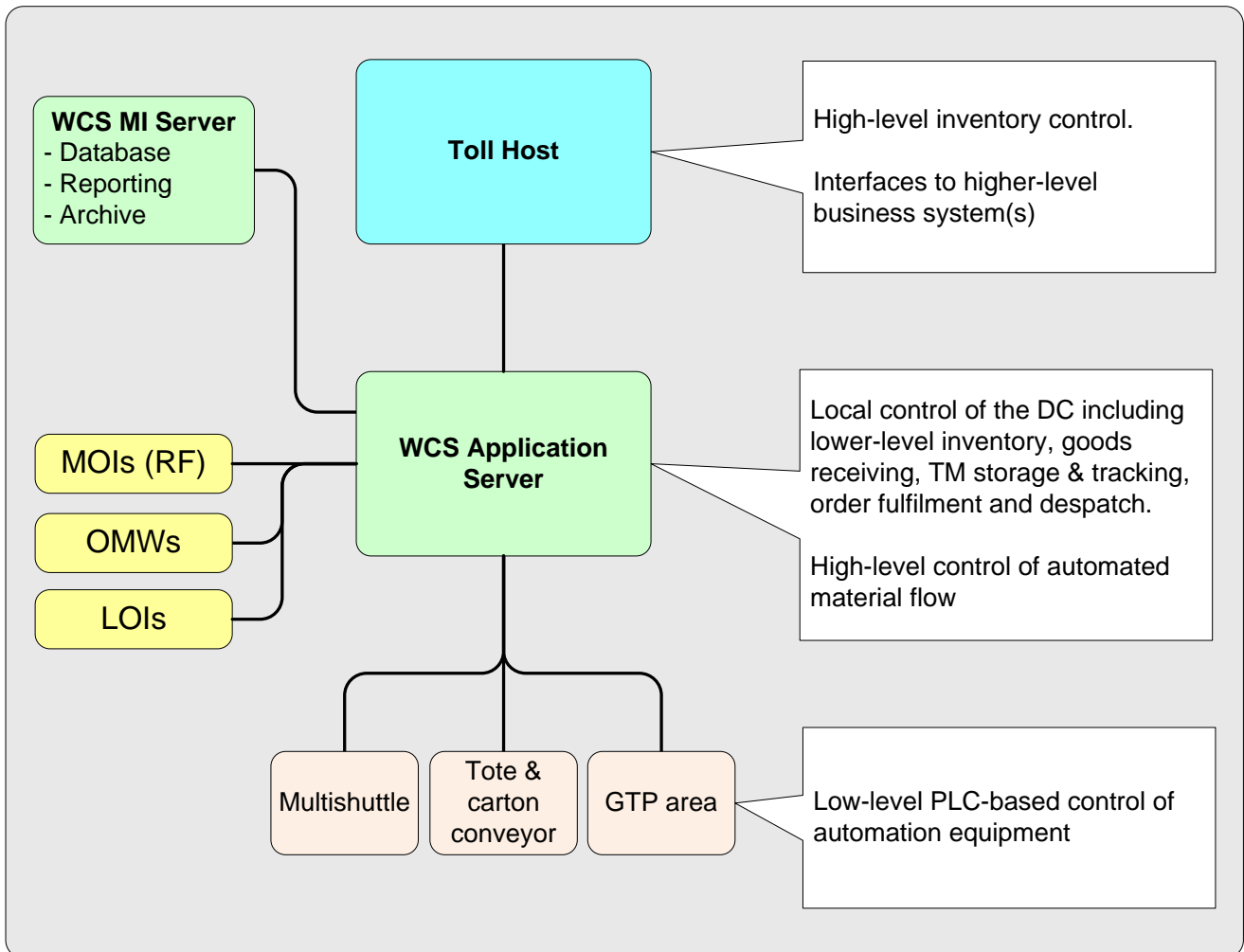
1.2.1 WCS Application Server (Dual System)

The WCS Application Server hosts the main WCS functionality. It is a resilient dual system configuration.

1.2.2 Management Information Server (MIS)

The WCS Management Information Server (MIS) provides long-term historical information along with a near real-time copy of the live WCS application data via a proprietary open database with standard reporting tools.

The MIS functionality is provided as a database located on a server provided by Toll to which WCS has write access.

Section 21.4 provides details of the information passed to the MIS.

DEMATIC

DAI

1.3   WCS Functions Overview

The main functions of WCS are as follows:

Function	Summary	Section
Material & inventory management	Recording and tracking of containers and stock within the WCS domain, including status and quantity details	2
Order processing	Order queue and status management. Carton planning	9
TM moves	Execution of TM moves	5, 8
Receiving	Acceptance of new stock into the DC	6
Storage	Configuration and management of storage locations in hanging, manual and automated areas. Tracking of location contents. Location selection logic. Housekeeping	10, 12, 17
Replenishment & decant	Planning and execution of stock transfer from storage locations to pick locations in manual and automated areas	13, 15
Order picking	Picking of stock in hanging, manual and automated areas to satisfy orders	11, 14, 16
Order packing	Functions relating to repacking, labelling and lidding to prepare physical despatch units	18
Despatch	Functions relating the despatch buffer multishuttle, and loading despatch units onto vehicles to leave the DC	19
Operations Management (OM) Screens	Screens for viewing and configuring WCS-controlled operation.	20
Management Information	Collection of WCS events and statistics, with local OM viewing facilities for a limited time period	21
Host Interface	Communications between WCS and the Host. Message passing protocols and specific message processing logic	23
Material flow controller Interfaces	Interfaces to lower-level controllers. Documented in separate interface specifications	
System Management	Startup, shutdown etc. of WCS. Will be described in the associated System User Manual (SUM)	

1.4   Operator Interfaces

1.4.1   Operations Management Workstation (OMW)

An OMW is a general-purpose workstation providing access to the full set of OM screens (Section 20.2).

An operator must log in to an OMW in order to perform any OM-based functions. All OM screen actions are protected by user authorisation configuration (Section 20.3) and event logging (Section 21.2).

DEMATIC

1.4.2   Local Operator Interface (LOI)

An LOI is similar to an OMW but it is dedicated to a specific role on a nominated workstation e.g. GTP station, decant. An operator must log in to an LOI to perform any of the associated functions there.

Section 20.2.9 lists the LOI screens.

1.4.3   Mobile Operator Interface (MOI)

MOIs are used in the hanging and manual areas of the DC. Each MOI is a hand-held RF unit.

The physical devices used are:
- Zebra TC8000 handheld RF units
- Zebra WT41N0 wrist wearable RF units
- Intermec CV41 vehicle mounted RF units

An operator must log in to an MOI to perform any of the associated functions on it.

DEMATIC

2   LOCATION MANAGEMENT

This section describes the different types of warehouse picking and storage locations and conveyor locations.

2.1   Storage Areas

Stock is stored in one of three storage areas, depending on the stock attributes – manual storage, hanging storage and multishuttle storage. These areas are described in more detail below.

2.1.1   Manual Storage

Manual storage comprises five separate location types:

- Pallet locations in VNA for pallets up to 1.2m high
- Pallet locations in VNA for pallets up to 0.9m high
- Case shelving locations in VNA
- Pallet locations in Wide Aisle for pallets up to 1.2m high
- LSS case pick locations in Wide Aisle

The number of locations of each type and the layout in which they are arranged are configurable in WCS.

2.1.1.1   Manual Storage Location Configuration

The manual storage locations have a wide range of attributes attached to them. These attributes are used by putaway and stock selection processes to match the SKU requirements with the location. These attributes can be classified in the following groupings:

- Environmental: Size, weight restrictions, etc.
- Business: Stock owner, brand, etc.
- Process: Pick, marshalling, putaway, etc.

Locations can be created individually on an OM screen, but usually by importing location data from a file created by spreadsheet.

Location naming is fully configurable. Each location can have an associated barcode, which does not have to be the same as the location name.

2.1.2   Hanging Storage

The Garments On Hanger (GOH) storage area comprises a number of manual rails on the mezzanine floor, linked by a transport rail. GOH storage is split into two separate areas: single-level storage for long garments and double-level storage for shorter garments.

Hanging locations can be configured in the same way as manual locations, subject to the limitations imposed by the layout.

2.1.3   Automated Storage

There are three separate multishuttle storage areas.

The storage multishuttle holds stock totes. The order buffer multishuttle holds pick cartons. The despatch buffer multishuttle holds despatch cartons.

Further details on multishuttle storage are provided in Section 3.

2.2   Decant Area

The decant area comprises 16 decant stations. Each decant station has two pallet positions associated with it.

Additionally, a number of Pick & Drop locations may be configured to allow temporary storage of decant pallets when there is no space at any of the decant stations. See Section 2.7.2.

2.3   Picking Areas

Picking is performed in all three warehouse areas – manual, automated and hanging.

2.3.1   Manual Picking Areas

Any manual storage location can also be configured as a picking location. The main picking locations in the manual area are the LSS locations, but it is also possible to configure any pallet location as a picking location.

2.3.2   Product Nailing

A picking location can be set to a *NailingType* of either **STATIC** or **DYNAMIC**. If it is set to **STATIC** then only a specific associated SKU can be replenished to that location for picking. If it is set to **DYNAMIC** then any candidate SKU (SKU and location attribute have to match) can be located there for picking.

2.3.2.1   Static Nailing

WCS provides the facility to 'nail' a specific SKU to a specific static picking location (or multiple locations). This means that a SKU is always picked from the same location. In order for the SKU to be statically nailed it must be configured to be a static SKU using the *NailingType* attribute on the SKU. The configuration of *NailingType* is a local-to-WCS function, and defaults to **DYNAMIC** for new SKUs.

Any location that has a SKU nailed to it is not used for a different SKU until the nailing is changed or removed.

If WCS needs to store a TM (pallet or case) of the SKU and all nailed locations for that TM type are full, the move is not generated.

WCS automatically generates replenishments to statically nailed locations irrespective of demand.

2.3.2.2   Dynamic Nailing

If a SKU is configured for dynamic nailing, WCS attempts to nail the SKU if there is sufficient demand or if the SKU has been configured to keep a certain stock holding in the pick location.

- Active pick demand: WCS nails sufficient locations for the currently active pick demand and any inactive pick demand for the current day.
- Two SKU attributes maintain a stock holding in the pick location: *MinimumPickLocQty* and *MaxDynamicallyNailedPickLocs*. WCS tries to nail a location if the quantity in the pick

locations drops below the *MinimumPickLocQty* and the number of pick locations for the SKU is fewer than *MaxDynamicallyNailedPickLoces*.

2.3.3   Hanging Picking Areas

There are no dedicated GOH pick areas. All GOH locations are available for picking. The concept of static and dynamic nailing does not apply to GOH locations.

2.3.4   Automated Picking Areas

Within the automated area, all picking is performed at the GTP stations. There are 24 GTP stations.

2.4   Consolidation Locations

Despatch units which include elements picked in the hanging and GTP areas must be consolidated in the GTP – GOH merge area.

It is a manual process to coordinate the despatch of items picked flat with those picked in GOH for the same consignment. To aid this, WCS provides visibility of the outstanding work in each pick area for a consignment.

2.5   Pack Locations

Orders are packed and finished in different areas depending on the type of order.

Satchel orders are normally packed at one of the automated pack stations. There are up to 36 automated pack stations. Each automated pack station has the ability to print despatch labels, and some of them are equipped with a document printer.

Documentation for orders picked or packed in cartons is normally printed and inserted automatically at inline printing locations. There are 3 inline document printers.

Cartons are automatically lidded at one of the lidding stations. There are 3 automatic lidding machines.

2.6   QA Stations

There are four dedicated QA stations, each at a specific location within the automation area. A TM is directed to a QA station when WCS or an operator detects a problem with it. Each QA station provides functionality to investigate and correct problem TMs. The table below shows the dedicated QA stations and their main function.

QA Station	Equipment	Main Function
Decant QA	OMW Barcode scanner	Correction of problem totes generated at decant stations
Product QA	OMW Barcode scanner	Correction of stock tote problems detected at GTP stations Stock tote housekeeping and checking functions
Order QA	OMW Barcode scanner	Investigation of short-picked orders
Finishing QA	OMW Barcode scanner Document printer	Correction of printing and weight errors for despatch cartons

	Label printer	

As each QA station is equipped with an OMW, the functions performed there can in theory take place at an OMW anywhere in the DC. OMWs in the GOH and manual areas may be used to perform QA functions.

A suitably-privileged OM user is able to:
- Create a new TM record
- Transfer stock from one TM to another
- Transfer selected picked items from one TM to another
- Transfer all the picked items, along with any paperwork, from one TM to another
- Remove a hold state from stock in a TM
- Adjust the quantity of stock in a TM
- Set some or all of a picked order line in a TM unpicked
- Set a TM *missing*
- Request a specific tote or group of totes be retrieved from the storage multishuttle to the Product QA station
- Request a specific carton or group of cartons be retrieved from an order buffer to the Order QA station or the Finishing QA station
- Request an empty carton or group of empty cartons of a specific size be retrieved from an order buffer to the Order QA station or the Finishing QA station
- Print a carton LP or a despatch label (subject to the OMW having access to a label printer)
- Print despatch paperwork (subject to the OMW having access to a document printer)

2.7   P&D Locations

2.7.1   Manual Aisles

There are a number of Pick and Drop (P&D) locations located at each end of manual aisles. These locations are used as a temporary location for pallets which are being stored in the aisles (e.g. from receiving) and for pallets which are being retrieved from the aisles (e.g. for replenishment).

Each P&D location has a capacity of 1 pallet. The number of P&D locations at each end of each manual aisle is configurable on WCS.

Some P&D locations are floor locations. Other P&D locations are physically rack locations which are configured on WCS to be used as P&D locations.

2.7.2   Decant P&D

Pallets which are being trammed from the manual aisles to Decant are delivered to specific decant P&D locations.

Decant P&D locations are floor locations, each with a capacity of 1 pallet. WCS tracks the exact content of each P&D location.

The number of decant P&D locations is configurable on WCS. Each location has its own unique barcode.

When all the decant P&D locations are logically full (i.e. there is a pallet at or in transit to each location), no further pallets are delivered there.

DEMATIC

2.8   Buffer Locations

WCS uses buffer locations in areas where knowledge of the exact position of each pallet is not required. There is one pallet floor buffer – Cubiscan buffer.

Pallets containing stock that needs to be checked at Cubiscan are trammed to the Cubiscan buffer. The capacity of the Cubiscan buffer (in numbers of pallets) is configurable on WCS.

When the buffer location is logically full (i.e. the number of pallets there is the same as the configured capacity), no further pallets are delivered there.

2.9   Work In Progress (WIP) Areas

WCS provides a number of WIP areas. These are generic areas which have no defined capacity. The following WIP areas are used:

> Receiving (Section 6)
> Decant Sin Bin (following decant station exceptions, Section 15.5)
> Case Labelling (following full case picking, Section 14.2)
> Manual Packing (following split case picking, Section 14.3)
> GOH Despatch Staging (following GOH packing, Section 18.3)

2.10   Conveyor Locations

WCS exchanges data with conveyor **Programmable Logic Controllers** for TMs arriving at a number of conveyor locations. Full details of the conveyor locations where data is exchanged and the data which is exchanged are provided in the separate WCS-PLC Interface Specification.

2.11   Location Configuration

2.11.1   Location Attributes

The location attributes below are a sample of the configuration data applied to hanging and manual locations. Location data is loaded into WCS by an OM user importing the contents of a file containing comma-separated values.

Location Attributes	Description
Storage Area	GOH | WIDE | NARROW
Loc Id	Name of the location in WCS
Loc State	See section 2.11.2
Barcode	Location barcode
Usage	PICKING | STORAGE | RESERVE | INDENT | PICKDROP
Nailing Type	STATIC | DYNAMIC Only relevant if <Usage> = [PICKING]
Client	Only relevant if <Nailing Type> = [STATIC]
SKU Code	
Loc Type	FLOOR | SHELF | RAIL
TM Type	PALLET | CASE | EACH
Capacity	Maximum number of <TM Type>s permitted
Max Volume	Maximum volume of stock permitted, in cm^3
Max Weight	Maximum weight of stock permitted, in g
Size	SMALL | LARGE Only relevant if <Storage Area> = [GOH] or if <TM Type> = [PALLET]
Pick Seq	Each location has a pick sequence. See section 2.11.3
Putaway Seq	Each location has a putaway sequence. See section 2.11.3
Dim 1	Aisle
Dim 2	Bay
Dim 3	Level
Dim 4	Position
Dim 5	Depth

DEMATIC

DAI

The following is an example file to configure 1 hanging and 1 manual location:

```
Storage Area,Loc Id,Loc State,Barcode,Usage,Nailing Type,Client,SKU Code,Loc Type,TM
Type,Capacity,Max Volume,Max Weight,Size,Pick Seq,Putaway Seq,Dim1,Dim2,Dim3,Dim4,Dim5
GOH,H01B3,AVAILABLE,H01023,PICKING,DYNAMIC,,,RAIL,EACH,20,,10000,LARGE,706,4192,1,2,3,,
NARROW,LSS25:10A2:4,AVAILABLE,L2510124,PICKING,STATIC,SFG,00123456,SHELF,EACH,,600000,100000,,3881,4
55,25,10,1,2,4
```

2.11.2   Location States

Further control over the use of locations is provided. Locations can be set as follows:

Control State	Description
UNUSED	The location is not to be used
AVAILABLE	The location is fully in use
LOCKED	This indicates stock can be retrieved but no new stock can be stored there. The stock state is unaffected by being in a locked location
BARRED	This indicates stock can be neither stored nor retrieved from the location. Any stock in the location is put into a hold state [Held by location]
DAMAGED	This indicates stock can be neither stored nor retrieved from the location. Any stock in the location is put into a hold state [Held by location]. In effect this is the same as *BARRED* but it is intended to be a long term designation, with *BARRED* being a short term designation
STORE ONLY	Can be used for putaway but not retrieval

2.11.3   Location Sequences

Pick and Putaway walk sequences can be defined within a storage area(s) by using a sequence number held against each individual location.

The sequence defines the walk path to be used by WCS when directing an operator for picking or putaway purposes i.e. starting at the lowest sequence number and visiting required locations in ascending sequence number.

The sequence numbers do not need to be consecutive values but would normally be unique within the area (e.g. 10, 20, 25, 30, 31, 32, 40 is an acceptable sequence). Where sequence numbers are not unique then WCS is free to visit locations with the same sequence number in any order.

Sequence numbers are usually configured by loading them into WCS as part of location configuration spreadsheet (see section 2.1.1.1). They can also be configured individually for each location directly via a WCS screen.

2.12   Manual Warehouse Equipment

This section describes the various equipment types and associated dedicated RF devices which are used in the manual and hanging areas of the warehouse.

DEMATIC

2.12.1   Truck Types

There are six different truck types used in the manual warehouse for the movement and picking of stock. Each truck can carry no more than one pallet of stock at a time. There are restrictions on the type of operation for which each truck type can be used.

Each truck type is configured to have a weighting in WCS. A maximum total weighting is configurable for each aisle in the manual area. WCS does not direct a truck to an aisle if its weighting added to the trucks already in the aisle would exceed the maximum for the aisle.

2.12.1.1   Fork-Lift Truck (FLT)

Fork-Lift trucks are used for the movement of pallets around the warehouse. In general, they perform point-to-point tramming moves, including to and from individual decant locations. FLTs cannot access rack locations in VNA aisles and cannot be used for case picking from rack locations.

There are two types of FLT – Rack FLT and Floor FLT.

2.12.1.1.1   Rack FLT

In pallet racking aisles, Rack FLTs can access pallets only at floor level and on the two levels above floor level.

2.12.1.1.2   Floor FLT

In pallet racking aisles, Floor FLTs can access pallets only at floor level.

2.12.1.2   Reach Truck

Reach trucks are used for the movement of pallets around the warehouse and for the storage and retrieval of pallets in the pallet racking aisles. Reach trucks cannot access rack locations in VNA aisles.

2.12.1.3   High Level Order Picker (HLOP)

HLOPs are used to perform case picking from rack locations onto pallets. HLOPs can be used in all manual aisles (VNA and Pallet Racking). HLOPs must deposit picked pallets at floor P&D locations for onward movement by FLTs.

2.12.1.4   VNA Turret Truck

VNA turret trucks are used to store and retrieve pallets in the VNA aisles. Pallets must be picked and dropped at rack P&D locations for onward movement by FLTs. VNA turret trucks cannot be used for case picking.

2.12.1.5   Floor Truck

Floor trucks are used only to move pallets around the warehouse. They cannot access any type of racking.

WCS distinguishes between powered and manual floor trucks.

2.12.1.5.1 Powered Floor Truck

Rider trucks are powered floor trucks. They can be used to move pallets any distance within the DC.

2.12.1.5.2 Manual Floor Truck

Hand trucks and pump trucks are manual floor trucks. Unlike powered floor trucks, they are used only to move pallets over short distances.

2.12.2 Dedicated RF Devices

Some trucks are equipped with fixed RF devices. If fixed IP devices are used, WCS allows the truck type to be configured against the IP address. For these devices, only those RF-based WCS functions appropriate to the device are offered when an operator logs in.

2.12.3 Non-Dedicated RF Devices

If an operator logs in to WCS via an RF device which does not have a fixed IP, WCS cannot derive the truck type. The operator must indicate what type of truck is being used, so that WCS can offer only the RF-based functions appropriate to the truck type.

2.13 Related Elements

2.13.1 Operations Management Screens

There is a specific OM screen for the configuration of each warehouse area.

There is a specific OM screen which shows the occupancy of each warehouse area. Occupancy is shown both by number of locations and by the cubic capacity occupied in each location (as a percentage). For example, a VNA aisle might have 75% of its locations occupied but might only be using 50% of the available cubic capacity.

2.13.2 MOI Functions

There are no MOI-specific functions for location configuration and management.

2.13.3 LOI Functions

There are no LOI-specific functions for location configuration and management.

2.13.4 Operational Events

Section 21.2 defines the general format of Operational Events. The table below defines the information that is logged in addition to the standard details for the specific location management Operational Events.

Event	Trigger	Fields
LOC_CREATE	When a new location has been created.	Location Id
LOC_DELETE	When a location has been deleted.	Location Id
LOC_CONFIG_CHANGE	When changing a configuration value of location e.g. height, max weight etc.	Location Id, Height, Width, Depth, Max Weight
LOC_STATE_CHANGE	Location state change.	Location Id, Old

		State, New State
LOC_AREA_CREATE	When a new Area has been created.	Area Id
LOC_AREA_DELETE	When an Area has been deleted.	Area Id
LOC_AREA_CONFIG_CHANGE	When changing a configuration value of an Area e.g. height, max weight etc.	Area Id, Height, Width, Depth, Max Weight

2.13.5   Statistics

There are no statistics associated with location management.

2.13.6   Alarms and Alerts

The table below defines the alarms and alerts that are associated with location management. They are displayed on the WCS Alarms page.

Alarm	Description	Drill Down
xxx Storage Near Capacity	Area xxx is almost full	To the specific storage area screen
xxx Storage Full	Area xxx is full	To the specific storage area screen
Pick Area Demand > Capacity	The current pick demand for a SKU exceeds the available static capacity.	To the specific SKU

2.13.7   Configuration Parameters

The table below lists the configuration parameters that are used to control the location management functions.

Parameter Name	Function	Values	Section
Default SKU Case Volume	Volume of each case assumed for SKUs whose item dimensions are unknown to WCS. Used when calculating capacity of a manual storage location	$0..1,000,000$ cm^3	2.11.1
xxx Storage Nearly Full Percentage	Defines the percentage of available storage locations within area xxx that must be occupied for a Storage Nearly Full alarm to be raised	0..100	N/A

DEMATIC

3 MULTISHUTTLES

3.1 Overview

There are three multishuttles under the direction of WCS – a storage multishuttle used for totes, an order buffer multishuttle used for (pick) cartons, and a despatch buffer multishuttle used for (despatch) cartons.

This section contains details which are common to all multishuttles. Details specific to the storage multishuttle can be found in Section 16.8, details specific to the order buffer multishuttle can be found in Section 16.8.5, and details specific to the despatch buffer multishuttle can be found in Section 19.1.

Operations Management overview screens display summary and detailed counts of the number of empty and available locations in each multishuttle.

3.2 Multishuttle Layout

3.2.1 Aisles

A multishuttle comprises a number of aisles of racking, each with a dedicated elevator for infeeds and a dedicated elevator for outfeeds serving a number of levels. Each level within an aisle is served by a dedicated shuttle.

Each aisle comprises a number of shelves to the left and to the right of the shuttle. On each shelf are a number of bays, each two storage locations deep.

Within WCS, the aisles in the storage multishuttle are numbered 1 to 24, the aisles in the order buffer multishuttles are numbered 27 to 32, and the aisles in the despatch buffer multishuttle are numbered 25 and 26.

WCS references each individual storage location by aisle, side (left or right), bay (horizontally from 1 nearest the elevator), level (vertically upwards from 1) and depth (back or front).

3.2.2 Infeeds

Incoming TMs are diverted from the main conveyor onto the aisle infeed conveyors. There the conveyor system moves the TMs onto the multishuttle pickup positions, ideally two at a time.

WCS then instructs the multishuttle infeed elevator to take the TMs to the required level. The elevator moves each TM to an infeed level conveyor, each of which can hold two TMs.

WCS then instructs the shuttle to take a TM from the infeed level conveyor and put it in its storage location.

WCS never stores a TM in a front location if the corresponding back location is empty and available.

3.2.3 Outfeeds

TMs are required to be retrieved from the multishuttles subject to the limits described in Section 5.2.

WCS instructs the shuttle to pick up a TM from a storage location and take it to the outfeed level conveyor, which can hold two TMs.

WCS then instructs the multishuttle aisle's outfeed elevator to take TMs from the outfeed level conveyors and move them to an aisle dropdown station.

The TMs move from the dropdown station onto the main conveyor, where WCS routes them onwards to their destination.

3.3 Multishuttle Location Management

WCS Operations Management screens provide visibility of the capacity and number of free locations in each multishuttle. Summary figures may be analysed in detail to display attributes of the individual TM stored in a specific location.

Various attributes of the multishuttle are configured on WCS as described in the following sections.

3.3.1 Location Status

Each individual storage location may be configured to have one of the following status values:

State	Meaning
Available	Manually set or cleared. Indicates that the location is available for storage and retrieval
Locked	Manually set or cleared. Indicates that a TM may be retrieved but no new TM will be stored.
Barred *Damaged*	Manually set or cleared. Indicates that a TM may be neither stored in nor retrieved from the location. These two states are the same in their effect but may be applied for different reasons, allowing for example a damaged location to exist inside a block of temporarily barred slots. When removing the barred state from a block of locations, a user would not typically want to accidentally remove the damaged state as well.
Store Only	Manually set or cleared. Indicates that a TM may be stored in the location but not retrieved from it.
Not Exist	Non-changeable status. Indicates that the location is permanently unavailable, for example a location which does not exist due to the physical layout.

Manually-changeable location attributes may be set or cleared individually, or across a range of locations in a single operation. The action is performed on an Operations Management screen and is subject to the security settings of the user.

3.3.2 Equipment Fault Status

WCS displays an alarm on the Operations Management status line if the multishuttle controller systems report a fault with any of the following individual items of equipment:

- Pickup station in each aisle
- Infeed and outfeed elevators in each aisle
- Infeed and outfeed level conveyors on each level in each aisle
- Shuttle on each level in each aisle
- Dropdown station in each aisle

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WCS does not issue to the multishuttle controller systems further storage or retrieval missions that require the availability of any equipment that is reported to be in fault.

The problem should be investigated by a member of the maintenance staff. When the problem is corrected, the multishuttle controller reports this to WCS and the alarm is removed from the Operations Management status line.

3.3.2.1 Move Completion Delay

If WCS issues a move instruction to the multishuttle controller, but after a configurable number of minutes the move has not been completed, WCS highlights the delay on the Operations Management status line to prompt operator intervention. WCS considers the equipment to be in fault as above.

The problem should be investigated by a member of the maintenance staff. When the move is completed or a fault condition is reported for the equipment by the multishuttle controller, the warning is cleared from the Operations Management status line (possibly to be replaced by a warning regarding the new fault).

3.3.3 Equipment Out of Service

An Operations Management user with suitable authority may configure any of the following individual items of equipment to be considered out of service by WCS:

- Pickup station in each aisle
- Infeed and outfeed elevators in each aisle
- Infeed and outfeed level conveyors on each level in each aisle
- Shuttle on each level in each aisle
- Dropdown station in each aisle

WCS displays an alarm on the Operations Management status line if any multishuttle equipment has been set out of service.

WCS does not issue to the multishuttle controller systems further storage or retrieval missions that require the availability of any equipment that is set out of service.

3.4 Multishuttle Putaway

When WCS determines that a TM needs to be stored in a multishuttle, it automatically selects a specific destination for it.

Multishuttle location selection is a three-step process:

- Aisle selection within the multishuttle
- Level selection within the aisle
- Location selection within the level

The selection rules differ between the three multishuttles, however some basic principles are common to both:

- WCS directs the main conveyor system to direct the TM to the selected aisle.

- Once the TM reaches the multishuttle pickup station in that aisle, WCS directs the infeed elevator to route the TM to the infeed level conveyor on the selected level.

- Once the TM reaches the position on the infeed level conveyor nearer the shuttle, WCS directs the shuttle to route the TM to the selected storage location.

3.4.1 TM Height Check

Any TM which is reported to be overheight when it arrives at a multishuttle pickup station is given a destination location in the highest level in the multishuttle aisle. It will subsequently be retrieved to a QA station or reject lane for investigation and correction.

3.4.2 Putaway Aisle Selection

The aisle selection is made when the TM is reported on the main conveyor and has a destination of a multishuttle.

Before an aisle is considered for selection, all of the following must be true:

- The main conveyor infeed to the aisle is not in fault

- The pickup station in the aisle is not in fault

- The infeed elevator in the aisle is in service and is not in fault

- For at least one level in the aisle, all of the following are true:
    - The infeed level conveyor is in service, is not in fault, and has capacity for at least one TM
    - The shuttle is in service and is not in fault
    - There are more available empty locations than there are TMs already in transit to the level

If no eligible aisles are available for a TM, for example they are all out of service or full, the TM waits on the main conveyor until an aisle becomes available.

If one or more aisles are available, WCS will select one of these and direct the main conveyor system to route the TM to the infeed of that aisle.

The rules governing the selection of putaway aisle from those available are specific to each multishuttle. Putaway to the storage multishuttle is described in Section 16.8.3, to the order buffer in Section 16.9.3, and to the despatch buffer in Section 19.4.3.

3.4.3 Reselection and Recirculation

The aisle selection rules aim to ensure that a TM is never delivered to an aisle which has no space in its infeed. However, WCS caters for an unexpected failure to divert into the infeed by attempting to find an alternative downsteam multishuttle aisle for it.

If no eligible aisle is available, the TM waits on the main conveyor until an aisle becomes available.

3.5 Retrievals

Each aisle maintains its own queue of outstanding retrieval requests. Retrievals are generally performed as they are requested.

Retrievals to specific destinations are controlled by WCS and can be held back if the target destination is considered to be full. This is typically controlled by a limit on the number of TMs that can be in transit to the destination at any time and is covered further in Section 5.2.

It is not possible for an operator to alter the priority of automatically created retrievals e.g. to a GTP station. For manual requests it is possible to modify the priority of the retrieval either for the individual TM or for a list of TM retrieval requests.

3.6 Housekeeping Shuffles

A housekeeping shuffle move may be scheduled if a TM remains in its multishuttle location for longer than a configurable number of days (a WCS configuration parameter exists for each of the bays on a shelf).

This ensures that each TM stored in the multishuttle is regularly confirmed to be accessible and that each location's occupancy is regularly checked against the WCS view.

3.7 Shuttle Exception Handling

Exception conditions may occur during putaway or retrieval operations. These are: -

- Bin full   location found to be occupied on putaway attempt
- Bin empty   expected TM not found on retrieval attempt
- Putaway blocked   front depth location found to be occupied on putaway attempt to back depth location
- Retrieval blocked   front depth location found to be occupied on retrieval attempt from back depth location

Existing shuttle exceptions are highlighted on the Operations Management alarm screen and status line.

3.7.1 Bin Full Exception

If a bin full exception occurs, the shuttle stops at the location (subject to the configuration parameter described in Section 3.7.5) and an alarm is generated on WCS. WCS highlights the exception on the Operations Management status bar to prompt operator intervention. A member of the maintenance staff should visit the location to investigate the exception.

Once any shuttle fault condition is cleared on the multishuttle controller, the exception is handled via a WCS Operations Management screen as described below.

The operator is given the choice of:

- Confirm full   WCS allocates another destination for the TM

- Retry putaway   The storage attempt is repeated. If the retry fails, the exception is regenerated. This facility should normally be used only if something has been done to cure the problem.

If the operator confirms that the location is actually full, WCS creates a dummy TM in the location previously believed to be empty. This prevents that location being selected for any further putaway until the dummy TM has been retrieved.

3.7.1.1   TM Alternative Putaway

The TM that was originally being put away when the exception occurred has an alternative location selected for it in the same level according to the normal location selection rules.

If no suitable location is available in the level then the TM is retrieved from the multishuttle. If possible it will be routed back into the multishuttle, but if this is not possible then it will be directed to a QA station or reject lane.

3.7.1.2   Retrieval of the Unexpected TM

A retrieval move request is automatically generated for the dummy TM that WCS created in the slot. It is retrieved from the multishuttle for investigation.

The TM is initially retrieved using its WCS-generated dummy TM ID, i.e. this will not match any barcode physically on the TM. Once the multishuttle controller reports that the unexpected TM has been placed on the main conveyor, WCS deletes the dummy TM from its database.

If the actual TM barcode is read by the conveyor system and WCS recognises this to be a TM that is required elsewhere, the TM is routed to its required destination. Typically the TM is stored back in the multishuttle, but if this is not possible then it will be directed to a QA station or reject lane.

3.7.2   Bin Empty Exception

If a 'bin empty' exception occurs, the shuttle stops at the location and an alarm is generated on WCS. WCS highlights the exception on the Operations Management status bar to prompt operator intervention. A member of the maintenance staff should visit the slot to investigate the exception.

Once any shuttle fault condition is cleared on the multishuttle controller, the exception is handled via a WCS Operations Management screen as described below.

The operator is given the choice of:

- Confirm empty   The TM that was logically in the location is set *missing* and the location considered empty.
- Retry retrieval   The retrieval attempt is repeated. If the retry fails, the exception is regenerated. This facility should normally be used only if something has been done to cure the problem.

3.7.3   Putaway Blocked

The handling of a putaway blocked exception is the same as for a Bin Full exception (see Section 3.7.1).

3.7.4   Retrieval Blocked

The handling of a retrieval blocked exception is the same as for a Bin Full exception (see Section 3.7.1).

3.7.5   Automatic Confirmation

A single WCS configuration parameter determines whether shuttle exceptions for reasons Bin Full, Putaway Blocked and Retrieval Blocked are confirmed automatically by WCS.

DEMATIC

If this is the case, the process continues in the same manner as when a user confirms the exception as described in Section 3.7.1 above.

The automatic confirmation does not take place for a second consecutive exception on the same shuttle. Therefore, if a shuttle reports an exception when attempting to store a TM in an alternative location as described in Section 3.7.1.1, manual intervention is required.

3.8 Related Elements

3.8.1 Operations Management Screens

The Multishuttle Summary screen shows the occupancy of each multishuttle aisle and level. The Multishuttle Location List and Multishuttle Location Details screens allow a suitably-privileged user to change the state of specific multishuttle locations.

3.8.2 MOI Functions

There is no MOI associated with multishuttle functions.

3.8.3 LOI Functions

There is no LOI associated with multishuttle functions.

3.8.4 Operational Events

Section 21.2 defines the general format of Operational Events. The table below defines the information that is logged in addition to the standard details for the specific Multishuttle Operational Events.

Event	Trigger	Fields
MS_PUTAWAY	When a TM is put away into a multishuttle storage location	TM Id, Location Id, Move Reason
MS_RETRIEVAL	When a TM is retrieved from a multishuttle storage location	TM Id, Location Id, Destination Id, Move Reason
MS_EXCEPTION	When a multishuttle exception is handled	TM Id, Location Id, Exception, Action
MS_STATE_CHANGE	When a multishuttle location (storage location, pickup station, elevator, level conveyor, shuttle or dropdown station) changes state (i.e. is set in or out of service)	Location Id, Old State, New State
MS_AVAILABILITY_CHANGE	When a multishuttle location (pickup station, elevator, level conveyor, shuttle or dropdown station) changes availability (i.e. moves into or out of fault)	Location Id, Old Availability, New Availability

3.8.5 Statistics

The table below defines the statistics that are maintained for multishuttle functions.

Name	Index	Comments
TMs Put Away	Level 1..(32*13)	Incremented once per TM put away into a storage location in the level

TMs Retrieved	Level 1..(32*13)	Incremented once per TM retrieved from a storage location in the level
TMs Transferred Left	Level 1..(32*13)	Incremented once per TM transferred to the level from an adjacent aisle
TMs Transferred Right	Level 1..(32*13)	Incremented once per TM transferred to the level from an adjacent aisle
Multishuttle Exceptions	Level 1..(32*13)	Incremented once per multishuttle exception in the level handled
Pickup Station Available	Pickup station 1..(32*2)	Incremented once per minute that the pickup station is in service and available
Pickup Station Unavailable	Pickup station 1..(32*2)	Incremented once per minute that the pickup station is in service and unavailable
Pickup Station Out of Service	Pickup station 1..(32*2)	Incremented once per minute that the pickup station is out of service
Elevator Available	Elevator 1..(32*2)	Incremented once per minute that the elevator is in service and available
Elevator Unavailable	Elevator 1..(32*2)	Incremented once per minute that the elevator is in service and unavailable
Elevator Out of Service	Elevator 1..(32*2)	Incremented once per minute that the elevator is out of service
Level Conveyor Available	Level conveyor 1..(32*13*2)	Incremented once per minute that the level conveyor is in service and available
Level Conveyor Unavailable	Level conveyor 1..(32*13*2)	Incremented once per minute that the level conveyor is in service and unavailable
Level Conveyor Out of Service	Level conveyor 1..(32*13*2)	Incremented once per minute that the level conveyor is out of service
Shuttle Available	Level 1..(32*13)	Incremented once per minute that the shuttle is in service, available and not in exception
Shuttle Exception	Level 1..(32*13)	Incremented once per minute that the shuttle is in service and in exception
Shuttle Unavailable	Level 1..(32*13)	Incremented once per minute that the shuttle is in service, unavailable and not in exception
Shuttle Out of Service	Level 1..(32*13)	Incremented once per minute that the shuttle is out of service
Dropdown Station Available	Dropdown station 1..(32*2)	Incremented once per minute

		that the dropdown station is in service and available
Dropdown Station Unavailable	Dropdown station 1..(32*2)	Incremented once per minute that the dropdown station is in service and unavailable
Dropdown Station Out of Service	Dropdown station 1..(32*2)	Incremented once per minute that the dropdown station is out of service

3.8.6 Alarms and Alerts

The table below defines the alarms and alerts that are associated with multishuttles. They are displayed on the WMS Alarms page.

Alarm	Description	Drill Down
Pickup Station Fault	A multishuttle pickup station is unavailable or out of service	List of pickup stations with fault
Elevator Fault	A multishuttle elevator is unavailable or out of service	List of elevators with fault
Level Conveyor Fault	A multishuttle level conveyor is unavailable or out of service	List of level conveyors with fault
Shuttle Fault	A multishuttle shuttle is in exception, unavailable or out of service	List of shuttles with fault
Dropdown Station Fault	A multishuttle dropdown station is unavailable or out of service	List of dropdown stations with fault

3.8.7 Configuration Parameters

The table below lists the configuration parameters that are used to control the multishuttles.

Parameter Name	Function	Values	Section
MS Housekeeping Bay xx Too Long Days	Define the maximum number of days that a TM can be stored in each bay on a shelf before it should be relocated	1..365	3.6
Auto Confirm Multishuttle Exception	Determines whether shuttle exceptions for reasons Bin Full, Putaway Blocked and Retrieval Blocked are confirmed automatically	TRUE/FALSE	3.7.5

DEMATIC

4 INVENTORY MANAGEMENT

This section describes the ways in which WCS tracks and manages the inventory (containers and stock) in its domain.

The terms 'SKU', 'TM', and 'stock record' are defined, together with an explanation of their key attributes and the relationships between them.

4.1 Inventory Management Principles

- Inventory management within the facility rests with WCS. WCS tracks stock once it is received into the DC, and notifies it to the Host

- The Host maintains knowledge of total stock quantities of each SKU within WCS control, broken down by high-level availability state, i.e. available and held

- WCS is responsible for tracking stock throughout the DC

- WCS has the ability to adjust inventory quantities. Any adjustments are reported to the Host when confirmed

- The SKU of stock cannot be changed on WCS

- WCS has the ability to hold specific stock, with no net change of stock level. This prevents the stock from being used for order fulfilment. Multiple hold reasons are possible (Section 4.4.4)

- WCS provides a stock balance rationalisation feature to allow WCS to send a complete upload of the its view of stock holding for checking against the Host's view (Section 4.7)

4.2 SKUs

WCS maintains a SKU master database populated with details received from the Host.

The main attributes of a SKU are as follows:

- SKU Id
- Description
- Brand owning all stock of the SKU
- Client owning all stock of the SKU (derived from the brand)
- Product type - whether a quantity of 1 of the SKU represents a single item (retail), or is a ratio pack containing multiple different items (indent)
- Mechability – possible values are:
  - Nonmechable – stock of the SKU stored flat is picked in the manual area
  - Semimechable – the configuration of the brand and order type (Section 9.3.1) determines whether stock of the SKU stored flat is picked in the manual area or the GTP area
  - Mechable – stock of the SKU stored flat is picked in the GTP area
- Unit barcode
- Style – may be part of the configuration of which modules of the storage multishuttle are used to store totes containing stock of the SKU (Section 16.8.3.1)
- Dimensions and weight of a single item
- Fragility – a fragile item cannot be despatched in a satchel

As it is theoretically possible for more than one client to use the same SKU Id to refer to different SKUs, the unique identifier for each SKU within WCS is a combination of the client and the SKU Id.

Attributes of Host-owned SKUs are not editable on WCS. Any changes to the contents of the master database within WCS for these SKUs are made through the Host interface.

4.2.1   WCS-Owned SKUs

Most SKUs are created via the Host interface. WCS also allows for the local creation of SKUs by an authorised user via an OM screen. This is primarily intended for non-inventory stock that is not being handled via the Host (e.g. test SKUs).

WCS-owned SKUs cannot be used for Host order fulfilment and are never reported to the Host.

4.2.2   Purging of SKU Records

A SKU cannot be deleted from WCS if any other WCS application record (e.g. stock, pick) is referencing it.

Subject to the above:

- A Host-created SKU can be deleted via a message from the Host

- A Host-created SKU can be deleted automatically as a result of not having been seen in the DC or refreshed by the Host for a period of time

- A WCS-created SKU can be deleted manually via OM screen

A SKU that has been deleted from WCS is no longer visible on the application server, but historical records are retained on the MI database (Section 21).

DEMATIC

4.3　　　Transport Module (TM)

Transport Module (usually abbreviated to TM) is a generic term used in the Dematic Matflo software on which WCS is based. A TM can be any type of physical unit or container that is moved or managed by the system.

4.3.1　　　TM ID & Barcodes

Every TM that is handled via WCS has a unique ID in the WCS database. TM IDs are typically reflected in an attached barcode (permanent or label - Section 1.1 gives details), although a tote barcode also identifies the orientation of the tote.

4.3.2　　　TM Types

The following primary TM types are identified:

TM Type	Description	TM ID
Trolley	Container holding multiple cartons for picking into in manual areas of the DC	Permanent licence plate barcode label
Bin	Container holding multiple hanging units of stock during putaway and picking operations in GOH	Permanent licence plate barcode label
Bag	Group of multiple hanging units of stock, ready for despatch	Adhesive despatch label
Case	Container holding multiple units of stock, of a single SKU, stored flat. Typically identified and labelled by the Host prior to receipt into WCS control	Adhesive licence plate barcode label, although this is logically lost when the case is moved to a split-case pick location
Pallet	Container holding multiple cases of stock for storage and movement within the DC	Adhesive licence plate barcode label, although this may physically be lost when one or more cases are removed from the pallet
Tote	In-house plastic container, holding stock in the storage multishuttle and picked from at GTP stations. Can be split into multiple compartments, each holding stock of a different SKU	Unique tote identifier. On two opposite sides of each tote are a permanent licence plate barcode label consisting of the tote ID and an identifier of the side
Carton	Container holding picked stock. Normally created and auto-labelled by a carton erector. A carton can be transported on the conveyor system and stored in the order buffer and despatch buffer multishuttles. The picked stock may be despatched in the same carton. Alternatively, the picked stock may be removed and the empty carton reused with the same licence plate	Adhesive licence plate barcode label, normally automatically applied at carton erector
Satchel	Effectively a smaller despatch carton, into which picked stock is transferred at a pack station	Despatch label produced by WCS at a pack station

DEMATIC

4.3.3   Primary TM Attributes

The information held on WCS for a TM largely relates to its physical aspects as a unit of storage and movement. A TM record does not hold information about the TM contents except by cross-reference to an associated database record, e.g. Stock or Despatch Unit.

The main attributes of a TM on WCS are:

- Type, as in the table above
- ID, usually equates to a physical barcode, e.g. LPN
- Weight, where relevant
- Current location, as tracked by WCS
- Requested destination, if any
- Move reason, if any
- Contents/usage, e.g. stock, despatch, empty
- Cross-reference to contents, e.g. stock records or DUs

4.3.4   TM Locations

WCS is responsible for locating and tracking all TMs within its domain. Once a TM has been delivered into WCS control, no higher-level system is expected to require details of the TM's location while it remains within the WCS domain.

4.3.5   TMs in the WCS Database

WCS holds a TM in its database if any of the following are true:

- The TM is located in a WCS-controlled location

- The TM is in transit under WCS control, or is expected to re-appear into WCS control

- The TM has been pre-notified to WCS and is expected to be physically introduced in the near future

- The TM is temporarily out of WCS physical control but may return e.g. TM missing in transit or manually retrieved

Once none of the above applies, WCS is entitled to delete the TM record from its application database. However, references to the TM are retained in the event logs on both the WCS Application and MI servers thus allowing an audit trail to be followed with knowledge of the TM's ID.

4.4   Stock Record

A stock record identifies a grouping of individual items of stock which are in the same location or TM and which share the same attributes.

The main attributes of a stock record are as follows.

- SKU (Section 4.2)
- Number of stock units (Section 4.4.1)
- Cross-reference to the TM (physical container) holding the stock (Section 4.3)
- Storage state (whether received and stored in the DC as flat or hanging)
- WCS stock state (Section 4.4.2)
- WCS hold states (Section 4.4.4)

4.4.1 Stock Units

WCS utilises a single level of packaging of a SKU (the 'unit') which is used for all inventory accounting and picking operations. A TM may hold any number of units, subject only to physical constraints.

WCS does not use details of any standard packaging of the units, e.g. inners or standard case quantities.

4.4.2 WCS Stock States

State	Inv	Held	Meaning
expected			The stock has been pre-notified to WCS by the Host, but has not yet been physically seen by WCS at receiving
incoming			The stock has been seen by WCS and is within its control, but WCS has not yet informed the Host that the stock has been received. The stock may be valid to be put away into a storage location, but is not eligible to be reserved for picking
active	Y		The stock is in a known location within the control of WCS, usually either stored in a location or in transit to such a location. Stock will not remain *active* in transit indefinitely, as it will automatically be classed as *missing* if its TM does not arrive at its destination within a configurable time limit
outside	Y		The stock has been delivered to a location not considered to be under close WCS control, but still considered to be in the domain of WCS, e.g. a QA location. It is expected that the stock will be re-introduced or manually deleted from WCS at some point
missing	Y	H	The stock was lost in transit but has not yet been written off. It may later be found and re-introduced
gone			The stock has effectively been deleted from WCS. The stock record is retained on WCS for a short time (~1 day) for visibility on OM screens, but it cannot be resurrected

Inv: A "Y" in this column means that the stock is considered to be logically part of WCS inventory with respect to reporting stock levels to the Host, inventory summary screens etc.

Held: An "H" in this column means that the stock is automatically held by *stock state* (Section 4.4.4).

4.4.3 Stock/TM Relationship

A stock record references a TM which contains it.

WCS can hold multiple stock records against one TM, e.g. a pallet holding cases of several different SKUs.

4.4.4 WCS Hold States

Stock can become held on WCS for a variety of reasons, each of which can co-exist. If any of these hold states apply, the stock is not considered to be available for order fulfilment.

WCS reflects the hold state of a quantity of stock when reporting inventory levels or adjustments to the Host. From the Host perspective a quantity of a SKU is either available (no hold reasons apply) or held (one or more hold reasons apply) – the detailed reason(s) for the hold are not reported.

Held by	Meaning
Location	Stock is inaccessible due to the state of the location it is in, e.g. location barred or shuttle long-term out of service. This hold state is set or cleared automatically as a knock-on effect of the location state change
Stock state	The hold is as a result of its WCS stock state (Section 4.4.2). This hold state is automatically set and cleared to reflect the stock state
Contents	Set following an operator indication of suspect TM contents, e.g. during pick operation
Manual 1-10	10 different manual hold reasons can be applied via an OM screen, on an individual stock record or on all entries in a list created by a stock query. These are only ever set or cleared manually. The description of each manual hold reason is configurable

4.5 Example Stock/TM Relationships on WCS

This section provides some specific examples of how certain types of TM and their contents are represented on WCS as stock records and TMs together with some of the key data fields held on WCS.

4.5.1 Single-SKU Stock TM

Much of the time, stock is held in single-SKU TMs.
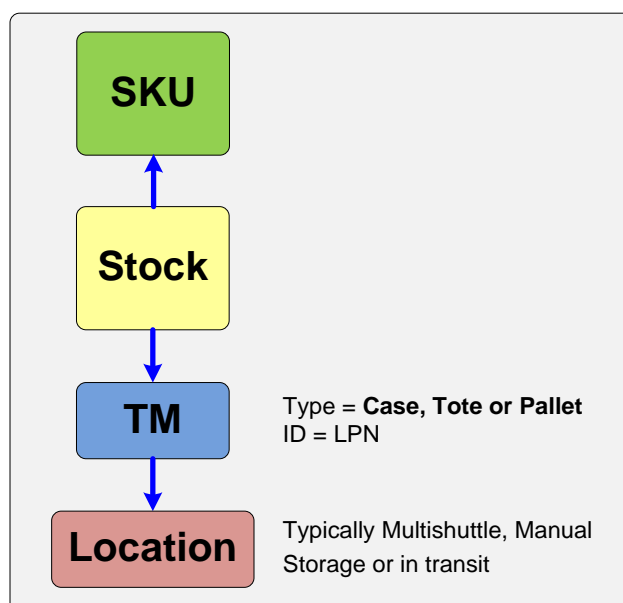
4.5.2   Multi-SKU Stock TM

It is possible to have multiple SKUs in one TM, e.g. a pallet holding cases of several different SKUs.
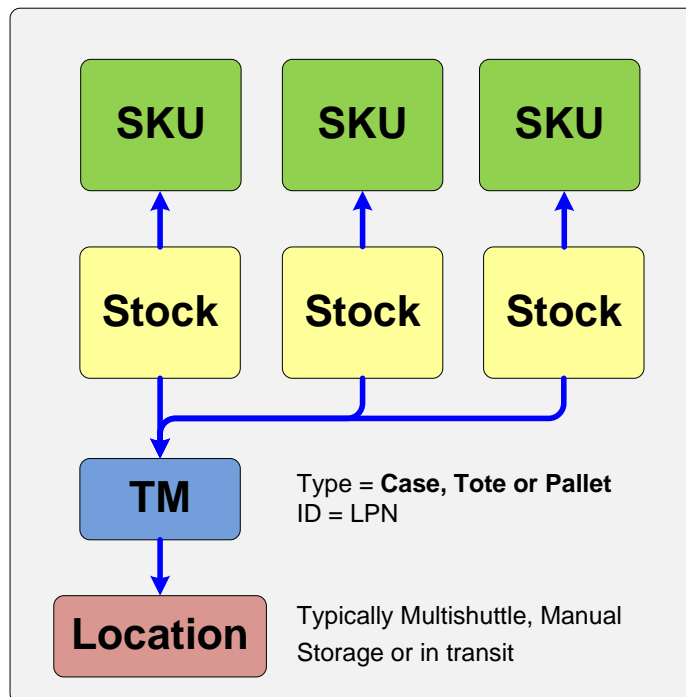
4.6   Inventory Management Functions

WCS allows suitably-privileged users the capability to check or adjust stock in the WCS domain. This includes the ability to:

- Perform planned or unplanned inventory checks (Section 4.9)
- Request a TM be routed to a QA station for further checking
- Adjust quantity of stock in a specific tote, pallet or location
- Delete a stock record
- Change manual hold states
- Split stock from one TM into two
- Merge compatible stock TMs (Section 4.6.5)
- Create stock of WCS-local SKUs in an identified TM (Section 4.6.1)

All adjustments are logged and, where relevant, reported to the Host.

4.6.1   Local Stock Creation

WCS provides the facility to create stock TMs of WCS-owned SKUs locally. This is essentially a feature to facilitate testing or local ad-hoc storage in a multishuttle. There are no inventory implications for the Host.

Stock created in this way is initially set to a state of *outside*. Once it has been created it can be put away in the same way as stock pre-notified by the Host.

4.6.2   Discrepant Stock Detected

During picking, decant etc. an operator may detect discrepancies in a stock record. In this event, WCS takes the problem away from that operator to be handled by another user with the appropriate security settings. (Meanwhile alternative stock is likely to be selected for picking.)

Where an operator detects a discrepancy relating to the stock, e.g. damaged stock, TM unexpectedly empty, then the affected stock record has a WCS hold state applied ('held by contents'). This hold state may be lifted at any time by a user with the authority to do so, typically after the suspect stock has been retrieved to a QA station for investigation and any adjustments have been made.

4.6.3   Missing Stock TM

Stock becomes *missing* in any of the following ways:-

- It is in transit and does not turn up at its expected destination within a configurable time period

- An automated handling device cannot locate the TM at its expected pickup location, following completion of any exception handling procedure

- An operator using a WCS MOI cannot locate the TM at its expected location, following confirmation that the operator is at the correct location

Missing stock is classified as unavailable from a Host inventory perspective.

When any stock is in a *missing* state, this is highlighted on an OM alert screen and should be investigated and resolved as soon as possible.

The *missing* stock automatically changes state (typically to *active*) if its TM is subsequently reported to WCS at a location.

4.6.4   Gone Stock TM

A suitably-privileged OM user may change the state of *missing* stock to *gone* if it is clear that the stock cannot be located. WCS will in any case automatically set missing stock to gone if it is not seen after a number of hours defined by configuration parameter *Missing Stock Gone Hours*.

A stock adjustment message is transmitted to the Host to inform it of the reduction in stock quantity.

4.6.5   Stock TM Merging

Stock records from two TMs may be merged into one so long as they are compatible, as shown below.

A suitably-privileged operator may select a "from" stock record and a "to" stock record. The "from" stock is effectively added to the "to" stock.

DEMATIC

For two stock records to be successfully merged, all of the following must be true:

- Same SKU
- Same hold state

4.6.5.1   Quantity

In the process of being merged, the quantity in the resultant stock record equates to the sum of the quantities in the original two.

4.6.5.2   Other Data Fields

Other fields in the resultant stock record are taken from the "to" stock record so any differing values in the "from" stock record are lost.

4.7   Stock Adjustments

4.7.1   Stock in WCS Inventory

Any exceptional change to the quantity of stock of a SKU within the WCS inventory causes an SLA message to be transmitted to the Host. Section 4.4.2 specifies which stock states form part of the WCS inventory.

An exceptional change means a write-on or write-off of a quantity of stock. It does not mean a change in stock quantity caused by a normal operation, e.g. a receipt of stock, a pick being performed, or the despatch of an order.

An OM user making an exceptional change must identify the reason for the change from a displayed list of reasons. The adjustment is made once the reason has been selected. The selected reason is translated into a code that forms part of the SLA message.

The list of reasons offered and the code each translates to are configured on an OM screen by a suitably-privileged user. The reason codes may be configured differently depending on the operation being performed and whether the adjustment is an increase or decrease in stock.

The reasons may also be configured differently for each client, so that the list of reasons offered to the user making the exceptional change varies depending on which client owns the SKU whose stock quantity is being adjusted.

The same method is used to define the reason codes included in the SLA messages caused by different types of exceptional change when there is no OM user to select a reason, e.g. *missing* stock automatically becoming *gone*, or a stock discrepancy discovered during a picking operation.

Details of the SLA message and its contents are provided in the WCS Host Interface Specification.

4.7.2   Other Stock States

An exceptional adjustment to *incoming* stock does not cause an SLA message to be transmitted to the Host. The Host is informed of the quantity of stock received when its PO line is closed as described in Section 6.5.

It is not possible to make an exceptional change to the quantity of stock in any other state.

4.8   Stock Balance Host Synchronisation

The Host is continuously updated with changes to the overall view of WCS inventory holding, including:
- Net change of quantity of a SKU, e.g. due to a quantity adjustment
- A quantity of a SKU changing its net availability, due to stock becoming held or unheld
- Contents of a packed despatch unit

Therefore it is not expected that the Host's view of the WCS stock holding should become incorrect. However, as a verification of this, WCS has the ability subject to configuration parameter *Stock Balance Send* to send to the Host a stock balance report daily at a time specified by configuration parameter *Stock Balance Hour*. A stock balance report can also be triggered manually by a suitably-privileged OM user.

The stock balance reports the WCS holding of each SKU, broken down by WCS availability.

4.9   Stock Checking at QA

WCS provides the ability to retrieve stock TMs to a QA station for checking. This usually occurs in any of the following ways:

- Manual request via OM screen: an individual stock TM or a filtered query list of stock TMs may be manually flagged for stock checking. This includes totes which WCS believes to be empty

- Automatically: following an system-detected discrepancy, e.g. overweight tote created at decant

QA station operations are described in Section 2.6.

4.10   Stock Checking at GTP Station

To allow for planned checking of larger numbers of totes, WCS provides an option to perform checking at one or more GTP stations.

GTP checking is only used for planned checking by manual request (in the same way as for planned checking at QA – Section 4.9).

Any quantity discrepancies detected result in the operator being asked again to count the stock. After two consecutive counts resulting in the same value, WCS accepts the updated quantity and informs the Host accordingly.

4.10.1   Station in Checking Mode

For WCS to begin checking operations at a GTP station, the station must have been placed into Stock Check mode (Section 16.1.1).

Totes can be retrieved for checking even if no operator is currently logged in to the station.

4.10.2   WCS Tote Selection for Checking

WCS retrieves totes whose stock records have been manually tagged as requiring checking. The flow of totes to the station is subject to normal flow control, i.e. there is a limit on the number of totes in transit to any one station at a time. The flow of totes can be stopped at any time simply by taking the station out of Stock Check mode.

A tote requiring checking is delivered to the stock tote position, in the same way as a tote which is to be picked from.

4.10.3   Log In as Checker

During a checking operation WCS uses the LOI screen to perform all dialogue with the checker.

Before any prompt is issued, an operator with the necessary authorisation logs in to the screen.

4.10.4   Tote Check Operation

Once a tote for checking is present in the station and a checker is logged in, the checking process may commence.

The screen shows the tote ID, the compartment to be counted (if any) and the expected contents (SKU, description, colour, size) if any. The expected quantity in the tote is not normally shown (but see Section 4.10.6).

4.10.5   Checking SKU

The SKU is checked visually, as the GTP station is not equipped with a scanner.

The operator is not required to explicitly confirm the SKU, but if the wrong SKU is observed then the operator flags the Wrong SKU exception as described in Section 4.10.7.1.

4.10.6   Checking Unit Count

WCS initially displays a randomly selected number of units within the value of configuration parameter *Stock Check Initial Variance* of the expected quantity.

If the value of this parameter is set to 0 then WCS always prompts the checker with the expected value.

The checker is prompted to confirm the number of units by adjusting the displayed value upwards or downwards and then confirming the correct quantity. This can be done on either the RapidPick pushbutton or on the WCS LOI screen.

When the checker enters the count, if it is the same as that expected then WCS accepts it. If the next compartment in the tote requires a count then this takes place, otherwise the tote is returned to storage.

If the checker enters a different count from what WCS expected, the checker must count the contents again. This continues until the checker enters the same quantity twice consecutively. WCS then accepts this new quantity.

4.10.7   Stock Checking Exceptions

If the operator detects a problem confirming the count of items, the operator presses the Problem button on the LOI screen.

This displays a new screen offering a button for each possible exception. The operator can press one or more buttons to flag the appropriate reason(s) for the problem. If any of these buttons is pressed a second time, the exception is unflagged.

DEMATIC

When the operator has flagged all the appropriate reasons, the operator presses the Send Away button to release the tote. Alternatively, the operator presses the Back button to return to the main stock checking screen.

The possible exceptions are a subset of those that can be encountered during the GTP picking process as described in Section 16.6.

4.10.7.1   Exception: Wrong SKU

If the operator sees that the SKU of some or all of the stock is not as described on the LOI screen, the operator flags the Wrong SKU exception.

When the operator presses the Send Away button, WCS places a hold on the stock with the Wrong SKU exception as a reason. The tote will be sent to a QA station for further investigation.

4.10.7.2   Exception: Stock Damaged

If the operator sees that the stock is damaged, the operator flags the Stock Damaged exception.

When the operator presses the Send Away button, WCS places a hold on the stock with the Stock Damaged exception as a reason. The tote will be sent to a QA station for further investigation.

4.11   Stocktake

A suitably-privileged OM user through the standard Location Query, List and Detail screens can request a stocktake to take place in a location or group of locations in the GOH or manual areas of the DC. This can include locations which WCS believes to be empty of stock.

WCS automatically prevents further putaway, picking or retrieval tasks from being started in the selected locations.

A suitably-privileged OM user can cancel all or part of a stocktake request before the stocktake is performed.

4.11.1   Stocktake Process

An operator equipped with a WCS MOI and barcode scanner selects Stocktake. The MOI lists all the aisles in which there is at least one location that the operator can stocktake, taking into account the operator's truck type (if any) and the trucks already in the aisles.

The operator selects one of these aisles.

WCS directs the operator to a specific location, which is the location with the earliest pick walk sequence in the selected aisle that requires a stocktake and that is accessible to the operator.

The operator scans the location barcode. WCS rejects the scan if a stocktake is not required in the scanned location. WCS accepts the scan if a stocktake is required in the scanned location, even if it is not the location to which the operator was directed.

The stocktake process then takes place at the location. The process differs between locations where WCS tracks the individual cases (Section 4.11.1.2) and locations where WCS tracks only the quantities of stock (Section 4.11.1.1).

DEMATIC

When the operator has completed the stocktake process at the location, WCS directs the operator to the next location, which is the location with the earliest pick walk sequence in the aisle that still requires a stocktake and that is accessible to the operator. The operator can exit at any time.

4.11.1.1   Manual Storage & Reserve Locations

WCS tracks individual cases in storage and reserve locations in the manual area of the DC.

After scanning the location barcode, the operator is instructed to scan the LP of each case in the location.

The LOI displays the case LP most recently scanned, along with the number of cases that are expected still to be scanned.

WCS accepts the scan of a known case LP, even if WCS believed that case to be in a different location.

If the operator scans a case LP that is unknown to WCS, the LOI prompts the operator to scan the SKU and the quantity of items in the case.

If the operator scans the same case LP more than once, WCS ignores the duplicate scans.

When the operator has scanned all the cases physically in the location, the operator scans the location barcode. If this is different from the location that the operator initially scanned, the operator is prompted to scan the location barcode again. If this scan is still different from the expected location, WCS disregards all the cases scanned and requires another stocktake in the expected location.

4.11.1.2   GOH, Manual Picking & Indent Locations

WCS tracks the quantity of stock of each SKU in GOH locations and in picking and indent locations in the manual area of the DC. WCS does not track individual LPs.

After scanning the location barcode, the operator is instructed to scan the SKU and enter the quantity of items for all the stock in the location.

The LOI displays the SKU most recently scanned and the quantity, along with the number of items that are expected still to be identified.

If the operator scans the same SKU more than once, WCS accepts the total quantity of items entered each time.

When the operator has identified all the stock physically in the location, the operator scans the location barcode. If this is different from the location that the operator initially scanned, the operator is prompted to scan the location barcode again. If this scan is still different from the expected location, WCS disregards all the cases scanned and requires another stocktake in the expected location.

4.11.2   Stocktake Results

WCS records a stocktake **pass** for each case expected in a location that was successfully identified in the location.

WCS records a stocktake **fail** for each case expected in a location that was not identified in the location. WCS sets the case *missing*.

WCS records a stocktake **fail** for each case expected in a different location that was identified in the location. WCS updates its record of the case's location to be the physical location.

WCS records a stocktake **fail** for each unknown case identified in the location. WCS creates a record for the case and accepts the case's location to be the physical location. If the scanned SKU is known to WCS, WCS sends a Stock Level Adjustment message reporting the increase in stock to the Host.

WCS records a stocktake **pass** for each exact quantity of a SKU expected in a location that was successfully identified in the location.

WCS records a stocktake **fail** if a larger quantity of a SKU was expected in a location than what was successfully identified in the location. WCS accepts the new quantity and sets the discrepant quantity of stock *missing*.

WCS records a stocktake **fail** if a quantity of a SKU was identified in a location where none was expected. WCS creates a stock record for the quantity of the SKU and accepts its location to be the physical location. If the scanned SKU is known to WCS, WCS sends a Stock Level Adjustment message reporting the increase in stock to the Host.

WCS records a stocktake **fail** if a smaller quantity of a SKU was expected in a location than what was successfully identified in the location. WCS accepts the new quantity and sends a Stock Level Adjustment message reporting the increase in stock to the Host.

WCS records a stocktake **pass** for each location that was expected empty of stock and for which no cases or stock were identified in the location.

If the operator scans an unknown SKU barcode when identifying an unexpected case or some unexpected stock in a location, WCS creates a local dummy SKU record for the barcode. An alarm is raised on the OM status bar. It is a manual operation to investigate the location and if necessary trigger the Host to send a SKU Master Update message, creating a record in WCS for the actual SKU. Standard WCS functionality then allows the WCS view of the location contents to be corrected.

4.12   Related Elements

4.12.1   Operations Management Screens

The SKU List screen shows the number of TMs and quantity of stock of each SKU.
The SKU Details screen lists the individual TMs and stock records of a SKU.
The Stock Details screen allows a suitably-privileged user to adjust the stock quantity or hold state of a stock record.
The TM List and TM Details screens allow a suitably-privileged user to request specific TMs be retrieved to a specific QA station.

4.12.2   MOI Functions

The table below shows the MOI functions specific to inventory management.

Function	Description	Menu Level	Section
Stocktake	Used to confirm the contents of a location in GOH or manual areas	Top Level	4.11

4.12.3   LOI Functions

There is no LOI associated with inventory management.

4.12.4   Operational Events

Section 21.2 defines the general format of Operational Events. The table below defines the information that is logged in addition to the standard details for the specific Inventory Management Operational Events.

Event	Trigger	Fields
STOCK_ADJUST_QTY	When a user makes an exceptional adjustment to a quantity of stock (i.e. a write-on or write-off)	TM Id, SKU, Old Quantity, New Quantity, Reason Code
STOCK_HOLD_STATE	When a hold state is set or cleared on a stock record	TM Id, SKU, Hold State, Set/Cleared
TM_MANUAL_REQUEST	When a user manually requests a TM be retrieved	TM Id, Location Id, Destination Id, Move Reason
STOCKTAKE_REQUEST	When a user requests a stocktake be performed in a location	Location Id
STOCKTAKE_PASS	When a case or quantity of stock is confirmed in a location	Location Id, TM Id, SKU, Quantity
STOCKTAKE_FAIL	When a discrepancy regarding a case or quantity of stock is found in a location	Location Id, TM Id, SKU, Expected Quantity, Actual Quantity

4.12.5   Statistics

The table below defines the statistics that are maintained for Inventory Management.

Name	Index	Comments
Stocktake Location Passes	GOH or manual aisle	Incremented once per stocktake performed in a location with no fails
Stocktake Location Fails	GOH or manual aisle	Incremented once per stocktake performed in a location with one or more fails

4.12.6   Alarms and Alerts

The table below defines the alarms and alerts that are associated with inventory management. They are displayed on the WMS Alarms page.

Alarm	Description	Drill Down
Missing stock	Some stock is currently lost in transit	List of stock
Unknown SKU	Unknown SKU barcode scanned during stocktake	List of dummy SKU records

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4.12.7   Configuration Parameters

The table below lists the configuration parameters that are used to control inventory management.

Parameter Name	Function	Values	Section
Missing Stock Gone Hours	Defines the number of hours unseen after which **missing** stock is automatically set **gone**	0..720	4.6.4
Stock Balance Send	Defines whether WCS sends a daily stock balance to the Host	TRUE/FALSE	4.7
Stock Balance Hour	Defines the hour of day at which WCS sends any stock balance to the Host	0..23	4.7
Stock Check Initial Variance	Defines the range higher or lower than the expected quantity within which WCS randomly selects the initial displayed value for a stock check	0..100	4.10.6

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5   TM MOVES

This section covers various move-related functionality that applies generally to the way in which WCS controls TMs which are transported on the conveyor systems or relocated manually.

5.1   SWAP Stations

A SWAP station (SWAP = Scan, Weigh And Profile) is a conveyor location used to weigh and measure the dimensions of each TM passing through it. There is typically a reject station downstream on the conveyor to which any TM which fails appropriate validation is directed.

There are SWAP stations at three locations on the conveyor: on the decant loop, on the finishing line and on the despatch sorter.

5.1.1   Decant Loop SWAP Station

The SWAP station on the decant loop is used to validate totes of stock which have been loaded onto the conveyor at decant stations following the decant process as described in Section 15. Empty totes may also be loaded onto the conveyor at decant stations.

The decant loop SWAP station reports to WCS for each tote passing through it:
- The barcode read on opposite sides of the tote
- Weight of the tote
- Whether the tote passes the profile checks (i.e. that there is no material overhanging the tote or causing it to exceed the maximum permitted height)

WCS accepts the tote provided all of the following are true:
- There are two barcodes, which reference the same valid tote ID
- The two barcodes reference opposite sides of that tote
- The tote need not already be known to WCS. If it is, its current location on WCS must be one from which arrival at a SWAP station is permitted. This means that if a decant operator pushes a tote onto the conveyor without having completed the decant process, the tote is rejected
- The reported weight of the tote does not exceed the maximum permitted
- The reported weight of the tote is within a configurable percentage of that calculated by WCS based on its expected contents
- The tote passes all profile checks

If WCS accepts the tote then it is typically routed towards a specific aisle of the storage multishuttle as described in Section 16.8.3, although if the tote is empty it may be routed towards the empty tote buffer if there is capacity.

If WCS does not accept the tote, it is diverted to the Decant QA station. An operator there decides whether to remove the tote from the conveyor, or to correct the problem and return the tote to the conveyor.

Totes which are returned to the conveyor from the Decant QA station must pass through the SWAP station again for verification.

Any other type of TM passing through the decant loop SWAP station is rejected.

5.1.2   Finishing Line SWAP Station

The SWAP station on the finishing line is used to validate cartons containing picked items before the cartons are lidded and labelled.

The finishing line SWAP station reports to WCS for each pick carton passing through it:
- The barcode read on opposite sides of the carton
- Weight of the carton
- Whether the carton passes the profile checks (i.e. that there is no material overhanging the carton or causing it to exceed the maximum permitted height)

WCS accepts the carton provided all of the following are true:
- There are two barcodes, which reference the same carton ID
- The carton is known to WCS
- Either:
    - All the DUs in the carton are in a state of *picked*, i.e. all the items that should have been picked into it have been picked into it, and it has not yet been lidded, or
    - All the DUs in the carton are in a state of *picked*, each in a satchel, i.e. the carton has previously visited a pack station
- All required despatch paperwork has already been inserted
- The reported weight of the carton does not exceed the maximum permitted
- The carton passes all profile checks

If WCS accepts the carton then it is typically routed towards a specific carton lidder as described in Section 18.6.3, although cartons into which one or more manual picks are to be added are routed towards the despatch sorter reject lane, and a configurable random percentage of cartons can be diverted to the Finishing QA station for checking.

If WCS does not accept the carton, it is diverted to the Finishing QA station. An operator there decides whether to remove the carton from the conveyor, or to correct the problem and return the carton to the conveyor.

Any other type of TM passing through the finishing line SWAP station is rejected.

5.1.3   Despatch Sorter SWAP Station

The SWAP station on the despatch sorter is used to measure labelled pick cartons and full cases before they are diverted onto a despatch lane.

The despatch sorter SWAP station reports to WCS for each TM passing through it:
- The despatch label barcode read on the TM
- Each dimension of the TM
- Weight of the TM

WCS accepts the TM provided the reported barcode is known to WCS and is expected on the despatch sorter. Any case for which the despatch label footer barcode as described in Section 18.4.1 has not yet been scanned is not accepted.

WCS records the dimensions and weight of each TM. WCS does not use the dimensions or weight, or the lack of them, when deciding whether to accept the TM.

If WCS accepts the TM then it is routed towards one of the despatch lanes according to the rules described in Section 19.5. The selected despatch lane may be the reject lane.

If WCS does not accept the TM then it is diverted onto the reject lane. Any pick carton into which one or more manual picks are to be added does not yet have a despatch label and is therefore diverted onto the reject lane.

5.2   TM Flow Control

This section describes how flow is controlled to the various destinations or intermediate flow control points in the automated material flow.

Where an in-transit limit is defined, WCS will not action TM retrievals to a destination which would cause the limit to be exceeded. The limit may be exceeded in circumstances where WCS has no choice other than to make the move, typically non-retrieval moves.

If a TM becomes *missing* (Section 4.6.3) then it no longer counts towards any in-transit limits.

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5.2.1   TM Destinations

When looking for TMs to retrieve from the multishuttles, WCS applies configurable limits to the number of TMs that can be in transit to various destinations. These limits do not prevent TMs from being requested; a requested TM remains in the multishuttle until the number of TMs already in transit to its destination drops below the limit.

Target minimum numbers of TMs in transit to various destinations are also available, to allow the proportion of TMs being retrieved to each destination to be configured. A target minimum value has no effect if there is no TM to be retrieved to that destination.

Destination	Flow Control
Multishuttle aisle infeed	WCS does not send more TMs to a multishuttle aisle than will fit in the appropriate infeed conveyor, unless all available aisles have reached their limit. Any excess TMs routed to an aisle may not be diverted successfully, and will be forced to wait while a new destination is calculated. WCS does not restrict stock totes returning to the storage multishuttle from a GTP station, as the aisle infeed is the only possible destination for the tote
GTP station	Configurable limit defined by parameter *Max Totes To GTP Station* (see Section 16.7.6) for the maximum number of stock totes in transit to each GTP station from the associated storage multishuttle aisle
	Configurable target defined by parameter *Min Totes To GTP Station* for the minimum number of stock totes in transit to each GTP station from the associated storage multishuttle aisle. The aim is to ensure that a GTP station operator is never waiting for work. The target minimum is subject to all maximum limits en route
	Configurable limit for each GTP station for the maximum number of pick cartons in transit to the GTP station from the associated order buffer
	Configurable target defined by parameter *Min Cartons To GTP Station* for the minimum number of pick cartons in transit to each GTP station from the associated order buffer. The aim is to ensure that a GTP station operator is never waiting for work. The target minimum is subject to all maximum limits en route
Product QA station	Configurable limit defined by parameter *Max Totes To Product QA* for the maximum number of stock totes in transit to the Product QA station from the storage multishuttle
	Configurable target defined by parameter *Min Totes To Product QA* for the minimum number of stock totes in transit to the Product QA station from the storage multishuttle. The target minimum is subject to all maximum limits en route
Empty tote buffer	Configurable limit defined by parameter *Max Totes To Empty Tote Buffer* for the maximum number of totes in transit to the empty tote buffer
	Configurable target defined by parameter *Min Totes To Empty Tote Buffer* for the minimum number of totes in transit to the empty tote buffer. The target minimum is subject to all maximum limits en route
GTP – GOH merge	Configurable limit defined by parameter *Max Cartons To GTP GOH Merge* for the maximum number of pick cartons in transit to the GTP – GOH merge area

	Configurable target defined by parameter *Min Cartons To GTP GOH Merge* for the minimum number of pick cartons in transit to the GTP – GOH merge area. The target minimum is subject to all maximum limits en route
Order QA station	Configurable limit defined by parameter *Max Cartons To Order QA* for the maximum number of pick cartons in transit to the Order QA station from the order buffers
	Configurable target defined by parameter *Min Cartons To Order QA* for the minimum number of pick cartons in transit to the Order QA station from the order buffers. The target minimum is subject to all maximum limits en route
Pack station	Configurable limit defined by parameter *Max Cartons To Active Pack Station* for the maximum number of pick cartons in transit to each automated pack station that is in service and where an operator is logged in Configurable (typically lower) limit defined by parameter *Max Cartons To Idle Pack Station* for the maximum number of pick cartons in transit to each automated pack station that is in service and where no operator is logged in
	Configurable target defined by parameter *Min Cartons To Active Pack Station* for the minimum number of pick cartons in transit to each automated pack station that is in service and where an operator is logged in Configurable (typically lower) target defined by parameter *Min Cartons To Idle Pack Station* for the minimum number of pick cartons in transit to each automated pack station that is in service and where no operator is logged in. The target minimums are subject to all maximum limits en route
Finishing line	Configurable limit defined by parameter *Max Cartons To Finishing* for the maximum number of pick cartons in transit to the finishing line, including the Finishing QA station The limit is applied when WCS decides whether to retrieve a carton from the order buffer to the finishing line. The limit does not apply to cartons in transit to the finishing line from an automated pack station, although such cartons are included in the count of cartons already in transit
	Configurable target defined by parameter *Min Cartons To Finishing* for the minimum number of pick cartons in transit to the finishing line, including the Finishing QA station. The target minimum is subject to all maximum limits en route
Relocation	Configurable limit defined by parameter *Max Totes For Relocation* for the maximum number of stock totes in transit from a storage multishuttle aisle onto the main decant loop to recirculate the loop and return to the storage multishuttle
	Configurable target defined by parameter *Min Totes For Relocation* for the minimum number of stock totes in transit from a storage multishuttle aisle onto the main decant loop to recirculate the loop and return to the storage multishuttle. The target minimum is subject to all maximum limits en route
	Configurable limit defined by parameter *Max Cartons For Relocation* for the maximum number of pick cartons in transit from an order buffer aisle onto the

	main order loop to recirculate the loop and return to the order buffer
	Configurable target defined by parameter *Min Cartons For Relocation* for the minimum number of pick cartons in transit from an order buffer aisle onto the main order loop to recirculate the loop and return to the order buffer. The target minimum is subject to all maximum limits en route
Despatch lane	Configurable limit for each despatch lane for the maximum number of TMs in transit to the despatch lane. The limit is applied when WCS decides whether to retrieve a pick carton from the despatch buffer to a despatch lane. The limit does not apply when WCS decides at the despatch sorter SWAP station on the destination despatch lane for a TM that has not been retrieved from the despatch buffer, although such TMs are included in the count of TMs already in transit
	Configurable target defined by parameter *Min TMs To Despatch Lane* for the minimum number of TMs in transit to each despatch lane. The target minimum is subject to all maximum limits en route

5.3   Manual TM Updates

Suitably-privileged users are able to update WCS's knowledge of the location of a TM as follows:

Whenever an LOI user scans the LP of a TM, WCS updates its record of the TM to be at the location specific to that LOI.

An MOI user can scan the LP of a TM and a location barcode so that WCS updates its record of the TM to be at the location.

An MOI user can scan the LP of a TM and the LP of a parent TM so that WCS updates its record of the TM to be in the parent TM.

An OM user can identify a TM to WCS and update the TM record to be at a new location (including setting the TM *missing*).

An OM user can identify a TM to WCS and update the TM record to be in a parent TM.

WCS rejects an attempt to manually update the location of a TM if the TM is already subject to an action or move (e.g. if a carton is in the process of being picked into at a GTP station).

5.4   Related Events

5.4.1   Operations Management Screens

There is a specific OM screen for each location type showing in transit limits and a count of TMs in transit to each.
Standard TM, stock and location OM screens provide the ability to update WCS's knowledge of the location of a TM.

5.4.2   MOI Functions

The table below shows the MOI functions specific to TM moves.

Function	Description	Menu Level	Section

Relocation	Used to manually relocate a TM to either a new location or to a parent TM	Top Level	5.3

5.4.3 LOI Functions

There is no LOI associated with TM moves.

5.4.4 Operational Events

Section 21.2 defines the general format of Operational Events. The table below defines the information that is logged in addition to the standard details for the specific TM Move Events.

Event	Trigger	Fields
TM_LOC_CHANGE	When the location of a TM changes	TM Id, Old location, New location, Move reason

5.4.5 Statistics

The table below defines the statistics that are maintained for TM moves.

Name	Index	Comments
Conveyor Arrivals	Conveyor Location	Incremented once per TM arrival at a conveyor location and handled successfully
Conveyor Rejections	Conveyor Location	Incremented once per TM arrival at a conveyor location and rejected by WCS (e.g. overweight at decant loop SWAP station)
Conveyor Exceptions	Conveyor Location	Incremented once per TM arrival at a conveyor location with insufficient data for WCS to accept or reject (e.g. no barcode read)

5.4.6 Alarms and Alerts

There are no alarms and alerts associated with TM moves.

5.4.7 Configuration Parameters

The table below lists the configuration parameters that are used to control TM moves.

Parameter Name	Function	Values	Section
Max Tote Weight	Defines the maximum weight of a stock tote and its contents allowed into the storage multishuttle	1..100 kg	5.1.1
Empty Tote Weight	Defines the weight of an empty tote to be used when WCS validates the weight of the	1..100 kg	5.1.1

Parameter Name	Function	Values	Section
	contents of a tote		
Decant Weight Tolerance	Defines the maximum percentage discrepancy between the expected and measured weight of a stock tote and its contents to be allowed into the storage multishuttle	1..100	5.1.1
Max Carton Weight	Defines the maximum weight of a pick carton and its contents allowed to be lidded and labelled	1..100 kg	5.1.2
Min Totes To GTP Station	Defines the maximum or target minimum number of TMs in transit to a destination. Described in Section 5.2.1	0..100	5.2.1
Min Cartons To GTP Station			
Max Totes To Product QA			
Min Totes To Product QA			
Max Totes To Empty Tote Buffer			
Min Totes To Empty Tote Buffer			
Max Cartons To GTP GOH Merge			
Min Cartons To GTP GOH Merge			
Max Cartons To Order QA			
Min Cartons To Order QA			
Max Cartons To Active Pack Station			
Max Cartons To Idle Pack Station			
Min Cartons To Active Pack Station			
Min Cartons To Idle Pack Station			
Max Cartons To Finishing			
Min Cartons To Finishing			
Max Totes For Relocation			
Min Totes For Relocation			
Max Cartons For Relocation			
Min Cartons For Relocation			

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Parameter Name	Function	Values	Section
Min TMs To Despatch Lane			

6 RECEIVING STOCK

This section describes how stock is received into the warehouse by WCS.

6.1 Inbound Stock Pre-Notification

All incoming stock is pre-notified to WCS. The Host sends a Purchase Order (PO) for each incoming container in advance of the goods being unloaded.

As it is theoretically possible for more than one client to use the same pre-advice reference to refer to different POs, the unique identifier for each PO within WCS is a combination of the client and pre-advice reference.

The PO contains a separate line for each SKU specifying the expected quantity to be received.

6.1.1 Reconciliation Against Purchase Order

The PO specifies the expected quantity for each SKU within a delivery. When stock is booked in, WCS checks that the quantity of the SKU is expected on one of the outstanding POs.

6.1.1.1 Under Receiving

The quantity received can be less than the pre-advised quantity on the PO. Only the quantity that was actually received is reported back to the Host.

6.1.1.2 Over Receiving

Over receipt against a PO is allowed provided the additional quantity is less than the configured tolerance level defined by the configuration parameter, *Over Receipt Perc Tolerance*.

6.1.1.3 No Purchase Order

It is not possible to receive stock if there is no corresponding PO.

6.1.2 New SKUs

When the Host sends SKU details to WCS for a new SKU, a flag in the message indicates if an item of the SKU needs to be measured by the Cubiscan machine. WCS uses this information to ensure that items requiring measuring are built onto a separate pallet/trolley.
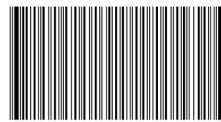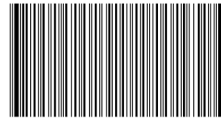
6.1.3 Receiving Paperwork

The receiving process requires the SKU barcode to be scanned for each received SKU. Some cases do not have the SKU barcode printed on the outside of the case. In order to help the receiving process, WCS provides the functionality for the printing of a Barcode Receiver Report which can be used to help the receiving process.

6.1.3.1 Printing the Report

The Barcode Receiver Report for a PO can be manually printed from the OM View Delivery screen.

6.1.3.2 Report Content

DEMATIC

	Barcode Receiver Report	**25 Nov 2016**

| **Pre-Advice Ref** | ABC12345 | |||||||||

Client	SFG	**Due Date**	26 Oct 2017
Supplier Name	A Supplier	**Shipment Ref**	ABC123XY
No of Lines	5		

Line Id	SKU Id	Description	Garment Type	Quantity	Supplier Code	Category	Barcode	Cubiscan	Storage Destination
1	XXX123	Red Dress	BOX	20	A1	Gold		No	VNA
7	XXX123	Red Dress	BOX	5	A1	Gold		No	Steaming
2	YYY456	Blue Skirt	GOH	10	A1	Gold		Yes	GOH
3	ZZZ888	Ratio Pack Z8	BOX	5	A2	Silver		No	Indent

etc…

The Barcode Receiver Report identifies the PO in the report header and then lists a separate line for each PO line. The following information is printed for each PO line:

- PO Line No
- SKU ID
- SKU description
- Garment Type (Hanging / Flat / Future Hanging)
- Expected Quantity
- Supplier Code
- Supplier Category
- Scannable SKU Barcode
- Cubiscan indicator (Yes / No; Yes indicates that one item of the SKU needs to be sent to Cubiscan)
- Storage Destination (VNA / Decant / Wide Aisle / Steaming)

The lines on the report are sorted by SKU ID by default.

6.2   Receipt of Boxed Stock

Boxed stock is received against the pre-advised details and built onto a pallet. All cases are uniquely barcoded as part of the receiving process and are then built onto a pallet. Once the pallet is complete, it is handed over for tramming and storage.

6.2.1   Equipment Used

The operator uses a hand-held RF device to drive the receipt and pallet build process. Barcoded labels are taken from a pre-printed roll of unique label barcodes.

6.2.2   Box Pre-Sort

As part of the container unloading process, cases are manually sorted according to their planned destination. This process is entirely manual although the Barcode Receiver Report indicates the expected storage destination for each SKU to help the operators. There is no data entry into WCS as part of this manual process.

6.2.3   Case Labelling and Pallet Building

Pallet building is a manual process. The operator is responsible for deciding whether to build single-SKU or multi-SKU pallets (based on the number of cases of one SKU that have been received). The operator also decides which SKUs to mix on a multi-SKU pallet and how tall to build the pallet.

6.2.3.1   Starting a Pallet

The operator must select the pallet type to be built to start the process. A pallet may be any of the following types:

- Cubiscan
- Decant
- Steaming
- VNA storage
- Wide-Aisle storage

Once the pallet type has been selected, the operator must scan the pallet licence plate. The pallet can be a new pallet or can be a part-built pallet that has previously been parked. If the pallet is a part-built pallet, it must be of the same type as the operator has decided to build.

6.2.3.2   Adding Cases to the Pallet

Each received case has a unique barcode label applied and associated with the box.

The operator is prompted to scan the SKU barcode of each case. If the case has a printed SKU barcode, this is scanned. If the case does not have a printed SKU barcode, the barcode on the relevant line of the Barcode Receiver Report is scanned.

When the case label has been associated with the SKU, the operator is prompted to enter the quantity that is in the case.

If the entered quantity is greater than the configured tolerance, a warning is displayed and the operator is prompted to confirm the actual received quantity (by re-typing the value).

6.2.3.3   Pallet Build Restrictions

There are some restrictions on which SKUs can be built on the same pallet. WCS prevents the mixing of restricted SKUs (e.g. SKUs for different clients) by displaying an error message if an attempt is made to mix restricted SKUs.

6.2.4   Instruction Sequence

The flowchart below shows the main instruction sequence for receiving boxed stock and building pallets. Some error conditions are not shown but are described in the following text.

DEMATIC

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START (log on) → Select 'Boxed Receiving'

Select 'Boxed Receiving' → Prompt to enter unique pre-advice ref

Prompt to enter unique pre-advice ref → Shipment has unreceived boxes?

Shipment has unreceived boxes? — no → Display error message

Display error message → (back to Prompt to enter unique pre-advice ref)

Shipment has unreceived boxes? — yes → Prompt for pallet type to be built

Prompt for pallet type to be built → Select pallet type from list

Select pallet type from list → Prompt to scan pallet licence plate

Prompt to scan pallet licence plate → Scan destination pallet

Scan destination pallet → Prompt to scan a case

Prompt to scan a case → Scan stock case / Complete pallet

Scan stock case → Case OK for pallet?

Case OK for pallet? — no → Display error message → (back to Scan stock case)

Case OK for pallet? — yes → Prompt to place case on pallet

Prompt to place case on pallet → WCS adds case to pallet → (back to Prompt to scan a case)

Complete pallet → Is pallet full?

Is pallet full? — yes → Prompt to scan pallet

Is pallet full? — no → Park pallet

Prompt to scan pallet → Prompt for pallet height → Pallet ready for tramming → FINISH (log off)

Park pallet → (back to Prompt to scan a case) / FINISH (log off)

Key:

Operator action / decision

WCS action / decision

MOI action / display

FINISH (log off)

6.2.4.1   Error Reporting

An error message is displayed in the following situations:

- The scanned SKU is not on the pre-advice list.
- The scanned SKU is not a boxed product.
- The scanned case label is not in the correct range for a case label.
- The scanned case label is already in use.
- An attempt is made to place a case onto a pallet for a client that is different from the other cases already on the pallet.
- An attempt is made to place a case of a different product type onto a part-built pallet. (e.g. adding indent to a replen pallet).

6.2.4.2   Pallet Completion

The operator can declare a pallet to be full at any time. When a pallet is declared to be full, the operator is prompted to confirm the pallet height by selecting from a list. The only valid pallets are 1.2m and 0.9m. A pallet that is less than 0.9m high is considered to be 0.9m high. Similarly, a pallet that is between 0.9m and 1.2m is considered to be 1.2m high.

6.2.4.3   Parking a Pallet

Sometimes, an operator may finish working on a pallet but decide that it is not full (e.g. a part-built Cubiscan pallet to which more cases could be added from another delivery). In this situation, the operator declares the pallet to be 'parked'.

Further receipts can be built onto a parked pallet as part of the normal pallet build process.

6.2.5   Indent Receiving

Indent receiving is similar to boxed receiving in that a number of cases are built onto a pallet. However, indent pallets are always single-SKU and the individual cases are not uniquely barcoded.

The operator must scan the destination pallet and the SKU barcode and then confirm the number of cases that have been built onto the pallet.

DEMATIC

DAI

START (log on) → Select 'Indent Receiving'

Select 'Indent Receiving' → Prompt to enter unique pre-advice ref

Prompt to enter unique pre-advice ref → Shipment has unreceived boxes?

Shipment has unreceived boxes? — no → Display error message → (back to Prompt to enter unique pre-advice ref)

Shipment has unreceived boxes? — yes → Prompt to scan a new pallet

Prompt to scan a new pallet → Scan pallet label

Scan pallet label → SKU needs Cubiscan?

SKU needs Cubiscan? — yes → Display 'Cubiscan reminder' → Scan SKU barcode

SKU needs Cubiscan? — no → Scan SKU barcode

Scan SKU barcode → Valid SKU?

Valid SKU? — no → Display error message → (back to Scan SKU barcode)

Valid SKU? — yes → Prompt for case quantity

Prompt for case quantity → Pallet ready for tramming

Pallet ready for tramming → More pallets on receipt?

More pallets on receipt? — yes → (back to Prompt to scan a new pallet)

More pallets on receipt? — no → FINISH (log off)

Key:

Operator action / decision

WCS action / decision

MOI action / display

6.2.5.1   Indent SKUs Requiring Cubiscan

Occasionally, indent SKUs may need to be measured at the Cubiscan although this is not usually the case. When the SKU barcode is scanned, if the SKU needs to be checked at Cubiscan, a message is displayed to inform the operator that a case of the SKU needs to be checked at Cubiscan. A case of the SKU is not built onto a separate Cubiscan pallet because the indent cases are not barcoded and therefore cannot be tracked.

6.3   Receipt of GOH Stock

The GOH receipt process is similar to boxed receiving. A quantity of items of the same SKU are scanned onto uniquely barcoded bins (the equivalent of a boxed case). The bins are then loaded onto GOH trolleys for transport to storage as part of the putaway process.

6.3.1   Equipment Used

The operator uses a hand-held RF device to drive the receipt and assignment to bin process. Barcoded labels are taken from a pre-printed roll of unique label barcodes.

6.3.2   Bin Labelling and Quantity Entry

Each received bin has a unique barcode label applied and associated with the bin. This can be done as part of the receiving/unloading process or as part of the trolley build process.

The operator is prompted to scan the SKU barcode of each SKU. If the item has a printed SKU barcode, this is scanned. If the item does not have a printed SKU barcode, the barcode on the relevant line of the Barcode Receiver Report is scanned.

When the bin label has been associated with the SKU, the operator is prompted to enter the quantity that is in the bin.

If the entered quantity is greater than the configured tolerance, a warning is displayed and the operator is prompted to confirm the actual received quantity (by re-typing the value).

DEMATIC

DAI

Flowchart:

START (log on) → Select 'GOH Receiving'

Select 'GOH Receiving' → Prompt to enter unique pre-advice ref

Prompt to enter unique pre-advice ref → Shipment has unreceived GOH SKU?

Shipment has unreceived GOH SKU? — no → Display error message → (back to Prompt to enter unique pre-advice ref)

Shipment has unreceived GOH SKU? — yes → Prompt to scan a SKU barcode

Prompt to scan a SKU barcode → Scan SKU (or paperwork) barcode

Scan SKU (or paperwork) barcode → SKU on receipt?

SKU on receipt? — no → Display error message → (back to Prompt to scan a SKU barcode)

SKU on receipt? — yes → Manually apply and scan bin label

Manually apply and scan bin label → Bin label OK?

Bin label OK? — no → Display error message → (back to Manually apply and scan bin label)

Bin label OK? — yes → Prompt to enter quantity in bin

Prompt to enter quantity in bin → Enter quantity in bin

Enter quantity in bin → Quantity valid?

Quantity valid? — no → Display error message → (back to Enter quantity in bin)

Quantity valid? — yes → FINISH (log off) / (back to Prompt to scan a SKU barcode)

Key:
- Operator action / decision
- WCS action / decision
- MOI action / display

6.3.2.1 Error Reporting

An error message is displayed in the following situations:

- The scanned SKU is not on the pre-advice list.
- The scanned SKU is not a GOH product.
- The scanned bin label is not in the correct range for a bin label.
- The scanned bin label is already in use.

6.4 Handover to Putaway

A pallet is eligible for putaway once it has been closed and becomes available on the tramming dialogue for a trammer to collect. A pallet can be stored before the entire PO has been received.

Similarly, a GOH bin is eligible for putaway once it has been closed and can be stored before the entire PO has been received.

Note, however, that stored stock is not available for picking until the PO line against which it was received has been closed.

6.4.1 PO Receipt Summary Report

A PO Receipt Summary Report can be printed for a PO at any time from the OM View Delivery screen. This report shows the following information for the requested PO:

- SKU
- Quantity Expected
- Quantity Received
- PO Line Status (Open / Closed)

6.5 Closing POs

PO lines are always manually closed on WCS, via the OM View Delivery screen. When a PO line is closed, a confirmation message is triggered to the Host indicating the quantity received for the PO line, taking into account any exceptional adjustment to the *incoming* stock as described in Section 4.7.2.

Once a PO line has been closed, no further receipt of stock is accepted against the PO line.

When all lines on a PO have been closed, the overall PO is also automatically closed.

6.6 Related Elements

6.6.1 Operations Management Screens

There is a specific OM screen showing all details of a PO. This screen is used to print the Barcode Receiver Report and the PO Receipt Summary Report. Individual PO lines can also be closed from this screen.

6.6.2 MOI Functions

The table below shows the MOI functions specific to Cubiscan.

Function	Description	Menu Level	Section

Boxed Receiving	Used to receive boxed stock against a PO	Receiving	6.2
Indent Receiving	Used to receive indent stock and build an indent pallet	Receiving	6.2.5
GOH Receiving	Used to receive GOH stock against a PO	Receiving	6.3

6.6.3 LOI Functions

There is no LOI at Receiving.

6.6.4 Operational Events

Section 21.2 defines the general format of Operational Events. The table below defines the information that is logged in addition to the standard details for the specific Receiving Operational Events.

Event	Trigger	Fields
RCV_CREATE_CASE	When a case has been received against a PO	Case Id, SKU, Quantity in Case, PO Ref
RCV_CREATE_BIN	When a GOH bin has been received against a PO	Bin Id, SKU, Quantity in Bin, PO Ref
RCV_CREATE_INDENT	When an indent pallet has been received against a PO	Pallet Id, SKU, No of Cases on Pallet, PO Ref
RCV_PALLET_ADD	When a received case has been added to a pallet	Pallet Id, Case Id
RCV_PALLET_CLOSE	When a pallet is closed at receiving	Pallet Id

6.6.5 Statistics

The table below defines the statistics that are maintained for Receiving.

Name	Index	Comments
Cases Received	1	Incremented when a case is received.
Bins Received	1	Incremented when a bin is received.
Pallets Built	1	Incremented when a pallet is closed at receiving

6.6.6 Alarms and Alerts

The table below defines the alarms and alerts that are associated with the Receiving process. They are displayed on the WCS Alarms page.

Alarm	Description	Drill Down
PO Not Closed	A started PO has not been closed within *PO Not Closed Hours* (configurable)	To a list of the specific PO(s)
Stock Not Put Away	Received stock (pallets/trolleys) has not been stored within *Stock Not Put Away Hours* (configurable)	To a list of the specific pallets / trolleys

6.6.7 Configuration Parameters

The table below lists the configuration parameters that are used to control the Cubiscan process.

Parameter Name	Function	Values	Section
Over Receipt Perc Tolerance	Defines the percentage of a per-notified receipt that can be received in addition to the advised quantity	0..1000	6.1.1.2
PO Not Closed Hours	Defines the number of hours after which alarm *PO Not Closed* is displayed	1..168	6.6.6
Stock Not Put Away Hours	Defines the number of hours after which alarm *Stock Not Put Away* is displayed	1..168	6.6.6

DEMATIC

7 CUBISCAN OPERATION

This section describes the WCS-related elements of the operation at Cubiscan. Whilst the process of capturing the Cubiscan data for a SKU is outside the control of WCS, the delivery of pallets to Cubiscan and the building of pallets to take away from Cubiscan are under WCS control.

7.1 Delivery of Pallets to Cubiscan

Multi-SKU pallets containing one case of each new SKU are built at Receiving (under Host control) and are trammed to Cubiscan under WCS control (see section 8).

On delivery to Cubiscan, the cases are disassociated from the pallet and are considered to have a location of 'Cubiscan'. The pallet is deleted from WCS on delivery.

7.2 Cubiscan Operation (Not Under WCS Control)

The Cubiscan operation is not under WCS control. However, it is documented here for completeness.

One case of each new SKU is delivered to Cubiscan for the item dimensions and weight to be measured. Once the data has been captured, it is transmitted to the Host.

On receipt of the dimension data from Cubiscan, the Host transmits the information to WCS by sending a SKU Master Update (SMU) message. Provided the information sent is acceptable, WCS clears the 'new product' flag held against the SKU.

7.3 Pallet Building of Scanned SKUs

After a SKU has been checked, the item is returned to the case and the case is built onto a multi-SKU pallet for putaway.

7.3.1 Equipment Used

The operator uses a hand-held RF device to drive the pallet build process.

7.3.2 Build Process

Cases which have completed their processing at Cubiscan are sent to one of two destinations:

- Cases of SKUs which will be picked in GTP are sent to Decant for input into the multishuttle.
- Cases of SKUs which must be picked from manual locations (i.e. LSS) are sent to manual storage.

WCS maintains two logical pallets at Cubiscan – one for each of the above destinations. A pallet is always scanned before the first case is placed on it. The operator is responsible for deciding when a pallet is full and for recording the pallet height.

7.3.3 Instruction Sequence

The flowchart below shows the main instruction sequence for building pallets.

DEMATIC

DAI

Flowchart:

START (log on) → Select 'Cubiscan Pallet Build' → Prompt to scan a case

Prompt to scan a case branches to:
- Scan stock case
- Declare pallet full

Scan stock case → Cubiscan data rcvd for SKU?
- no → Reject case scan → (back to Prompt to scan a case)
- yes → GTP SKU?
  - no → Is there a manual area pallet?
    - no → Scan manual area pallet → Prompt to place case on manual pallet
    - (yes) → Prompt to place case on manual pallet
    - Prompt to place case on manual pallet → WCS adds case to manual pallet → (back to Prompt to scan a case)
  - yes → Is there a GTP pallet?
    - no → Scan GTP pallet → Prompt to place case on GTP pallet
    - (yes) → Prompt to place case on GTP pallet
    - Prompt to place case on GTP pallet → WCS adds case to GTP pallet → (back to Prompt to scan a case)

Declare pallet full → Prompt to scan pallet → Manual pallet?
- no → Pallet ready for tramming
- yes → Prompt for pallet height → Pallet ready for tramming
- Pallet ready for tramming → FINISH (log off)
- Pallet ready for tramming → (back to Prompt to scan a case)

Key:
- Operator action / decision
- WCS action / decision
- MOI action / display

7.3.4   Pallet Build Completion

A pallet may be declared to be full at any time by selection of an on-screen 'Pallet Full' button. The operator is prompted to scan the pallet barcode. If the pallet is a manual storage pallet, the operator is prompted to select the pallet height.

7.3.5   Pallet Build Exceptions

A number of exceptions are handled during the pallet build process.

7.3.5.1   Pallet Already In Use

If the pallet scanned is already in use in the warehouse, the operator is told that the pallet is already in use and prompted to scan a new pallet.

7.3.5.2   Pallet Unsuitable

If a new GTP pallet is required but the current manual area pallet is scanned, or vice versa, the operator is told that the pallet is unsuitable.

7.3.5.3   SKU Not Cubiscanned

If the Cubiscan data for a SKU has not been received when a case of the SKU is scanned, the operator is told that the SKU is not complete and the case is rejected.

7.4   Hanging Garments

GOH stock also has access to Cubiscan. Items are manually scanned outside the control of WCS. Delivery to and return from hanging Cubiscan is also outside the control of WCS.

7.5   Related Elements

7.5.1   Operations Management Screens

There is a specific OM screen showing the current volume of work (in cases) at Cubiscan. The current part-built pallets are also shown.

7.5.2   MOI Functions

The table below shows the MOI functions specific to Cubiscan.

Function	Description	Menu Level	Section
Cubiscan Pallet Build	Used to build a pallet at Cubiscan	Top Level	7.3.3

7.5.3   LOI Functions

There is no LOI at Cubiscan.

7.5.4   Operational Events

Section 21.2 defines the general format of Operational Events. The table below defines the information that is logged in addition to the standard details for the specific Cubiscan Operational Events.

DEMATIC

Event	Trigger	Fields
CUB_CREATE	When a new Cubiscan pallet has been started.	Pallet Id, Pallet Type
CUB_ADD	When a case has been added to a Cubiscan pallet.	Pallet Id, Case Id, SKU, Quantity
CUB_COMPLETE	When a Cubiscan pallet has been closed	Pallet Id, Height

7.5.5 Statistics

The table below defines the statistics that are maintained for Cubiscan.

Name	Index	Comments
Cases Added	Pallet Type (GTP/Manual)	
Pallets Built	Pallet Type (GTP/Manual)	

7.5.6 Alarms and Alerts

The table below defines the alarms and alerts that are associated with the Cubiscan process. They are displayed on the WCS Alarms page.

Alarm	Description	Drill Down
Cubiscan Overdue	A SKU has not been returned from Cubiscan within *Cubiscan Overdue Hours* (configurable) of it being delivered there.	To a list of the specific SKUs
Stored Stock Requires Cubiscan	There is stock stored of a SKU for which WCS requires Cubiscan dimensions, and there is no stock of the SKU at or in transit to Cubiscan	To a list of the specific SKUs

7.5.7 Configuration Parameters

The table below lists the configuration parameters that are used to control the Cubiscan process.

Parameter Name	Function	Values	Section
Cubiscan Overdue Hours	Defines the number of hours after which alarm *Cubiscan Overdue* is displayed	1..168	7.5.6

DEMATIC

8 TRAMMING

Tramming is the process of transporting stock between storage and processing areas of the DC. There is no equivalent tramming process for hanging goods.

There are three types of tramming movement – inbound, replenishment and outbound. These are described in the following sections.

8.1 Inbound Tramming Flows

The diagram below shows the inbound tramming flows from receiving to storage.

Inbound Tramming Flows
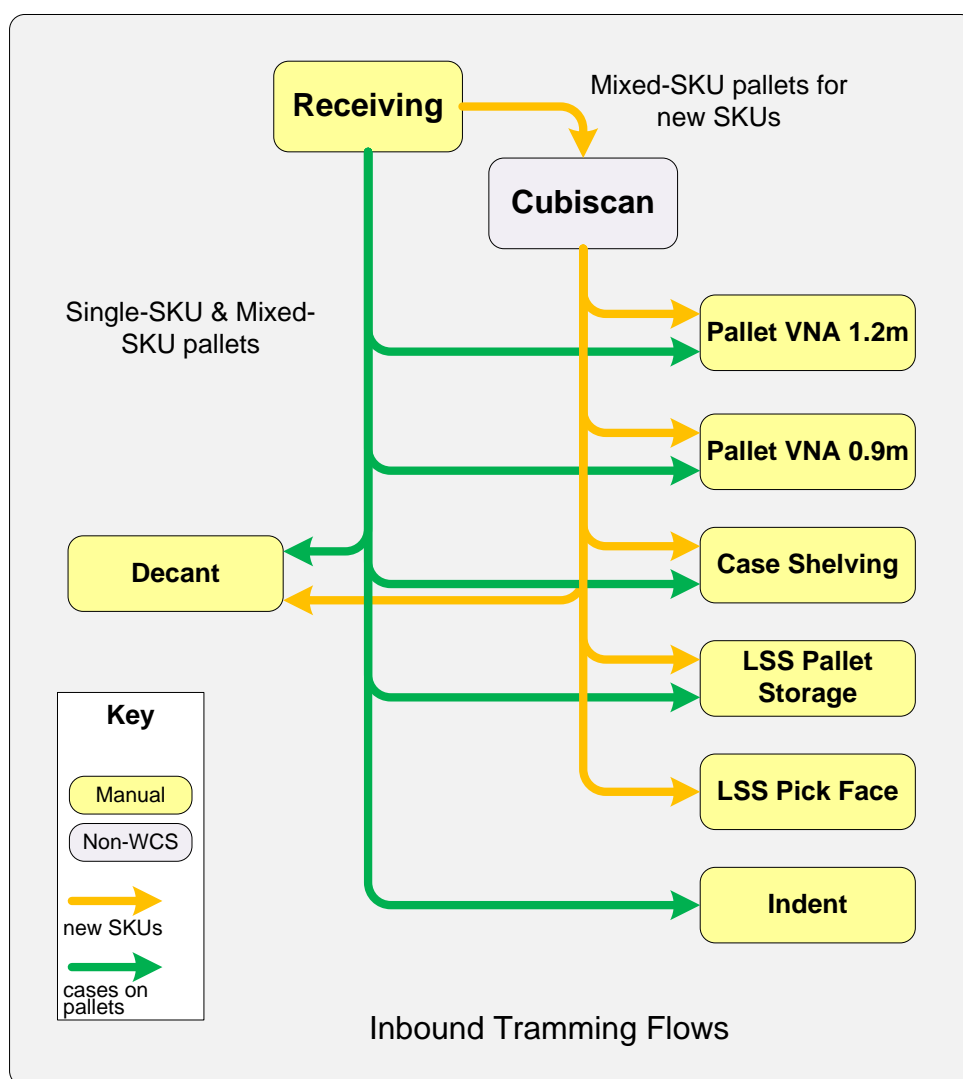
8.1.1 Selection of Inbound Tramming Destination

WCS automatically selects the storage area for a pallet based on its contents by applying the following selection rules in the following sequence:

- If the pallet has been flagged for Cubiscan on receipt, it is sent to Cubiscan.

- If the pallet contains Indent product, it is sent to a storage area which contains available locations which have been configured to store Indent.

- If the pallet contains only SKUs for which there is replenishment demand in the multishuttle, the pallet is sent to Decant.

- If the pallet contains a single SKU and is over 0.9m in height, it is sent to Pallet VNA 1.2m.

- If the pallet contains a single SKU and is less than 0.9m in height, it is sent to Pallet VNA 0.9m.

- If the pallet contains nonmechable SKU(s) and there is an available storage location in LSS Reserve Pallet Storage, it is sent to that area.

- If the pallet contains multiple SKUs, the storage destination is determined based on the number of SKUs on the pallet.

  o If the number of SKUs on the pallet is fewer than or equal to *Max Mixed SKUs for VNA Pallet* (configurable) and the pallet is over 0.9m in height, it is sent to Pallet VNA 1.2m.
  o If the number of SKUs on the pallet is fewer than or equal to *Max Mixed SKUs for VNA Pallet* (configurable) and the pallet is less than or equal to 0.9m in height, it is sent to Pallet VNA 0.9m.
  o If the number of SKUs on the pallet is greater than *Max Mixed SKUs for VNA Pallet* (configurable), the pallet is sent to Case Shelving.

8.2   Replenishment Tramming Flows

The diagram below shows the replenishment tramming flows within the warehouse.

Replenishment Tramming Flows
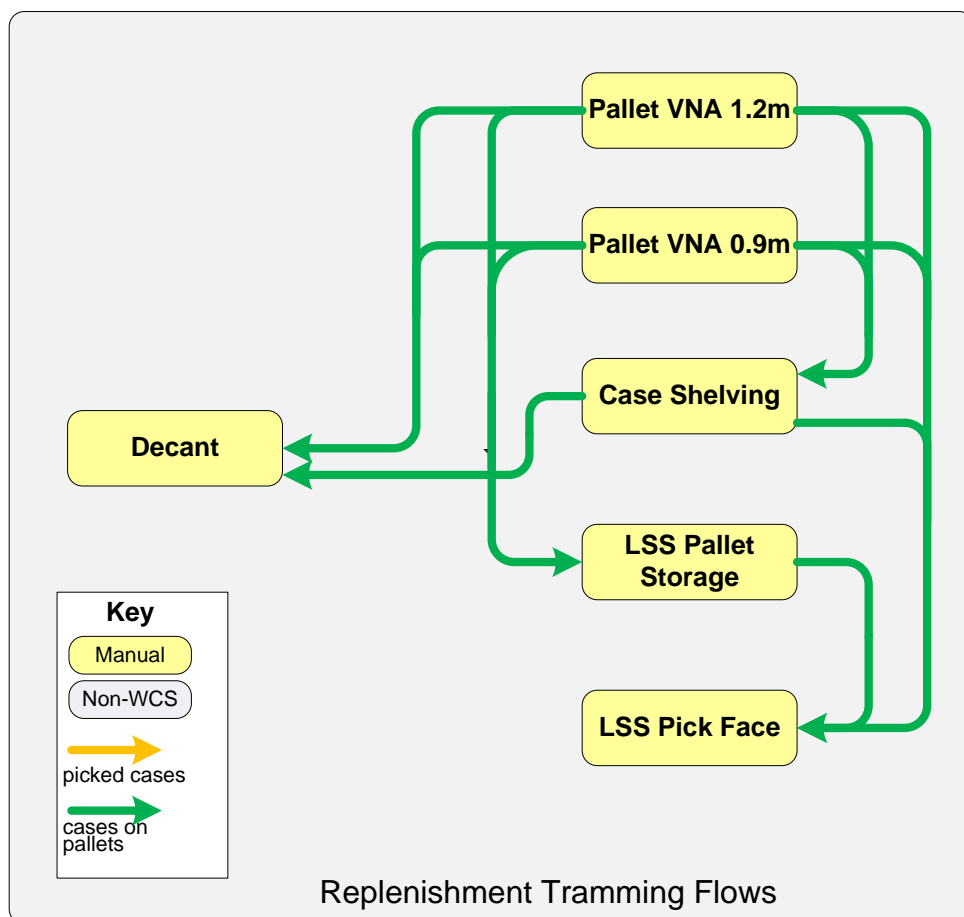
8.2.1   Selection of Replenishment Tramming Destination

Replenishment moves are always created in response to pick location demand in a pick area. The replenishment destination is selected as part of the replenishment move creation (e.g. a replenishment move for a GTP SKU always has a destination of Decant).

8.3   Outbound Tramming Flows

The diagram below shows the outbound tramming flows within the warehouse.

Outbound Tramming Flows
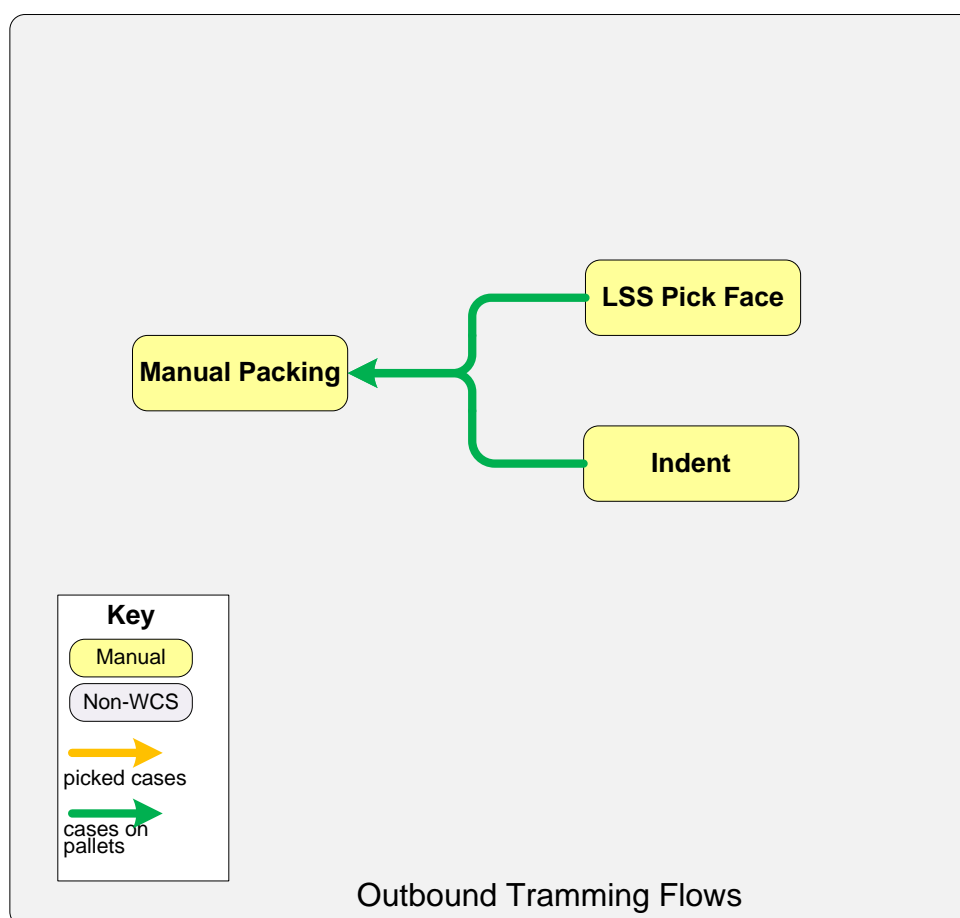
8.4   Tramming Locations

The table below shows the locations from which a trammer may pick up a pallet.

Area	Location	Location Type
Receiving	Floor – any pallet	Trammer Selected
Cubiscan	Floor – any pallet	Trammer Selected
Pallet VNA 1.2m	Specific P&D	WCS Selected
Pallet VNA 0.9m	Specific P&D	WCS Selected
Case Shelving	Specific P&D	WCS Selected
LSS Pick location	Specific P&D	WCS Selected
Indent	Specific P&D	WCS Selected

8.4.1   Location Types

There are two tramming location types: 'Trammer Selected' and 'WCS Selected'. At a Trammer Selected location, the trammer is not instructed to pick up a specific pallet. The trammer may select any pallet. At a WCS Selected location, the trammer is directed to a specific pallet. This is usually because there is only one pallet at these locations.

8.5 Tramming Destinations

The specific destination for a tramming moves depends on the destination area and the type of truck being used.

8.5.1 Aisles Requiring Specialist Access Equipment

If the destination area is Pallet VNA 1.2m, Pallet VNA 0.9m or Case Shelving, the destination location is always the P&D location for destination aisle.

8.5.2 Pallet Racking Areas

If the destination area is LSS Pallet Storage or Indent and the truck type being used is capable of accessing the specific destination rack location, the destination location is the rack location. If the truck type is not capable of accessing the specific destination rack location, the destination location is the P&D location for the destination aisle.

8.5.3 Decant

For moves to a specific decant station, the destination is a specific pallet position (1 or 2) within the decant station.

For moves to a decant pallet P&D location, the destination is a specific location.

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8.6 Tramming Control

8.6.1 Tramming Operation Overview
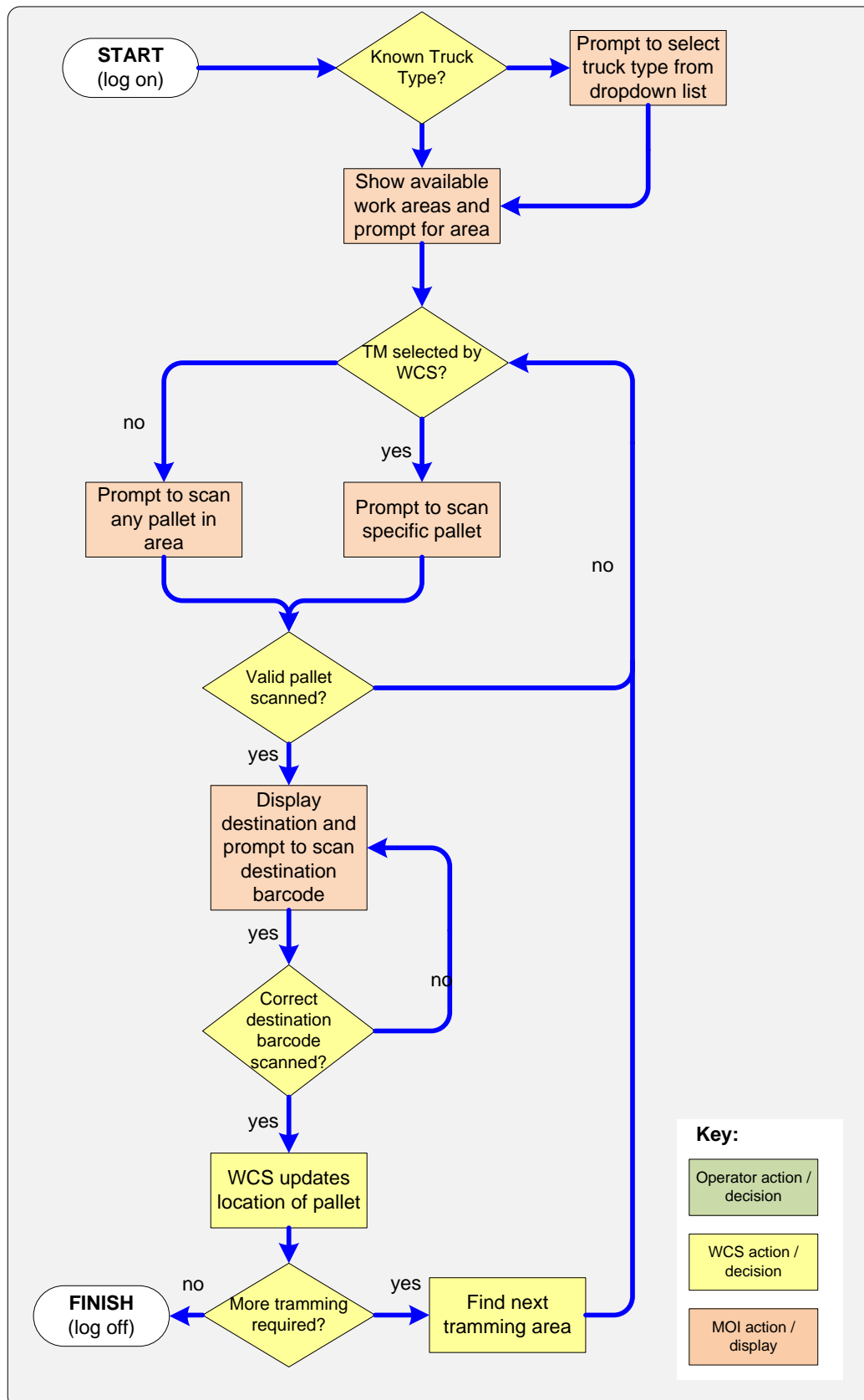
8.6.2   Equipment Used

The operator uses an RF device appropriate to the truck type to drive the tramming process (see section 2.12).

8.6.3   Instruction Sequence

8.6.3.1   Logging On

A tramming operator must log on to an RF device to start the tramming operation. If it is a device which has been configured with a fixed IP address and the device has been configured to be on a specific truck type, this determines the areas where the operator can work.

If the device is not associated with a known truck type, the operator is prompted to select the current truck type to allow WCS to restrict the tramming operator to those areas where the truck can work.

8.6.3.2   Selection of Initial Work Area

The initial work area for a trammer is selected by the trammer as WCS has no knowledge of the initial location of the trammer. After logging on and entering the truck type (if necessary), WCS shows those areas where the truck is allowed to work, provided there is currently some tramming work to be performed. If there is no available work in a valid area for the truck, the area is not shown.

The trammer must select the initial area where a pallet is going to be picked up.

8.6.3.3   Selection of Pallet

Once a work area has been allocated, WCS either requests that a specific pallet be picked up or may request that any pallet within the area is picked up. This depends on the type of work area (see section 8.4.1).

For a trammer selected area (receiving / Cubiscan), any pallet can be scanned.

For a WCS selected area, WCS selects the pallet which has the highest move priority and indicates this to the operator. If there is more than one pallet with the same move priority, the pallet that has been waiting for longest is selected. The requested pallet should be scanned by the operator.

8.6.3.4   Scanning of Pallet

When the pallet barcode has been scanned, WCS displays the required destination of the pallet and prompts the trammer to deliver the pallet to the location and scan the location barcode to confirm delivery.

8.6.3.5   Confirmation of Pallet Delivery

The trammer must scan the location barcode of the required destination to confirm delivery. If the wrong barcode is scanned, the trammer is re-prompted to go to the correct destination.

When pallets are delivered to specific decant stations, the trammer must scan the barcode of the decant pallet position to confirm delivery.

DEMATIC   DAI

8.6.3.6   Overriding the Destination

A trammer may override the requested destination for a pallet by selecting the 'Exception' function on the RF device and then selecting 'Override Delivery'. The trammer is then prompted to take the pallet to a new destination and scan the barcode of the location.

If the scanned location is valid for delivery of the pallet, the pallet's location is updated.

If the scanned location is not valid for delivery of the pallet (e.g. Cubiscan pallet delivered to storage), an error message is displayed and the trammer is re-prompted to deliver to the original WCS-selected destination.

8.6.3.7   Selection of Next Pick-Up Location

Following confirmation of pallet delivery, WCS selects the next pick-up location for the trammer. The closest location to the trammer's last drop location is selected, provided there is a pallet awaiting tramming.

The relative position of each tramming area in relation to each other is configurable. An example of the configuration is given below although this may need refining when the true distances are known.

Area	Receiving	Cubiscan	Manual Aisles North	Manual Aisles South	Decant
Receiving	0	1	2	10	4
Cubiscan	1	0	1	9	7
Manual Aisles North	2	1	0	8	5
Manual Aisles South	10	9	8	0	1
Decant	4	7	6	1	0

8.6.3.8   Overriding the Next Pick-Up

Whilst the trammer is always prompted to pick up the next pallet from a specific WCS-selected area, the trammer can override this by scanning a different pallet in a different area.

If the pallet scanned is awaiting a tramming move, the pick-up is accepted.

If the pallet scanned is not awaiting a tramming move, an error message is displayed and the operator is prompted to pick up a pallet from the next WCS-selected location.

8.7   Tramming Exceptions

8.7.1   Unknown Pallet Scanned

If the pallet scanned by the operator is unknown to WCS, an error message is displayed and the operator is re-prompted to scan a pallet to start the tramming move.

8.7.2   Wrong Pallet Scanned

As WCS allows the operator to override pick-up instructions (see section 8.6.3.8), there is no exception if the 'wrong' pallet is scanned.

8.7.3 Wrong Destination Location Scanned

As WCS allows the operator to deliver to a different destination than that prompted (see section 8.6.3.6), there is no exception associated with scanning a different destination barcode to that prompted.

8.8 Related Elements

8.8.1 Operations Management Screens

The Tramming Workload screen shows the number of pallets awaiting tramming, by pick-up location and destination. The time when the pallet became eligible for tramming is also shown.

8.8.2 MOI Functions

The table below shows the MOI functions specific to Cubiscan.

Function	Description	Menu Level	Section
Tramming	Used to instruct tramming movements	Top Level	8.6.3
Exception	Handles tramming exceptions	Tramming	8.6.3.6
Override Delivery	Allows a pallet to be delivered to an alternative destination, if valid	Exception	8.6.3.6

8.8.3 LOI Functions

There is no LOI associated with tramming.

8.8.4 Operational Events

Section 21.2 defines the general format of Operational Events. The table below defines the information that is logged in addition to the standard details for the specific Tramming Operational Events.

Event	Trigger	Fields
TRAM_DELIVER	When a pallet has been delivered	Pallet Id, Location
TRAM_OVERRIDE_DEST	When a pallet has been delivered to a trammer-selected location	Pallet Id, Actual Location, Required Location
TRAM_OVERRIDE_PICK UP	When a trammer has picked up a pallet other than the one instructed	Pallet Id, Actual Location, Required Location

8.8.5 Statistics

The table below defines the statistics that are maintained for Tramming.

Name	Index	Comments
TRAM_PICKUP_LOC	Pick-Up Location	
TRAM_DROPDOWN_LOC	Dropdown Location	

8.8.6 Alarms and Alerts

The table below defines the alarms and alerts that are associated with the Tramming process. They are displayed on the WCS Alarms page.

Alarm	Description	Drill Down
No Tramming Work	Indicates that there is currently no tramming work but there are trammers logged in.	To a list of Users logged in for Tramming.
No Trammers	Indicates that there is outstanding tramming work but there are no trammers logged in.	To a list of outstanding tramming moves.
Tramming Move Not Started	Indicates that a tramming move has not been started within 'n' (configurable) minutes of its request.	To a list of pending tramming moves.
Tramming Move Not Completed	Indicates that a started tramming move has not been completed within 'n' (configurable) minutes of its start.	To a list of started tramming moves.

8.8.7   Configuration Parameters

The table below lists the configuration parameters that are used to control the tramming functions.

Parameter Name	Function	Values	Section
Max Mixed SKUs for VNA Pallet	Defines the maximum SKUs allowed on a mixed SKU pallet stored in VNA	1..100	8.1.1

9   ORDER PROCESSING

Order Processing refers to the overall handling of despatch orders from the point of receipt of the order from the Host, to the point that the vehicles on which the resultant bags, cases, cartons satchels and pallets have been loaded for despatch are closed.

This main section describes the higher-level process flows and WCS facilities relating to order processing. Specific operational details in the various DC areas are covered in separate sections later in this document.

9.1   Order Process & State Summary

Transmission from WMS

Pending

Order release for picking

Key:
Process

State

Released

DU planning

Planned

Reservation of stock

Reserved

Execution started

Started

Picking completed

Picked

Packed in despatch unit

Packed

Loaded onto vehicle

Loaded

Vehicle **closed** for despatch

Despatched
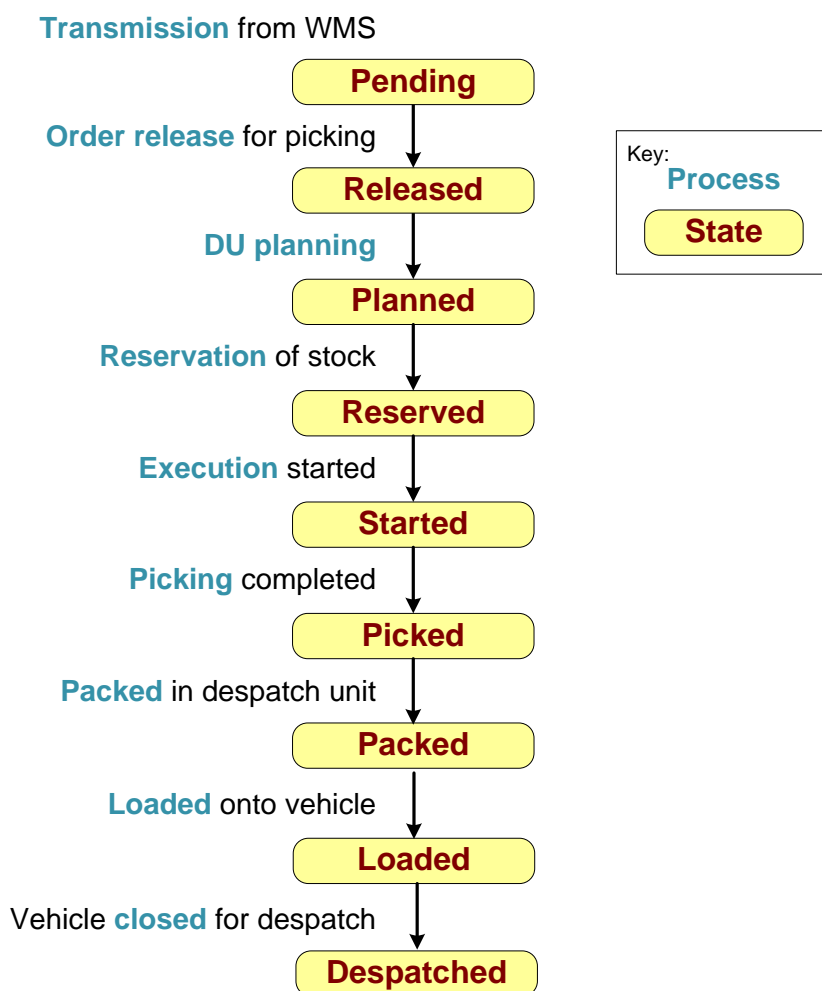
The diagram above gives an overview of the main processes and states associated with order processing. The processes are described in more detail in the following sections.

Process	Purpose	Section(s)
Transmission	Receipt from the Host of orders and lines	23
Order release	Manual process of releasing orders or cartons for picking on WCS	9.4
DU planning	Automatic planning by WCS of individual target carton contents	9.5
Reservation	Selection and reservation of specific stock for picking	9.6
Execution	Various staring & picking processes across multiple pick areas and pick methods	11, 14, 16
Packing	Packing of the picked items in their despatch units, preparation of the despatch units so they are physically ready to leave the DC	18
Despatch	Transfer into the vehicle by which the items leave the DC	19

The states can apply to different order processing elements (consignments, orders, picks, DUs). These are described in more detail in Section 9.2.

9.2 Order Processing Elements

The diagram below show the primary WCS elements used in order processing and some examples of relationships between them.

Order fits into 2 large cartons plus one medium carton

Entire order fits into one satchel

Three single-unit orders batch-picked to carton

Picking is directly to the despatch carton

Picking is to carton. The carton contents will subsequently be converted into individual satchels identified by shipping label ID for despatch

Batch-pick carton
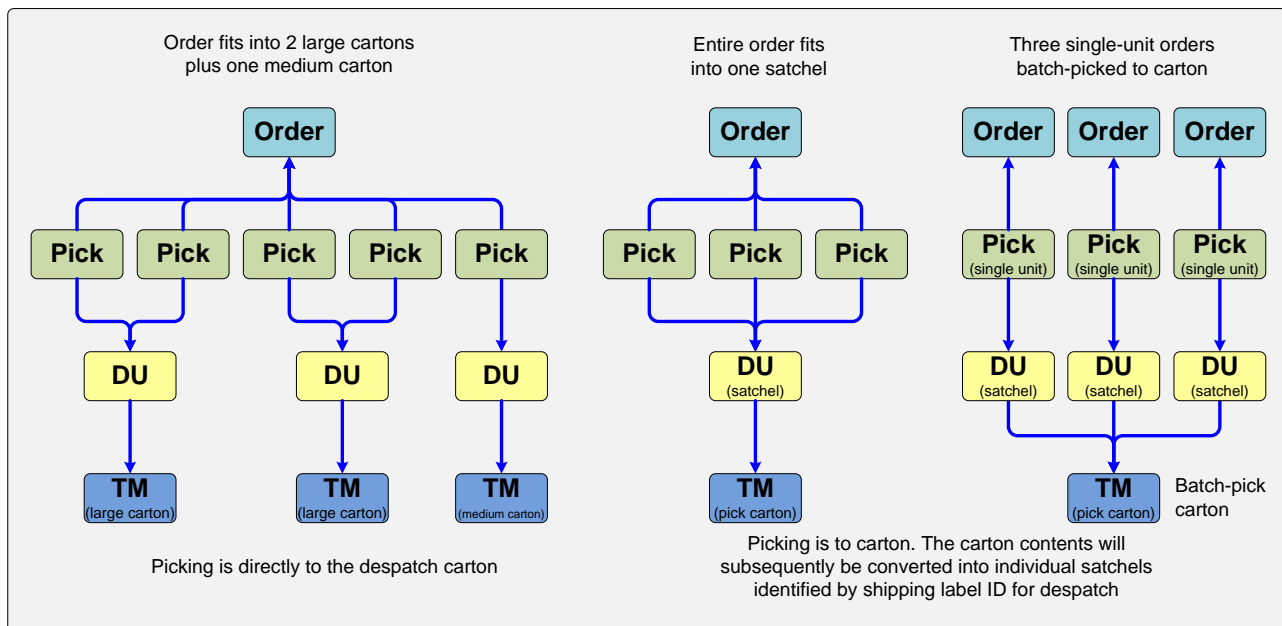
Element	Description	Section(s)
Pick	Represents one line or part of a line from an order	9.2.1
DU	Despatch Unit. A grouping of picks destined to be despatched together in the same TM	9.2.2
Order	A grouping of lines for the same store or customer	9.2.3
Consignment	A collection of orders which will typically be despatched together	9.2.4
TM	Transport Module e.g. carton, satchel, pallet	4.3

DEMATIC

9.2.1   Pick

Initially a WCS pick record reflects a single order line (SKU & quantity) as received from the Host. If the line is subsequently broken down due to picking from different places or into different cartons, the pick becomes split such that each pick record reflects parts of the original line still sharing the same characteristics.

The key data fields that WCS holds for a pick are:
- Reference to an order (Section 9.2.3)
- Reference to a DU (Section 9.2.2)
- SKU and quantity required/picked
- Where reserved or picked from
- Pick state
- Current TM (planned or actual TM holding the picked stock)

9.2.1.1   Pick State

The possible processing states for a pick are as follows, with the earliest states at the top of the list. Additional states may be defined during the WCS engineering phase.

Normal State	Comment
Pending	The state of the pick on initial receipt from the Host
Released	The pick has been released for WCS reservation and picking as part of an order. Order release is described in Section 9.4
Planned	The pick has been planned into a target DU
Wait Replen	There is enough stock within the DC to satisfy the pick but replenishment is required to move the stock to a pick area
Reserved	WCS has found, and reserved, stock to satisfy the pick (Section 9.6)
Wait Batch	WCS is waiting to find other orders to be batch picked together in the same TM
Started	A pick instruction has been issued to an operator or to automated equipment to execute the pick
Picked	The stock has been picked from the location or tote where it was stored
Packed	The stock is in the despatch unit in which it will leave the DC. The despatch unit physically holds all the contents required for it to leave
Buffered	The carton containing the pick is stored in the despatch buffer
Sorted	The despatch unit containing the pick is at a location from where it can be loaded onto a trailer
Loaded	The despatch unit containing the pick has been loaded onto an open trailer
Despatched	The despatch unit containing the pick has been loaded onto a trailer which has been closed and is ready to leave the DC
Abandoned	The pick has been abandoned. When the contents of a picked container are abandoned, the picked stock is converted to stock records with an appropriate state (e.g. *missing*) and needs to be handled subsequently

Deleted	The entire order of which the pick forms a part has been deleted. This allows the Host to resend the picks as part of a new order.

Exception State	Comment
Unsatisfiable	There is insufficient stock of this SKU within the domain of WCS
Unpickable	There is sufficient quantity of the SKU to satisfy this pick but it is not reservable or pickable due to its status or location (e.g. on hold or not yet decanted)
Unreachable	Picking and packing was performed but the resultant DU has become trapped or has gone missing. If it turns up it may be included in the order. If not, a supervisor must decide whether to abort or repick the contents

9.2.2   Despatch Unit

Despatch Unit (usually abbreviated to DU) is a generic term used in the DAI software on which WCS is based. A DU record defines common attributes of the contents of a physical or planned TM that holds stock for a single order destined for despatch.

Prior to picking and packing, the DU is a logical entity that groups together picks that should end up in the same carton or satchel.

In many instances the logical term DU can be used interchangeably with carton, which is a physical TM containing the DU. However, in some scenarios there is not a one-to-one relationship between the DU and the TM, e.g. when batch picking multiple orders to a single pick carton.

The key attributes of a DU record are as follows.

- Reference to an order (Section 9.2.3)
- Reference to a TM (Section 4.3) holding the DU, when known
- DU state
- DU type – the format and size of the physical despatch unit. This may be the same as the TM in which it is picked

9.2.2.1   DU State

Up until the point that all its picks are *picked*, the state of the logical DU reflects that of the picks grouped into it (Section 9.2.1.1).

If any one of the picks is in one of the exception states then the DU is also shown in that state. Where multiple picks are in different exception states, the earliest state is shown.

If none of the picks is in an exception state, the state of the DU is shown as earliest of the pick states, with the exception that if any one pick has reached a state of *started* or later then the DU is shown at least as *started* even if some of the picks have an earlier state.

9.2.3   Order

All orders are pre-defined by the Host.

The key data fields that WCS holds for an order are:
From WMS:
- Order ID
- Reference to a consignment (Section 9.2.4)
- Order type
- Customer address details, if the order is to be despatched for a specific customer. Each order has a reference to either a store or a customer. An order of type Click To Collect has a reference to both a store and a customer
- Signature required flag, i.e. whether an additional label should be affixed to the despatch unit/s

and local to WCS:
- Order state

along with all the fields configurable by brand and order type as listed in section 9.3.1.

Data fields which apply to all the orders in a consignment are listed in section 9.2.4.

As it is theoretically possible for more than one client to use the same order ID to refer to different orders, the unique identifier for each order within WCS is a combination of the client and the order ID.

9.2.3.1   Order State

The order state uses the same range of possible values as the pick state (Section 9.2.1.1) interpreted at the order level as follows:

If any one of the picks in the order is in one of the exception states then the order is also shown in that state. Where multiple picks are in different exception states, the earliest state is shown.

If none of the picks is in an exception state, the state of the order is shown as earliest of the pick states, with the exception that if any one pick in the order has reached a state of *started* or later then the order is shown at least as *started* even if some of the picks have an earlier state.

9.2.4   Consignment

A consignment is a grouping of one or more orders as defined by the Host.

Orders for the same consignment and order type are typically picked into the same despatch units. WCS is responsible for grouping together the lines in these orders.

Orders for the same consignment are typically despatched in the same vehicle. It is a manual operation to ensure that the despatch units for the consignment are released to the despatch sorter lane together.

The key data fields that WCS holds for a consignment are:
From WMS (i.e. derived from the orders in the consignment):
- Reference to a brand

- Assembly date and time (the time by which the orders should be despatched). This is used to prioritise orders with the same pick priority – see Section 9.3.3
- Hold flag. This prevents WCS from automatically releasing the lines for picking (but they can be manually released)
- Store address details, if the order is to be despatched to a store
  Each order has a reference to either a store or a customer. An order of type Click To Collect has a reference to both a store and a customer
- For each order type:
  o Whether a pack list is required to be despatched with the picked items in the final DU
  o Whether a returns slip (one per order) is required to be despatched with the picked items
- Whether cartons for the consignment require manual intervention, at either an automated pack station or a manual pack station. For example, this allows VAS operations to be carried out on the picked items

and local to WCS:

- Consignment state

along with all the fields configurable by brand as listed in section 9.3.2.

A consignment record is created when details of a new order are received from the Host as part of a consignment that is unknown to WCS. WCS accepts further orders as part of the same consignment, provided no part of the consignment has been released for picking.

9.2.4.1 Consignment State

The consignment state uses the same range of possible values as the pick state (Section 9.2.1.1) interpreted at the consignment level as follows:

If any one of the picks in the consignment is in one of the exception states then the consignment is also shown in that state. Where multiple picks are in different exception states, the earliest state is shown.

If none of the picks is in an exception state, the state of the consignment is shown as earliest of the pick states, with the exception that if any one pick in the consignment has reached a state of *started* or later then the consignment is shown at least as *started* even if some of the picks have an earlier state.

9.2.4.2 Deletion of Consignments

Consignments, and their orders, DUs and picks, are deleted automatically from WCS once a day, a configurable number of days after each is despatched or abandoned. This takes place during the End of Day process described in Section 24.2.

Audit trail details relating to the consignment are retained on the MIS.

DEMATIC

9.3   Order Pool Management

All consignments received from the Host are placed into a single order pool. Each consignment is tagged with a state and priority which effectively creates a queue of consignments within the pool.

For visibility, WCS provides facilities for viewing the current order pool via OM screens. These include:

- High level consignment summary (at a glance broken down by brand, order type, pick area or status)
- Lists and reports (user-selectable)
- Individual consignment, order and pick details

Via OM screens an operator with suitable access rights may affect orders in various ways, including:

- Releasing (all or part of) the consignment for picking
- Abandoning (all or part of) the consignment
- Changing certain data fields (Section 9.8 defines which fields can be changed manually)

9.3.1 Order Processing Configuration

A configuration table specifies for each combination of brand and order type:
- Whether orders should:
  - Be automatically released for picking immediately when WCS receives the details from the Host. See Section 9.4.1
  - Be scheduled at a configurable time daily for checking whether they should be automatically released for picking. See Section 9.4.2
  - Never be automatically released for picking. See Section 9.4.3
- Maximum number of DUs in the consignment for it to be automatically released for picking. For example, this can be used to prevent an unexpectedly large ecommerce order from being released
- Stock reservation priority. See Section 9.6.1
- Maximum time for WCS to keep an order in a *wait batch* state. See Section 9.7
- Pick priority. See Section 9.3.3
- Whether stock with a storage type of hanging should be despatched hanging or flat
- Pick area (manual or GTP) for semimechable SKUs stored flat (see Section 4.2)
- Whether items picked in the manual area should be merged with pick cartons from the GTP area for the same consignment. See Section 14.4
- Despatch buffer flag. If this is set, then any cartons for the consignment travelling on the conveyor between the finishing area and the despatch sorter are diverted into the despatch buffer
- Valid physical DU types, including whether full cases are logically loaded onto the vehicle for despatch individually or on a pallet
- Whether pick cartons are routed to a pack station for individual bagging (this is expected to be the default setting for order type Click To Collect Bags)
- Optional free text instruction displayed during packing (see Section 18.5.4)
- Percentage of pick cartons to divert to the Finishing QA station for checking (see Section 5.1.2)
- Carton lid colour
- Whether WCS automatically abandons picks in an *unsatisfiable* state (see Section 9.6.5)
- Whether WCS automatically abandons picks in an *unpickable* state (see Section 9.6.5)

This configuration table allows, for example, ecommerce orders for a specific brand to be automatically released for picking within an hour of WCS receiving the order details from the Host, while store orders for the same brand wait to be manually released for picking.

The table is configurable by suitably-privileged users. A change to the table does not affect orders which are already in the WCS database.

Each order newly-received from the Host follows by default the order processing configuration defined for its brand and order type. A suitably-privileged user can subsequently modify the behaviour of an individual order or a group of orders.

9.3.2 Brand Configuration

A configuration table specifies for each brand:
- The time of day at which a scheduled check for order release takes place for scheduled order types. See Section 9.4.3
- Number of order types to trigger scheduled order types to be released for picking

The table is configurable by suitably-privileged users. A change to the table does not affect consignments which are already in the WCS database.

Each consignment newly-received from the Host follows by default the brand processing configuration defined for its brand. A suitably-privileged user can subsequently modify the behaviour of an individual consignment or a group of consignments.

9.3.3   Pick Priority

Subject to system throughput optimisation and stock availability, orders are normally sequenced by pick priority. This is initially derived from the order configuration table defined for the brand and order type as described in Section 9.3.1, but a suitably-privileged user may change the pick priority of an individual order or group of orders.

Orders with the same pick priority are normally sequenced based on the assembly date and time of their respective consignments.

The sequence by which orders are prioritised for the reservation of stock for individual picks is described in Section 9.6.1.

9.4   Order Release

As soon as WCS receives the details of a consignment from the Host, the orders in the consignment are eligible to be manually released for picking.

The order processing configuration table (Section 9.3.1) determines whether WCS automatically releases an order for picking, or waits for a supervisor to manually release (all or part of) it.

Once some or all of a consignment has been released for picking, it becomes eligible for WCS to plan the picks of the entire consignment into despatch units. WCS rejects any attempt by the Host to add further orders to the consignment.

9.4.1   Immediate Release

The order processing configuration table allows orders of specific order types to be automatically released for picking as soon as WCS has received the details from the Host.

WCS never automatically releases for picking a consignment if the orders in the consignment have their Hold flag set by the Host. The consignment may be manually released to clear the Hold flag.

WCS never automatically releases for picking an order if there are more DUs for the order type in the consignment than the maximum derived from the order processing configuration table. The order may be manually released to override this maximum.

9.4.2   Scheduled Release Check

The order processing configuration described in Section 9.3.1 allows orders of specific order types to wait until a specific time of day, at which WCS applies a number of rules to decide whether the orders should be automatically released for picking.

If WCS decides not to release the orders for picking, it waits until the same time the following day and applies the same rules again. WCS may have received more orders into the same consignment from the Host in the intervening period. The process continues daily until the orders are no longer waiting to be released.

The time of day at which the scheduled check takes place is derived from the brand configuration described in Section 9.3.2.

The rules applied are as follows:
- The Host specifies a maximum wait date for each order in a consignment. When the earliest maximum wait date of all the orders in the consignment is reached, WCS automatically releases for picking all the orders in the consignment that are configured for scheduled release
- The Host specifies the carton fill percentage at which the consignment is released. When the total volume of lines to be picked for all the orders in the consignment reaches this percentage of a large carton, WCS automatically releases for picking all the orders in the consignment that are configured for scheduled release. The configured percentage can be more than 100
- The number of order types to trigger consignment release is configurable by brand. When the Host has informed WCS of orders in the consignment of at least this number of different order types, WCS automatically releases for picking all the orders in the consignment that are configured for scheduled release

Only one rule needs to be satisfied for WCS to automatically release the consignment for picking.

WCS never automatically releases for picking a consignment if any of the orders in the consignment has its Hold flag set by the Host.

WCS never automatically releases for picking an order if there are more DUs for the order type in the consignment than the maximum derived from the order processing configuration table.

A consignment that is configured for scheduled release may be manually released for picking with immediate effect. This clears any Hold flag and overrides any maximum number of DUs.

9.4.3   Manual Release

WCS provides order summary and query screens to allow a supervisor to determine outstanding order workload and visibility of consignments that are awaiting release in each of the three pick areas of the DC (hanging, manual and GTP).

Consignment and order lists may be viewed and filtered in various ways e.g. based on brand, order type, pick area.

Using an OM screen the supervisor may release for picking in each pick area:
- A filtered list of consignments or orders
- A specific consignment or order
- A specific number of picks in a specific consignment or order (e.g. to pick part of a large consignment which is to be despatched in several days' time)

A consignment that WCS is waiting to automatically release for picking may be manually released with immediate effect.

9.4.4   Unrelease for Picking

A supervisor using an OM screen may reverse a (manual or automatic) release for picking of a consignment. This effectively holds the consignment until it is manually released again.

This does not affect DUs where the picking process has already started.

9.5   DU Planning

When a consignment has been fully or partly released for picking, WCS automatically plans the entire consignment into a number of despatch units (DUs).

Each flat DU represents a single despatch carton or satchel. Items in the same consignment to be despatched hanging are split into DUs, each of which will be despatched as a hanging bag.

9.5.1   Volumetric DU Fill

WCS plans to three different physical DU types for items despatched flat:
- Large carton (the largest DU type)
- Medium carton
- Satchel (the smallest DU type)

Not all orders are permitted to use all of these DU types. For example, the expectation is that only ecommerce orders will be despatched in satchels.

The maximum usable internal dimensions, maximum usable volume and maximum contents weight for each DU type are configurable within WCS.

When WCS plans picks into a DU, WCS ensures that the dimensions of each single item can fit within the maximum usable internal dimensions for the DU type, that the total volume of all the planned picks is within the configured maximum usable volume for the DU type, and that the total weight of all the planned picks is within the configured maximum contents weight for the DU type.

9.5.2   Foldable and Nestable SKUs

In some cases an item may be longer then a small carton and therefore cube into a large. In reality the item (e.g. a shirt) could be folded in half and still fit in a small carton. In another example some SKUs (e.g. hats) are nestable, but the cube is added together.

WCS uses the concept of foldable SKUs and nestable SKUs. For these SKU types a different set of cubing rules needs to be applied.

The individual dimensions of a foldable SKU are ignored by WCS. The overall volume and the weight of a single item of the SKU are taken into consideration.

For a single item of a nestable SKU, the dimensions, overall volume and weight are considered as normal. For each additional item of the same SKU in the same DU, the largest dimension and the total volume are increased by a percentage (typically less than 100%) defined by the Host. The smallest two dimensions are considered unchanged. The total weight is increased as normal by 100% for each additional item.

9.5.3   Fragile SKUs

Any SKU flagged as fragile is not permitted to be despatched in a satchel. WCS plans order lines for fragile SKUs as normal along with other SKUs, but if any SKU in a DU is fragile then WCS disregards satchels when calculating the smallest DU type that it can fit in.

9.5.4 Pick Sequencing

When planning DUs to be picked into a carton, WCS sorts the candidate picks according to the hierarchy of sequences specified by the Host for the orders in the consignment.

If no hierarchy is specified by the Host, WCS treats the individual orders within the consignment as the only hierarchy.

The same hierarchy is used to determine the sequence in which each pick should be performed into a carton at the GTP stations. Items may be added to the carton later at the GTP – GOH merge area.

9.5.5 GOH DUs

Picks to be despatch hanging for the same order type in a consignment are built into a single DU, provided that does not exceed the capacity for a trolley bin.

The capacity of a bin is defined by configuration parameters *Max GOH Pick Items in Bin* and *Max GOH Weight in Bin*. If the next pick in sequence would cause either of these values to be exceeded, a new DU is created for subsequent picks.

9.5.6   DU Planning Logic

WCS automatically plans picks into DUs as soon as they have been released for picking.

DUs to be picked in the manual area are planned separately from other DUs.

DUs to be picked in GOH and despatch hanging are planned separately from other DUs.

DUs to be picked in the GTP area, and DUs to be picked in GOH and despatched flat, are planned together.

WCS creates a list of all the released picks, sorted in the sequence defined in Section 9.5.4. At this point WCS does not consider the availability or otherwise of stock to satisfy each pick.

DUs are then logically created one by one using the logic shown in the following flowchart:
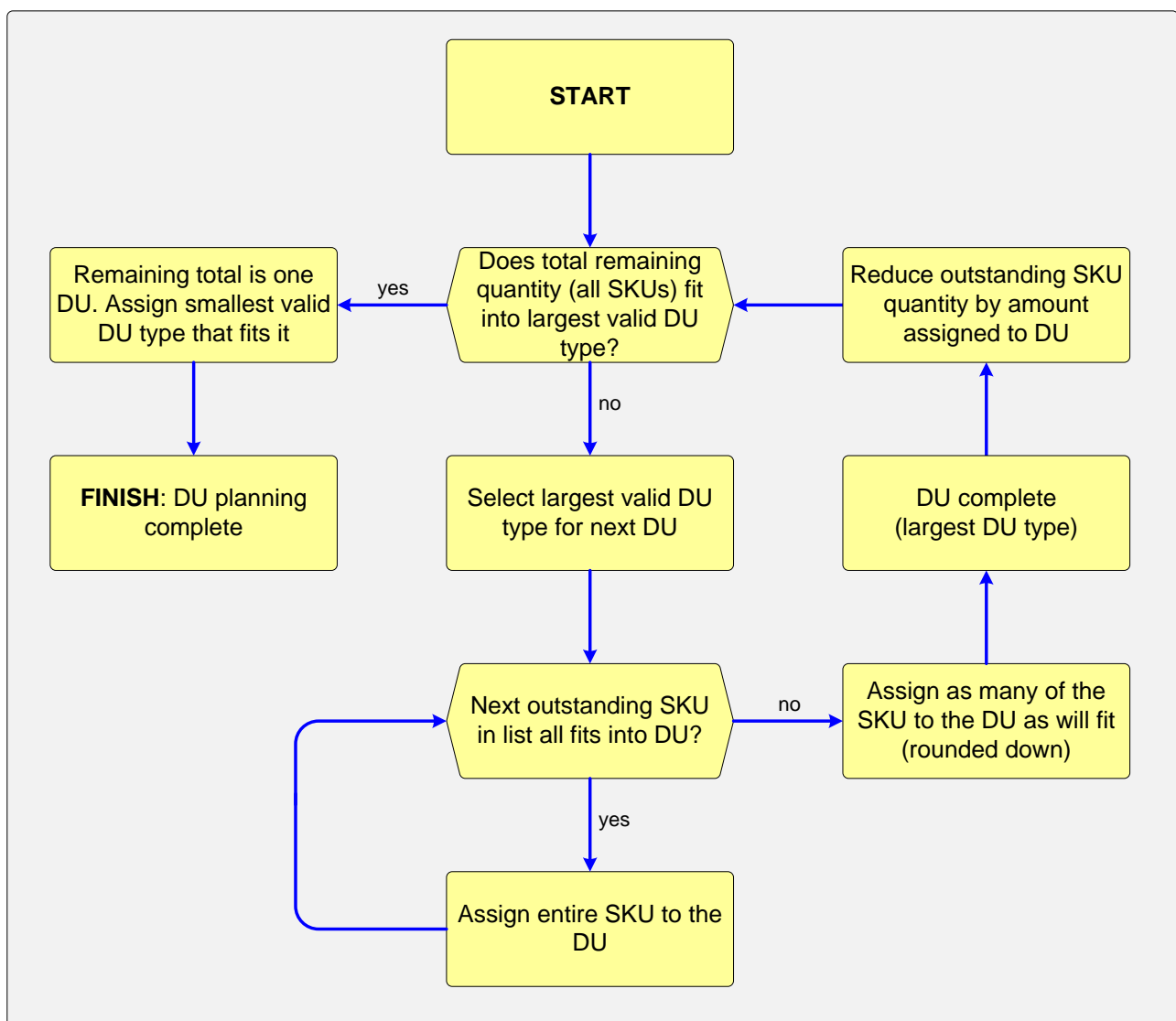
In this context, fitting into a DU means by both volume and weight. Taking the total of what is already present plus a quantity of the candidate SKU being considered, the quantity fits so long as the total volume does not exceed the configurable maximum percentage of the volume of the DU

type (taking into account nestable SKUs as described in Section 9.5.2), and the total weight does not exceed the maximum allow weight for the DU type, taking account of the nominal weight of the packaging itself.

If the picks in a consignment are sorted by order, any order in the consignment which requires more than one DU does not share any of those DUs with picks from another order.

Once a DU has been planned, reservation of stock to satisfy the picks takes place.

9.5.7   Order Replanning

Circumstances may arise that cause WCS to need to replan one or more outstanding picks for an order. An example of this is when a carton is unexpectedly reported full, which then requires one or more units to overflow into another DU.

WCS waits until the remaining picks for the order have been confirmed picked without exception. Then all the outstanding picks are replanned into new DUs, using the same rules as in Section 9.5.6. This typically results in one additional DU whose picks do not obey the hierarchy of sequences instructed by the Host.

Once a DU has been planned, reservation of stock to satisfy the picks takes place.

9.6   Stock Reservation

The process of reservation is where WCS selects specific stock from a specific TM to be used to satisfy the requirement of each pick record.

Stock reservation takes place for the picks in a DU as soon as it has been planned.

This is a continuous process – if after reserving stock for a pick, that stock becomes unavailable, e.g. its TM is reported missing, then WCS automatically attempts to reserve stock from a different TM for the pick.

9.6.1   Stock Reservation Priority

WCS holds for each order a stock reservation priority. This is initially derived from the order processing configuration table record for the order's brand and order type, described in Section 9.3.1.

The stock reservation priority for each order is not necessarily related to the sequence in which each order is released for picking. Pick priorities are described in Section 9.3.3.

If WCS cannot find enough stock of a SKU to satisfy a pick, it looks for any picks for the same SKU which are in a *reserved* state and whose order has a lower stock reservation priority. The stock is unreserved from any such picks so that the original, higher priority, pick may reserve it instead.

This allows an order to be picked without being delayed by older, less urgent orders when there is insufficient stock to satisfy all of them.

WCS therefore does not reserve stock for a pick if this would leave insufficient stock to satisfy a pick with a higher stock reservation priority but which has not yet been released for picking.

Orders with the same stock reservation priority are typically prioritised based on their respective pick priorities (Section 9.3.3).

9.6.2 Stock Eligibility for Reservation

For stock to be eligible for reservation for a pick, all of the following must be true:-
- SKU matches that required for the pick
- There is sufficient quantity of stock to satisfy the pick, excluding the total quantity already reserved to satisfy other picks (but see Section 9.6.4 regarding the splitting of picks)
- The stock is not on WCS hold for any reason

If reserved stock subsequently becomes ineligible or if the expected quantity in the TM is reduced for any reason, then WCS will automatically look for alternative stock satisfying the same criteria to satisfy the pick.

9.6.3 Selection of Stock for Reservation

When selecting stock for reservation, there is no requirement for WCS to consider any dates regarding either the age of the stock or the time when it was received into the DC.

If there is more than one possible available pick location or stock TM from which WCS could reserve a pick, WCS makes a selection from the eligible stock according to the following rules:

- If there is stock of the same SKU stored both hanging and flat, WCS considers whether the order is configured so that stock can be despatched hanging. If so, the hanging stock is selected; if not, the flat stock is selected.
- Items picked flat are picked in the manual area if the SKU is nonmechable, or in the GTP area if the SKU is mechable. If the SKU is semimechable, the pick area is determined by the configuration of the order.

Once the pick area has been selected:

- In the hanging area:
    - o WCS selects the stock in a location which contains enough available stock to satisfy the pick (this is to avoid the pick being split, which would force the operator to visit more than one pick location)
    - o The next consideration is to select the location which is configured to have the lowest pick path sequence number as described in Section 2.11.3 (this is so that if the operator encounters a problem when attempting to pick from a location, the opportunity exists to attempt the pick from another location later in the pick path)

- In the manual area:
    - o WCS selects the stock in a location which contains enough available stock to satisfy the pick (this is to avoid the pick being split, which would force the operator to visit more than one pick location)
    - o The next consideration is to select the location which holds the smallest quantity of available stock of the SKU (this is to reduce the number of different pick locations for the SKU)
    - o The next consideration is to select the location which is configured to have the lowest pick path sequence number as described in Section 2.11.3 (this is so that if the operator encounters a problem when attempting to pick from a location, the opportunity exists to attempt the pick from another location later in the pick path)

- In the GTP area, WCS is free to select the stock from any tote so that throughput is optimised.

9.6.4 Splitting of Picks for Reservation

An order line for a quantity of 2 or more items can be reserved from multiple stock TMs. In this scenario, WCS splits the pick record to show the different TMs or pick states.

If the situation subsequently changes and the separate picks become identical (except for different pick quantities), WCS automatically merges the pick records back into a single pick. WCS only merges picks that were originally the same order line received from the Host.

9.6.5 Failure to Reserve

If WCS fails to reserve for a particular pick due to there being insufficient stock of that SKU in the DC across all stock states, then this causes one or more picks to become *unsatisfiable*.
If WCS fails to reserve while there is sufficient stock overall but when some of it is not in a suitable state for reservation (e.g. not in a location where it can be picked or replenished), then this causes one or more picks to become *unpickable*.

A flag on the order for each of these states determines whether WCS automatically abandons such picks (see Section 9.8.3).

Otherwise, an alarm is raised on the OM status line indicating that there are picks in an *unsatisfiable* or *unpickable* state.

9.7 Multiple Order Batching

9.7.1 GOH Area

In order to enhance picking efficiency, WCS automatically seeks the opportunity to batch together a number of picks in different consignments to be picked together in the same bin in the GOH area.

This batching is only done for picks that are to be despatched flat, and the picked stock is therefore to be taken to the GTP – GOH merge area (see Section 11.6).

For picks to be valid for GOH batch picking, all of the following must be true:
- Configuration parameter *Max GOH Batch Pick Orders* is set to a value greater than 1
- The picks are to be picked in the GOH area
- There are fewer GOH picks in the order than the value of configuration parameter *Max GOH Pick Items in Bin*
- The weight of the GOH picks in the order is less than the value of configuration parameter *Max GOH Weight in Bin*
- The order is to be despatched flat

Any picks which satisfy these conditions are set to a *wait batch* state when released for picking.

When a pick has been in a *wait batch* state for the number of minutes defined by configuration parameter *Max GOH Wait Batch Minutes*, WCS looks for other picks to batch into the same bin as this target pick.

For other picks to be valid for batch picking together with the target pick, all of the following must be true:

- All the picks are in a *wait batch* state
- All the picks are for the same client as the target pick
- Stock can be successfully reserved for all the picks
- The number of orders batched together does not exceed the configurable maximum *Max GOH Batch Pick Orders*
- The number of picks batched together does not exceed the configurable maximum *Max GOH Pick Items in Bin*
- The weight of the picks batched together does not exceed the configurable maximum *Max GOH Weight In Bin*

From the valid picks, WCS selects those to be batched with the target pick as follows:

- Picks for which the reserved stock is located in the same GOH location as the target pick
- Picks for which the reserved stock is located in the same GOH aisle as the target pick
- Orders with the highest pick priority
- Orders with the earliest assembly date and time

From the point of batch creation, picking into bin is the same process as picking a single-order DU. After picking, the trolley train including the bin will be routed to the GTP – GOH merge area so that the stock can be transferred into pick cartons.

9.7.2   GTP Area

In order to enhance picking efficiency, WCS automatically seeks the opportunity to batch together a number of single-unit orders in different consignments to be picked together into the same carton in the GTP area.

This batching is only done when the entire order is a single unit, and not for residual DUs from a larger order that happen to be a single unit.

For an order to be valid for GTP batch picking, all of the following must be true:

- Configuration parameter *Max GTP Batch Pick Orders* is set to a value greater than 1
- The order is to be picked in the GTP area
- The order is the only order in its consignment
- The order comprises a single pick of exactly one unit, so there will no hunting for partner units during packing
- The order is to be despatched in a satchel,
  and therefore:
  - The order does not include a fragile SKU
  - The order does not require gift wrapping
- The order requires a returns slip to be included in the satchel

Any order which satisfies these conditions is set to a *wait batch* state when released for picking.

When an order has been in a *wait batch* state for the maximum time configured for the order's brand and order type as described in Section 9.3.1, WCS looks for other orders to batch into the same carton as this target order.

For other orders to be valid for batch picking together with the target order, all of the following must be true:

- All the orders are in a *wait batch* state
- All the orders are for the same client as the target order
- All the orders have the same order type as the target order
- All the orders are to be despatched to the same store as the target order (or all are not to be despatched to a store)
- Stock can be successfully reserved for all the picks in the orders
- The stock reserved for all the orders is lo located in the same module of the storage multishuttle as the target order
- All the orders require the same paperwork (e.g. returns slip) as the target order
- All the orders require the same information label (or none) as the target order
- There is at least one automated pack station which is capable of packing all the orders
- The number of orders batched together does not exceed the configurable maximum *Max GTP Batch Pick Orders*
- The total volume of all of the orders is less than a (relatively low configurable) percentage of the volume of a large carton, specified by parameter *Max GTP Batch Pick Carton Percentage*. This is to avoid the carton becoming prematurely full

From the valid orders, WCS selects those to be batched with the target order as follows:

- Orders to be picked from the same stock tote as the target order
- Orders for which the reserved stock is located in the same aisle of the storage multishuttle as the target order
- Orders with the highest pick priority
- Orders with the earliest assembly date and time

Picking of a batch of DUs is always to a large carton which is subsequently sent to a pack station for packing.

From the point of batch creation, picking into the multi-order carton is the same process as picking a single-order DU. After picking, the carton will be routed to an automated pack station so that the individual orders can be separated and packed in satchels.

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9.8 Amending Orders

9.8.1 Individual Order Fields

A suitably-privileged OM user may amend the following fields in an order:
- Stock reservation priority. See Section 9.6.1
- Pick priority. See section 9.3.3
- Despatch buffer flag. If this is set, then any cartons for the order travelling on the conveyor between the finishing area and the despatch sorter are diverted into the despatch buffer
- Whether cartons for the order require manual intervention, at either an automated pack station or a manual pack station
- Optional free text instruction displayed during packing (Section 18.5.4)
- Whether WCS automatically abandons picks in an *unsatisfiable* state (see Section 9.6.5)
- Whether WCS automatically abandons picks in an *unpickable* state (see Section 9.6.5)

9.8.2 Unpicking Picks

A suitably-privileged OM user may change the state of a picked pick to unpicked at any point before it is confirmed *packed*. This function is intended for the situation whereby a user cannot find the picked stock in the TM in which it was supposedly picked.

The user may split into two a pick for multiple items of the same SKU and declare one part as unpicked, if the user can find only part of the supposed pick quantity in the TM.

The next time the TM is seen by WCS, it is directed back towards the pick area so that the pick can take place. If it is not possible to direct the TM back to the pick area, the TM is directed to the next QA station or sorter reject lane.

A stock adjustment message is transmitted to the Host to inform it of the reduction in stock quantity.

9.8.3 Setting DUs Gone

A TM containing a DU may become *missing* and then *gone* in the same way as a stock TM as described in Section 4.6.4. WCS automatically replans the affected picks into existing or new DUs so that they can be repicked.

9.8.4 Abandoning Picks

A suitably-privileged OM user may abandon some or all of a pick. Alternatively, a user may abandon a list of picks matching specific criteria, e.g. a single DU, order, consignment, or all picks for a single SKU.

A pick may also be abandoned automatically by WCS if its state is *unsatisfiable* or *unpickable* and the appropriate flag has been configured for the order (see Section 9.6.5).

After packing, it is not possible to abandon part of a DU. Therefore, if some of the picks in a DU are to be abandoned, all the picks in the DU must be abandoned.

WCS does not allow an abandoned DU to be despatched. If a pick is abandoned before it has been picked, WCS does not allow it to be picked.

Abandoning a pick on WCS in an irreversible action and should be performed with care.

If a pick is abandoned after being picked, the picked stock is converted to a stock record in a *missing* state which can be manually transferred into a known TM or location, or written off.

9.8.5   Deleting Orders

A suitably-privileged OM user may set an order *deleted* at any point before any of the picks in the order is *picked* and while none of the picks in the order is in a *started* state.

This allows the Host to resend the same picks to WCS as part of a different order with different data fields if required.

9.9   Related Elements

9.9.1   Operations Management Screens

The Order Summary screen shows the status of outstanding orders to be picked and to be despatched, summarised by pick area, brand, consignment and order type.

9.9.2   MOI Functions

There is no MOI associated with order processing.

9.9.3   LOI Functions

There is no LOI associated with order processing.

9.9.4   Operational Events

Section 21.2 defines the general format of Operational Events. The table below defines the information that is logged in addition to the standard details for the specific Order Processing Operational Events.

Event	Trigger	Fields
PICK_NEW	When a new pick is received from the Host	Consignment Id, Order Id, Line Number, SKU, Quantity
ORDER_NEW	When a new order is received from the Host	Consignment Id, Order Id
CONSIG_NEW	When a new consignment is received from the Host	Consignment Id
DU_NEW	When a new DU is created	DU Id
PICK_STATE_CHANGE	When a pick changes state	Consignment Id, Order Id, Line Number, SKU, DU Id, Old state, New state
ORDER_STATE_CHANGE	When an order changes state	Consignment Id, Order Id, Old state, New state
CONSIG_STATE_CHANGE	When a consignment changes state	Consignment Id, Old state, New state
DU_STATE_CHANGE	When a DU changes state	DU Id, Old state, New state

PICK_DU_ASSIGN	When a pick is assigned to a DU	Consignment Id, Order Id, Line Number, SKU, DU Id
PICK_SPLIT	When a pick is split into two	Consignment Id, Order Id, Line Number, SKU, Old quantity, New quantity
PICK_MERGE	When two previously split picks are merged back into one	Consignment Id, Order Id, Line Number, SKU, Old quantity, New quantity
ORDER_AMEND	When details of an order are amended	Consignment Id, Order Id, Field changed, Old value, New value
OP_CONFIG_CHANGE	When configuration settings for a brand and order type are amended	Brand, Order Type, Field, Old value, New value

9.9.5   Statistics

There are no statistics associated with order processing.

9.9.6   Alarms and Alerts

The table below defines the alarms and alerts that are associated with order processing. They are displayed on the WMS Alarms page.

Alarm	Description	Drill Down
Unsatisfiable Pick	A pick is in an *unsatisfiable* state	List of picks
Unpickable Pick	A pick is in an *unpickable* state	List of picks

9.9.7   Configuration Parameters

The table below lists the configuration parameters that are used to control order processing.

Parameter Name	Function	Values	Section
Max GOH Wait Batch Minutes	Defines the maximum time a pick should remain in a *wait batch* state	1..1440	9.7.1
Max GTP Batch Pick Orders	Defines the maximum number of orders to be batch picked into the same carton in the GTP area	1..100	9.7.2
Max GTP Batch Pick Carton Percentage	Defines the maximum percentage of the volume of a large carton to be used for batch picking in the GTP area	1..100	9.7.2

10   GOH PUTAWAY

10.1   Operation Overview

The storage of hanging garments is an entirely manual process. Operators transport garments around the GOH area on GOH trolleys which are pushed along the GOH rails. Some GOH rails are powered, typically those used to travel between different levels. RF devices are used to record the storage location of garments.

10.1.1   Basic Elements

Train – a number of linked GOH Trolleys

No LP

GOH Trolley

No LP

Multiple Bins

Can contain one or more bins of different SKUs. Each bin is single-SKU.

Bin

Unique LP

Single SKU

Can contain one or more garments of the same SKU

Garment

SKU Barcode

(no LP)

GOH – Basic Terminology
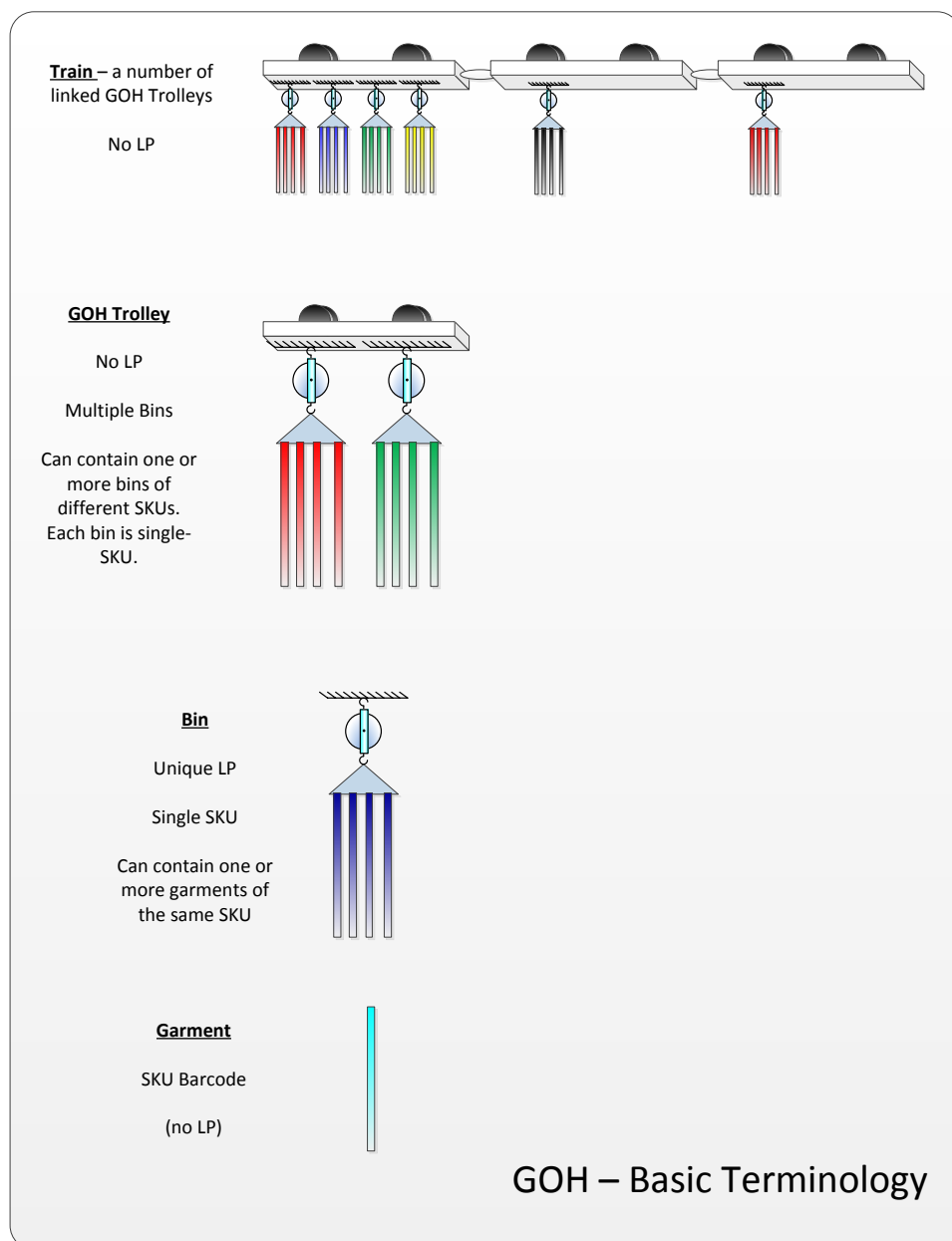
There is one fixed GOH trolley size. GOH trolleys do not have fixed barcoded licence plates. A number of GOH trolleys can be linked to form a GOH train. A GOH train does not have an associated barcode id although, when a train is used for picking, it has a logical WCS identifier.

Hanging garments are placed in bins. One bin may contain one or more items of the same SKU. Bins must be single SKU. One or more bins are attached to a GOH trolley for transport around the GOH area. Garments of a SKU are associated directly with a bin id. Each garment has an associated SKU barcode label but individual garments do not have unique barcodes.

10.1.2   Hanging Location Configuration

The hanging area comprises a number of fixed rails from which garments can be hung. The rails are arranged as a number of separate aisles.

Within an aisle, there can be single rails which are capable of storing long garments, and / or double rails, one above the other, from which short garments can be hung.

A rail is split into a number of separate consecutive locations. All hanging locations are the same size. Each location has a fixed location id and an associated unique barcode LP.

The layout is configurable in WCS. The following information can be configured for each aisle:

Field	Possible Values
Client	Specific Client Id or ANY
Brand	Specific Brand, set of Brands or ANY

The following information can be configured for each location within an aisle:

Field	Possible Values
Client	One of the Clients that has been configured for the aisle. Default to the aisle's client.
Brand	One or more of the Brands that have been configured for the aisle. Default to the aisle's Brand(s).
Rail Type	Single or Double
Location Id	The unique location id
Location Barcode	The unique location barcode
Size	Length of rail in location, in millimetres
Putaway Walk Sequence No	The relative putaway walk sequence number of the location
Pick Walk Sequence No	The relative pick walk sequence number of the location

10.2   Equipment Used

A GOH Putaway operator uses a handheld RF device to record the putaway of GOH items.

10.3   Collecting a GOH Trolley from Receiving

GOH items awaiting putaway are assembled into bins at Receiving.

A GOH putaway operator must first collect one or more assembled bins. The bins form a GOH train to start the putaway process. As GOH trolleys do not have a unique LP, it is transparent to WCS how many GOH trolleys are on the train. WCS effectively associates a number of bins with a putaway operator. The instruction sequence is shown below.

GOH Trolley Pick-Up for Putaway
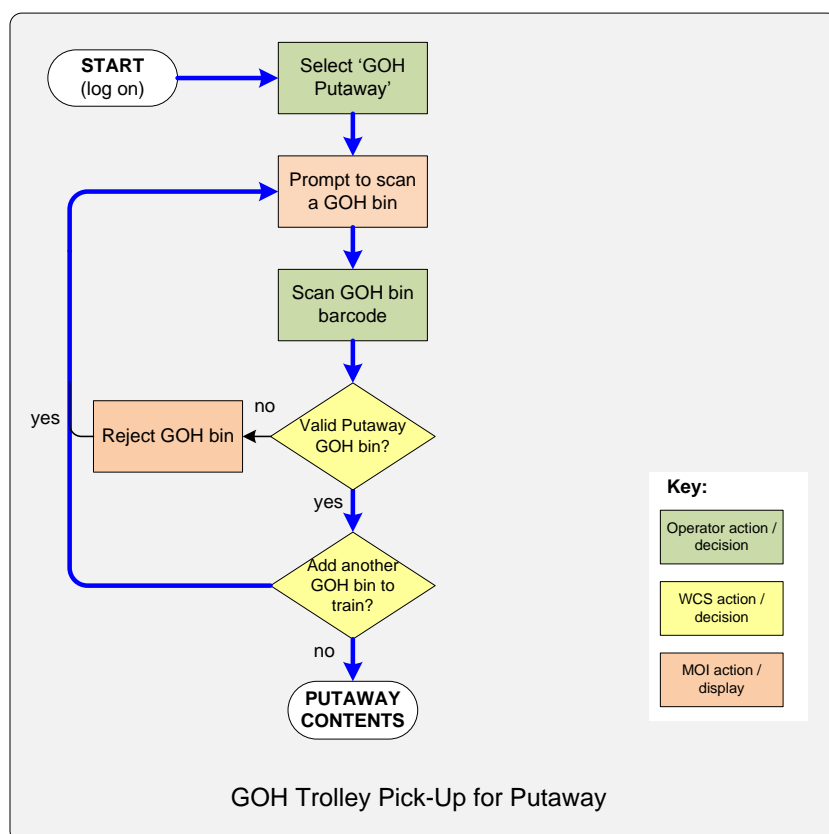
10.3.1   Maximum Number of GOH Bins on a GOH Train

The configuration parameter *Max GOH Bins on Putaway Train* defines the maximum number of GOH bins that can be built into a GOH train. If the operator attempts to exceed the configured limit, an error message is displayed and the bin is not added to the train.

10.3.2   Train Assembly Exceptions

10.3.2.1   Unknown Bin

If a GOH bin that is not known to WCS is scanned, an error message is displayed and the bin is not added to the train.

10.4   Storing GOH Items

Whilst the GOH storage area is completely manual and can be operated manually, WCS does drive the putaway operator on a specific putaway walk to optimise the walk and the use of storage locations.

10.4.1   WCS Selection of Storage Location

WCS applies very simple location selection (or recommendation) rules for GOH items. When selecting a storage location, the following conditions must be true for the selected location:

- There is sufficient space in the location.
- The location is configured to accept storage of items for the same Client as the SKU.
- The location is configured to accept storage of items for the same Brand as the SKU.

- The location is the correct hanging height (long or short) for the SKU.

The above conditions are then applied to the following storage selection rules:

- If there are no items of the SKU already stored, the first available location (by putaway walk sequence) which meets the above mandatory conditions is selected.
- If there are items of the SKU already stored and there is space available in the current location, the same storage location is selected.
- If there are items of the SKU already stored in multiple locations and there is space available in at least one of the locations, the location with most available space is selected.
- If there are items of the SKU already stored but there is no available space in any of the current locations where it is currently stored, a location with available space closest to one of the existing storage locations is selected.

10.4.2   Operator Instruction Sequence

The main operator instruction sequence for GOH storage is shown below. Note that this does not show all exceptions – these are described in the subsequent sections.

GOH Putaway

Key:
- Operator action / decision
- WCS action / decision
- MOI action / display

Flowchart:
START (from Pick-Up) → Select first Putaway location → Display storage location and SKU → Manual override of location?
- yes → Prompt to scan new location
- no → Prompt to scan location

→ Valid location scanned?
- no → Display storage location and SKU
- yes → Prompt to scan Bin LP

→ Valid Bin scanned?
- no → Prompt to scan Bin LP
- yes → Prompt to confirm quantity putaway

→ Enter quantity → Update location contents and trolley contents → More items on train?
- yes → Select next Putaway location → Display storage location and SKU
- no → FINISH (log out)

10.4.2.1   Overriding the Recommended Storage Location

WCS always recommends a storage location. However, the putaway operator can override the recommended location by scanning a location barcode. WCS cannot confirm whether or not the location is valid for storage until the bin LP is scanned.

If an invalid location barcode is scanned, an error message is displayed and the original recommended location and SKU combination is displayed.

If the SKU associated with the bin is not valid for storage in the scanned location (e.g. different client/brand), an error message is displayed and the original recommended location and SKU combination is displayed.

If the location/SKU combination scanned is valid but the SKU is already stored in another location and there is space available in the location, the recommended alternative storage location is displayed and the operator is prompted to confirm that the new location is acceptable. If the operator elects to store in the WCS-recommended location, the next storage location and SKU in putaway sequence are displayed. Note that this could result in instructions being displayed for a different SKU than the one that the operator attempted to override.

10.4.2.2   Confirmation of Putaway

When the bin LP has been scanned to confirm the SKU, the operator is prompted to confirm the quantity putaway.

If the quantity entered is greater than the current quantity in the bin, an error message is displayed and the operator is re-prompted to confirm the quantity.

If the quantity entered is fewer than the current quantity in the bin, the operator is prompted to confirm the quantity. If the same quantity is confirmed, WCS transfers the confirmed quantity from the bin into the location. If the same quantity is not confirmed, the operator is re-prompted to confirm the quantity. The quantity entered is only accepted if it is the same as the previous quantity entered.

If the quantity entered is exactly the same as the current quantity in the bin (this is the normal case), the quantity is transferred to the location and the trolley id is deleted.

10.4.2.3   Train Putaway Completion

When all known items on an operator's train have been stored, the operator is prompted to confirm that all GOH trolleys on the train are empty. If the operator confirms that the train is not empty, he/she is directed to take the train to GOH QA where the problem can be manually investigated and resolved.

10.4.2.4   Early Putaway Completion

It is possible that a GOH trolley may be physically empty before it is logically empty (e.g. receiving error, storage error). The operator may select the 'Confirm Train Empty' function at any time. If there are items logically remaining on the train, the operator is warned that some items have not been stored and is prompted to confirm that the train is empty. If the train is confirmed empty, the items which were logically on the train are made missing and an event is logged.

10.5   Related Elements

10.5.1   Operations Management Screens

There is a specific OM screen showing all current GOH putaway tasks.

10.5.2   MOI Functions

The table below shows the MOI functions specific to GOH Putaway.

Function	Description	Menu Level	Section
GOH Putaway	Used to store GOH stock	Top Level	10.3, 10.4.2
Train Empty	Confirms a train to be empty before it is logically empty.	GOH Putaway Options	10.4.2.4

10.5.3 LOI Functions

There is no LOI associated with GOH Putaway.

10.5.4 Operational Events

Section 21.2 defines the general format of Operational Events. The table below defines the information that is logged in addition to the standard details for the specific GOH Putaway Operational Events.

Event	Trigger	Fields
GOH_COLLECT	When a GOH operator collects a GOH bin from receiving	GOH Bin Id
GOH_STORE	When a GOH operator stores an item in a GOH location	GOH Bin Id, Location Id, SKU, Quantity
GOH_OVERRIDE	When a GOH operator overrides the recommended storage location for a SKU	GOH Bin Id, Recommended Location Id, Selected Location Id, SKU, Quantity
GOH_EARLY_COMPLETE	When a GOH operator confirms that a train is unexpectedly empty. An event is logged for each missing SKU on the trolley.	GOH Bin Id, SKU, Quantity

10.5.5 Statistics

The table below defines the statistics that are maintained for GOH Putaway.

Name	Index	Comments
GOH Bins Collected	1	
GOH SKUs Stored	GOH Aisle	Incremented once per SKU per putaway
GOH Items Stored	GOH Aisle	Incremented once per item per putaway

10.5.6 Alarms and Alerts

The table below defines the alarms and alerts that are associated with the GOH Putaway process. They are displayed on the WCS Alarms page.

Alarm	Description	Drill Down
Received GOH Not Stored	Indicates that a received GOH item has not been stored within 'n' (configurable) minutes of receipt confirmation.	To a list of GOH SKUs awaiting putaway.
GOH Putaway Not	Indicates that a GOH putaway task	To a list of outstanding GOH

| Finished | that has started, has not been finished within 'n' (configurable) minutes of starting. | putaway moves. |

10.5.7 Configuration Parameters

The table below lists the configuration parameters that are used to control the GOH putaway functions.

Parameter Name	Function	Values	Section
Max GOH Bins on Putaway Train	Defines the maximum number of GOH bins that can be linked to form a train for putaway	1..100	10.3.1

DEMATIC

11   GOH PICKING

11.1   Picking Overview

Picking the hanging element of orders uses the same equipment as for the putaway process described in Section 9.9.

Hanging picks are released for picking according to the rules described in Section 9.4.

11.2   Allocation of Picks to Bins

WCS combines released orders for the same store (ecommerce orders are treated as a single store) and despatch date into a single logical bin.

If the hanging picks in an order exceed the capacity for a GOH bin, the order is split into two or more bins. The picks are split between the bins so that the number of pick location aisles is minimised.

11.3   Order Start

An operator using a WCS MOI selects GOH Picking and builds a train by scanning one or more GOH trolley bins.

WCS assigns a logical bin of picks to each bin scanned. The picks assigned to the first bin scanned are for the highest priority consignment available.

If the items are to be despatched flat according to the order processing configuration table described in Section 9.3.1, then the destination of the train after picking is the GTP – GOH merge area. Otherwise, the train's next destination will be the auto baggers. All the picks assigned to the train require the same destination after picking.

The picks assigned to each subsequent bin scanned are selected to minimise the number of pick location aisles that the operator must visit.

The addition of bins to the trolley train stops if any of the following is true:
- There are no more released GOH picks to be added, without exceeding the configurable maximum number of pick location aisles *Max GOH Pick Aisles on Train* for a trolley train
- The configurable maximum number of items that can be picked on a single trolley train *Max GOH Picked Items on Train* has been reached
- The configurable maximum number of bins that can be used in a single trolley train *Max GOH Bins on Train* has been reached
- The configurable maximum weight of picks that can be built in a single trolley train *Max GOH Weight on Train* has been reached
- The operator selects the Train Full option instead of scanning another GOH bin

When the trolley train build has stopped, the operator is guided through the trolley train picking process.

11.4   Picking Process

The WCS MOI directs the operator to go to a specific pick location - the pick location with the lowest pick walk sequence number of all the picks in the trolley train.

The operator scans the pick location barcode to confirm to that the operator is at the correct location.

WCS displays the details (SKU, description, colour, size, quantity to pick) of the first outstanding pick to be performed at the location. The operator must find an item matching the description in the location. The operator then scans the SKU of the item to confirm that the correct item has been found.

If the pick is for a quantity greater than 1, the operator inputs on the MOI the actual number of items taken from the pick location. The operator can input a smaller quantity picked than instructed by WCS; if this happens then the next pick instructed by WCS will be for the remaining quantity. The operator cannot input a larger quantity than instructed by WCS.

WCS then indicates the GOH bin on which the item should be hung. The operator scans the bin LP to confirm that this has taken place.

If WCS requires one or more further picks from the same location, WCS displays the details of the next outstanding pick. This may or may not be for the same SKU, and may or may not be onto the same GOH bin as the previous pick.

If the next outstanding pick is from a different location, then WCS directs the operator to move to that location.

When there are no more outstanding picks for any of the bins in the train, WCS directs the operator to take the train to its next destination.

If the items are to be despatched flat, the GOH trolley should be taken to the GTP – GOH merge area as described in Section 11.6. Otherwise, the GOH trolley should be taken to the GOH auto baggers for packing as described in Section 18.2.1.

11.5   Picking Exceptions

11.5.1   Exception: Stock Shortage

If the operator is unable to find any stock of the correct SKU in the pick location, the operator selects the Stock Shortage option. WCS then holds all stock of the SKU that it thought was in the location with the Stock Shortage exception as a reason.

WCS returns the affected picks to a *released* state, to be reserved from an alternative location if possible.

The operator is then directed to the location for the next outstanding pick.

An alert is raised on the OM status line for the held stock. This alert remains until a supervisor investigates the problem and either removes the hold from the stock, or deletes the stock from WCS.

11.5.2   Exception: Stock Damaged

If the operator finds stock of the correct SKU in the pick location but sees that it is damaged, the operator selects the Stock Damaged option. WCS then holds all stock of the SKU in the location with the Stock Damaged exception as a reason.

WCS returns the affected picks to a *released* state, to be reserved from an alternative location if possible.

The operator is then directed to the location for the next outstanding pick.

An alert is raised on the OM status line for the held stock. This alert remains until a supervisor investigates the problem and either removes the hold from the stock, or deletes the stock from WCS.

11.5.3   Exception: Bin Full

If the operator sees that the bin is already so full that a single unit of the stock is unable to fit in the bin, the operator selects the Carton Full option.

WCS returns all the outstanding picks for that bin to a *reserved* state. They will be picked into a new bin as part of a future trolley train.

11.6   GTP – GOH Merge Area

In the GTP – GOH merge area, hanging stock to be despatched flat is transferred into pick cartons.

11.6.1   Location Configuration

Up to 1000 individual locations may be configured in the GTP – GOH merge area for the temporary storage of hanging items.

Each location is identified by a unique barcode and is capable of containing multiple items of different SKUs. Each location is configured to one client.

11.6.2   Stock Arrival

An operator uses a WCS MOI equipped with a barcode scanner to identify each bin that is delivered to the GTP – GOH merge area containing picked stock.

WCS verifies that the scanned bin is expected there, and indicates the client owning the stock.

The operator selects a location configured for the client and transfers the entire contents of the bin into it. The location may already contain stock.

The operator scans the location barcode to confirm that the stock has been transferred to the location. WCS verifies that the location is configured to the client that owns the stock.

If WCS is satisfied that the stock has been transferred, the bin is now eligible to be reused for another putaway or picking operation.

11.6.3   Carton Arrival

Pick cartons are delivered to the GTP – GOH merge area from the GTP area.

A pick carton may be empty, or may already contain items picked in the GTP area for the same order. It is not routed to the GTP – GOH merge area until all the hanging stock required to be transferred into it has been confirmed in a location in the GTP – GOH merge area.

11.6.4 Merge Process

An operator uses a WCS MOI equipped with a barcode scanner to identify each carton that arrives.

WCS verifies that the scanned carton is expected there, then displays the details (location, SKU, description, colour, size, total quantity of items required) of the first item to be transferred into the carton. The first item is derived from the sequence specified by the Host when it transmitted the order details to WCS, although any picks performed in the GTP area will already be in the carton.

The operator scans the SKU and if more than 1 was required, confirms the quantity transferred into the carton. WCS then displays details of the next item required.

11.6.5 Carton Takeaway

When all the items required have been transferred into the carton, WCS instructs the operator to scan the carton again. The operator scans the carton barcode as confirmation that the merge process is complete, then loads the carton onto the takeaway conveyor.

The carton is routed through the document inserters (Section 16.7.9) to either a pack station or the finishing line.

11.6.6 Exceptions

11.6.6.1 Stock Shortage

If the operator is unable to find any stock of the correct SKU in the GTP – GOH merge location, the operator selects the Stock Shortage option. WCS then holds all stock of the SKU that it thought was in the location with the Stock Shortage exception as a reason.

The operator is then directed to the location for the next item. When there are no outstanding items, the carton takeaway process takes place as normal.

The state of the affected picks remains unchanged. An alert is raised on the OM status line for the held stock. This alert remains until a supervisor investigates the problem and either removes the hold from the stock, or sets the picks unpicked.

If the hold state is removed, then the picks will be added to a future new carton. If a pick is set unpicked, it returns to a *released* state to be picked again if possible, although it may be automatically or manually abandoned.

11.6.6.2 Stock Damaged

If the operator finds stock of the correct SKU in the GTP – GOH merge location but sees that it is damaged, the operator selects the Stock Damaged option. WCS then holds all stock of the SKU in the location with the Stock Damaged exception as a reason.

The operator is then directed to the location for the next item. When there are no outstanding items, the carton takeaway process takes place as normal.

The state of the affected picks remains unchanged. An alert is raised on the OM status line for the held stock. This alert remains until a supervisor investigates the problem and either removes the hold from the stock, or sets the picks unpicked.

DEMATIC

If the hold state is removed, then the picks will be added to a future new carton. If a pick is set unpicked, it returns to a *released* state to be picked again if possible, although it may be automatically or manually abandoned.

11.6.6.3   Carton Full

If the operator sees that the carton is already so full that a single unit of the stock is unable to fit in the carton, the operator selects the Carton Full option.

The normal carton takeaway process then takes place. The outstanding picks will be added to a future new carton.

This exception cannot be selected if WCS believes the carton to be empty

11.6.6.4   Carton Unexpectedly Taken Away

If the carton is loaded onto the takeaway conveyor before the merge process has been confirmed complete, the carton returns to the GTP – GOH merge area.

If the carton unexpectedly appears on the conveyor at a location from where it is not possible to return to the GTP – GOH merge area, it is routed to the next QA station or sorter reject lane.

11.7   Related Elements

11.7.1   Operations Management Screens

There is a specific OM screen showing all outstanding GOH picks, summarised by order type and aisle.

11.7.2   MOI Functions

The table below shows the MOI functions specific to GOH picking.

Function	Description	Menu Level	Section
GOH picking	Used to perform GOH picks	Top Level	11.4
Train Full	Reports no more GOH bins to be built onto train	GOH Picking Options	11.4
GTP – GOH Merge	Used to transfer picked GOH stock into pick cartons	Top Level	11.6
Stock Arrival	Reports stock arrival in GTP – GOH merge area	GTP – GOH Merge	11.6.2
Merge	Reports stock transfer into carton	GTP – GOH Merge	11.6.4

11.7.3   LOI Functions

There is no LOI associated with GOH picking.

11.7.4   Operational Events

Section 21.2 defines the general format of Operational Events. The table below defines the information that is logged in addition to the standard details for the specific GOH Picking Operational Events.

Event	Trigger	Fields
GOH_BUILD	When a GOH operator adds a bin to a train	GOH Bin Id
GOH_PICK	When a GOH operator confirms a pick	GOH Bin Id, Location Id, SKU, Quantity, Order Id
GOH_PICK_EXCEPTION	When a GOH operator reports an exception when issued with a pick	GOH Bin Id, Location Id, SKU, Quantity, Order Id, Exception
GOH_MERGE_ARRIVAL	When an operator transfers an item from a bin to a GTP – GOH merge location	GOH Bin Id, Location Id, SKU, Quantity, Order Id
GOH_MERGE_CARTON	When an operator transfers a hanging item into a carton	Location Id, Carton Id, SKU, Quantity, Order Id
GOH_MERGE_EXCEPTION	When an operator reports an exception when issued with a merge instruction	Location Id, Carton Id, SKU, Quantity, Order Id, Exception

11.7.5 Statistics

The table below defines the statistics that are maintained for GOH Picking.

Name	Index	Comments
GOH Trains Built	1	
GOH Bins Built	1	
GOH Items Picked	GOH Aisle	Incremented once per item picked
GOH Items Merged	1	Incremented once per item transferred into carton
GOH Cartons Merged	1	Incremented once per carton for which the merge process is complete

11.7.6 Alarms and Alerts

The table below defines the alarms and alerts that are associated with GOH picking functions. They are displayed on the WMS Alarms page.

Alarm	Description	Drill Down
GOH stock held	There is stock stored in a GOH location with one or more hold state set	List of stock

11.7.7 Configuration Parameters

The table below lists the configuration parameters that are used to control the GOH picking functions.

Parameter Name	Function	Values	Section
Max GOH Pick Items in Bin	Defines the maximum number of items that can be picked in the	1..100	9.5.5, 9.7.1, 11.2

Parameter Name	Function	Values	Section
	same bin		
Max GOH Weight in Bin	Defines the maximum weight of items that can be picked in the same bin	1..100 kg	9.5.5, 9.7.1, 11.2
Max GOH Pick Items on Train	Defines the maximum number of items that can be picked on the same trolley	1..1,000	11.3
Max GOH Bins on Train	Defines the maximum number of bins that can be picked on the same train	1..100	11.3
Max GOH Weight on Train	Defines the maximum weight of items that can be picked on the same train	1..1,000 kg	11.3
Max GOH Pick Aisles on Train	Defines the maximum number of pick location aisles that can be assigned to a GOH trolley train	1..100	11.3

DEMATIC

12 MANUAL PUTAWAY

This section describes the process of selecting storage locations for the storage of palletised and loose case SKUs in the manual storage areas and the process of storing the pallets and cases.

12.1 Manual Storage Areas

The manual storage areas are defined in section 2.1.1.

12.2 Operation Overview

The storage of pallets and loose cases in the manual storage areas is controlled by WCS. Putaway operators use a range of equipment capable of accessing pallet and case storage locations. Operators are instructed via RF devices.

12.2.1 Basic Elements

All pallets have a barcoded licence plate which is used to track the location of the pallet.

All loose cases have a barcoded licence plate which is used to track the location of the case. Loose cases are transported on a pallet which has a barcoded licence plate.

The truck types which can be used for putaway in the manual storage areas are defined in section 2.12.1.

12.2.2 Manual Location Configuration

The manual storage area locations are highly configurable to allow control of which SKU goes where.

The following information can be configured for each aisle:

Field	Possible Values
Client	Specific Client Id or ANY
Brand	Specific Brand, set of Brands or ANY
Aisle Type	Narrow / Wide
Maximum Truck Weighting	0..1000. See Section 2.12.1

The following information can be configured for each location within an aisle:

Field	Possible Values
Client	One of the Clients that has been configured for the aisle. Default to the aisle's client.
Brand	One or more of the Brands that have been configured for the aisle. Default to the aisle's Brand(s).
Usage	Storage / Reserve / Indent

In addition to the above, location-specific configuration is described in sections 2.1.1.1 and 2.11.

12.3 Equipment Used

The equipment used to perform putaway depends on the type of pallet truck. In most cases, the operator uses a truck-mounted RF device. However, in some situations *[TBC]* a hand-held RF device is used.

12.4   Management of Putaway Operators

Putaway in the manual areas can be performed by two types of operators depending on the storage location. Trammers can deliver a pallet directly to storage if their truck type can access the location (see section 8.5.2). Putaway operators must perform putaway for those location types which cannot be accessed by a trammer.

12.4.1   Restricting Access to Manual Aisles

The truck type weighting (Section 2.12.1) is used to configure how many trucks of different types can be in the same aisle at a time. WCS gives putaway instructions to an operator only if the configuration of the aisle allows for the operator's truck type weighting.

If more than one truck is permitted into an aisle at the same time, the operators must manually ensure that they can work around each other. WCS does not restrict the movement of the operators within the aisle.

12.4.2   Capacity of P&D Locations

Putaway operators generally start a putaway operation by picking up a pallet from an aisle's P&D location. The capacity of each P&D location (i.e. how many pallets can be at the location awaiting putaway and how many pallets can be at the location awaiting tramming) is configurable.

If the number of pallets awaiting storage at a P&D location has reached the maximum allowed, no further pallets are trammed to the P&D location.

Similarly, if the number of pallets awaiting tramming at a P&D location has reached the maximum allowed, no further pallets are retrieved from the aisle to the P&D location.

12.4.3   Movement of Operators Between Manual Areas

There are three principle areas within which putaway operators work: VNA, Case Shelving and Wide Aisle. WCS does not move operators between these manual storage areas (e.g. between VNA and Indent). This is due to restrictions on physical work areas for the different truck types.

A putaway operator is prompted to select their working area when they first log in to WCS using an RF device. The operator is then only prompted to perform putaway tasks within the selected area until he/she logs out or selects a new working area.

12.4.4   Movement of Operators Within a Manual Area

WCS manages the movement of putaway operators within each manual area. In order to achieve this, a putaway operator is prompted to confirm their current aisle when they select a manual working area. The operator may reply with a specific aisle or can specify 'any'.

If a specific aisle has been specified, WCS selects the closest aisle to the current aisle which has an outstanding putaway task.

If a specific initial aisle has not been specified, WCS selects the aisle which has the oldest outstanding putaway task.

12.4.4.1 Meaning of 'Closest Aisle'

WCS uses the configured putaway sequence number for the lowest numbered location within an aisle to determine the closest aisle to the current aisle. The closest aisle is considered to be the aisle with the lowest putaway sequence number greater than the lowest putaway sequence number of the current aisle. If there are no aisles with a higher putaway sequence number, the aisle with the oldest putaway task is selected.

Example: If there are four adjacent aisles within a work area with configured putaway sequence ranges as follows:

> Aisle 1: 1 – 100
> Aisle 2: 101 – 200
> Aisle 3: 201 – 300
> Aisle 4: 301 – 400

Aisle 2 is closest to aisle 1 because the lowest putaway sequence number in aisle 2 is 101 (compared to 201 in aisle 3 and 301 in aisle 4) and is therefore the closest value to 1. Similarly, aisle 3 is closest to aisle 2 and aisle 4 is closest to aisle 3.

A special rule applies to aisle 4 as there are no aisles with greater putaway sequence number. In this case, WCS selects the aisle with lowest putaway sequence number (aisle 1).

12.5   Collecting a Pallet from a P&D Location

When a putaway operator is available for work (and WCS has determined the operator's current work area and aisle), the operator is prompted to go to a specific P&D location within the selected work area and scan one of the pallets that are awaiting putaway. Any pallet at the P&D location can be scanned.

Manual Pallet Pick-Up for Putaway
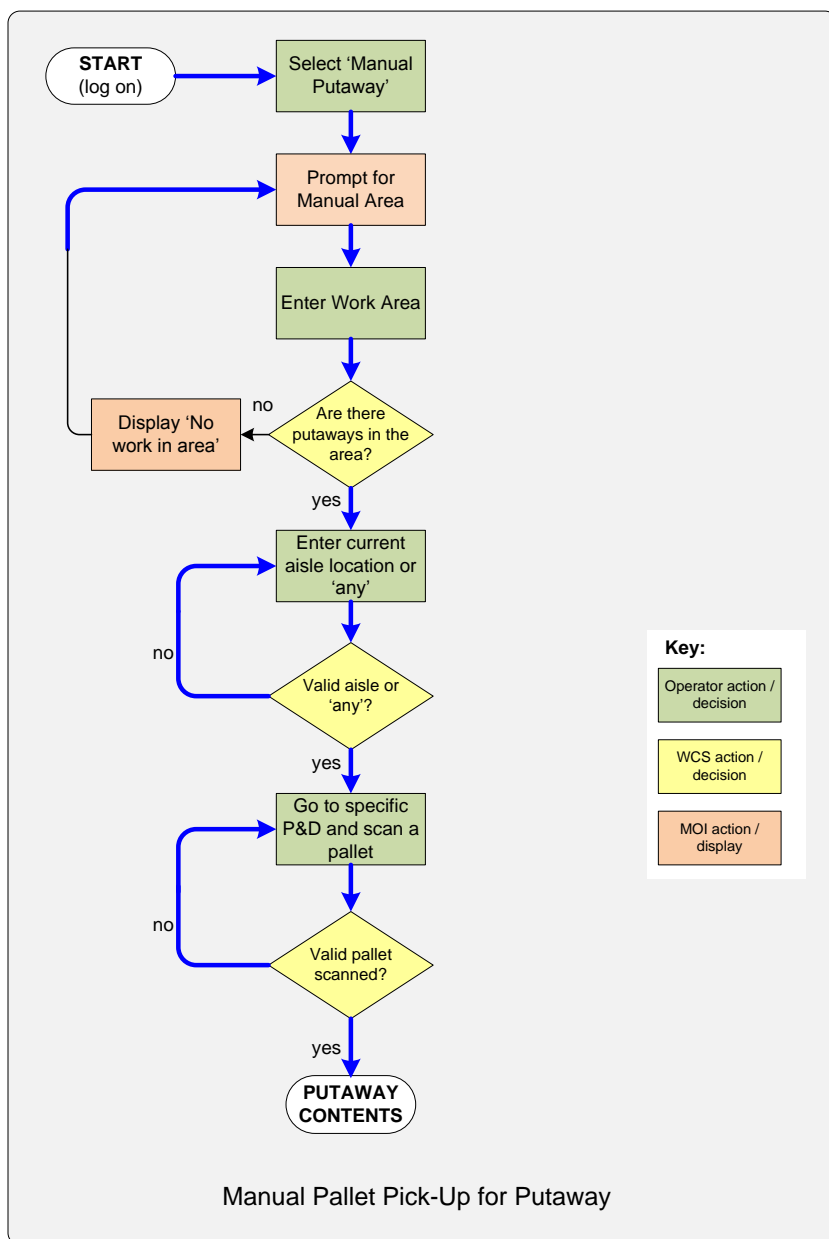
12.5.1   Going to the Wrong P&D Location

WCS validates the operator's location when a pallet is scanned for putaway. If the scanned pallet was not expected at the prompted P&D location, WCS checks if the pallet is valid for putaway.

If the scanned pallet has not yet been allocated to another putaway operator, pickup of the pallet is accepted.

12.5.2   Pallet Pickup Exceptions

12.5.2.1   Unknown Pallet

If a pallet that is unknown to WCS is scanned, an error message is displayed and the operator is re-prompted to scan a valid pallet at the P&D location.

12.5.2.2 Pallet Not Requiring Putaway

If a pallet that does not require putaway is scanned, an error message is displayed and the operator is re-prompted to scan a valid pallet at the P&D location.

12.6 Storing Pallets in Manual Locations

12.6.1 Storage Strategy Configuration

There are two WCS storage strategies available within the manual storage areas – Brand Grouping and Brand Spreading. The configuration parameter, *Manual Storage Strategy*, determines which of the approaches is used.

A pallet may contain stock for more than one brand. The brand with the largest quantity of stock on the pallet is used when applying the rules in this section.

12.6.1.1 Brand Grouping

Brand Grouping stores all pallets for a brand within the smallest number of aisles. The aim of this approach is to ensure that all stock for a brand is stored together. This approach makes stock taking simpler but can make picking slow as all picking for a brand can be in the same aisle which means that fewer pickers can pick the brand at the same time.

When the first pallet for a brand is stored, WCS selects the lowest numbered aisle within the storage area that has been configured to accept pallets of the brand and which currently has the least number of brands stored in it.

When subsequent pallets of a brand are stored, WCS selects an aisle that has been configured to store the brand and which already has some pallets of the brand stored. If the only aisle(s) where the brand is already stored are full, WCS selects the lowest numbered aisle within the storage area that has been configured to accept pallets of the brand.

12.6.1.2 Brand Spreading

Brand Spreading spreads the pallets for a brand across all aisles that have been configured to store that brand. The aim of this approach is to ensure that that the stock for a brand is spread across a wide storage area. This approach allows picking for a brand to be performed by multiple pickers (one in each aisle).

When any pallet for a brand is stored, WCS selects the lowest numbered aisle that is configured for the brand and contains the lowest number of pallets of the brand.

12.6.2 WCS Selection of Storage Location

WCS applies location selection rules for pallets. When selecting a storage location, the following conditions must be true for the selected location:

- The location is empty and available.
- The location is configured to accept storage of items for the same Client as the SKU.
- The location is configured to accept storage of items for the same Brand as the SKU.
- The location is the same height as or higher than the pallet.

The specific location selected within an aisle depends on the location selection strategy configured for WCS. The configuration parameter, *Location Selection Strategy*, controls this and can be set to Brand Grouping or Brand Spreading.

12.6.2.1   Brand Grouping Location Selection

Brand Grouping stores all pallets of a brand as close as possible to each other within an aisle. The aim of this approach is to have brand-pure rack columns for storage.

If there are no other pallets of the brand stored in the aisle, WCS selects the column which has available space closest to the South end of the aisle.

If there are already pallets of the brand stored in the aisle and there is available space in at least one of the columns which already contain pallets of the brand, WCS selects the column which has available space closest to the South end of the aisle.

If there are already pallets of the brand stored in the aisle but there is no available space in any of the columns which hold these pallets, WCS selects the column which has available space closest to the South end of the aisle.

In all cases above, once a column has been selected, the lowest available location in the column is selected.

12.6.2.2   Brand Spreading Location Selection

Brand Spreading distributes pallets of a brand across the locations within an aisle. The aim of this approach is to ensure that pallets of a brand are not concentrated in one area of the warehouse.

If there are no other pallets of the brand stored in the aisle, WCS selects the column which has available space closest to the South end of the aisle.

If there are already pallets of the brand stored in the aisle, WCS selects the column which holds the lowest number of pallets of the brand and has available space closest to the South end of the aisle.

In all cases above, once a column has been selected, the lowest available location in the column is selected.

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12.6.3   Operator Instruction Sequence

The main operator instruction sequence for pallet storage is shown below. Note that this does not show all exceptions – these are described in the subsequent sections.
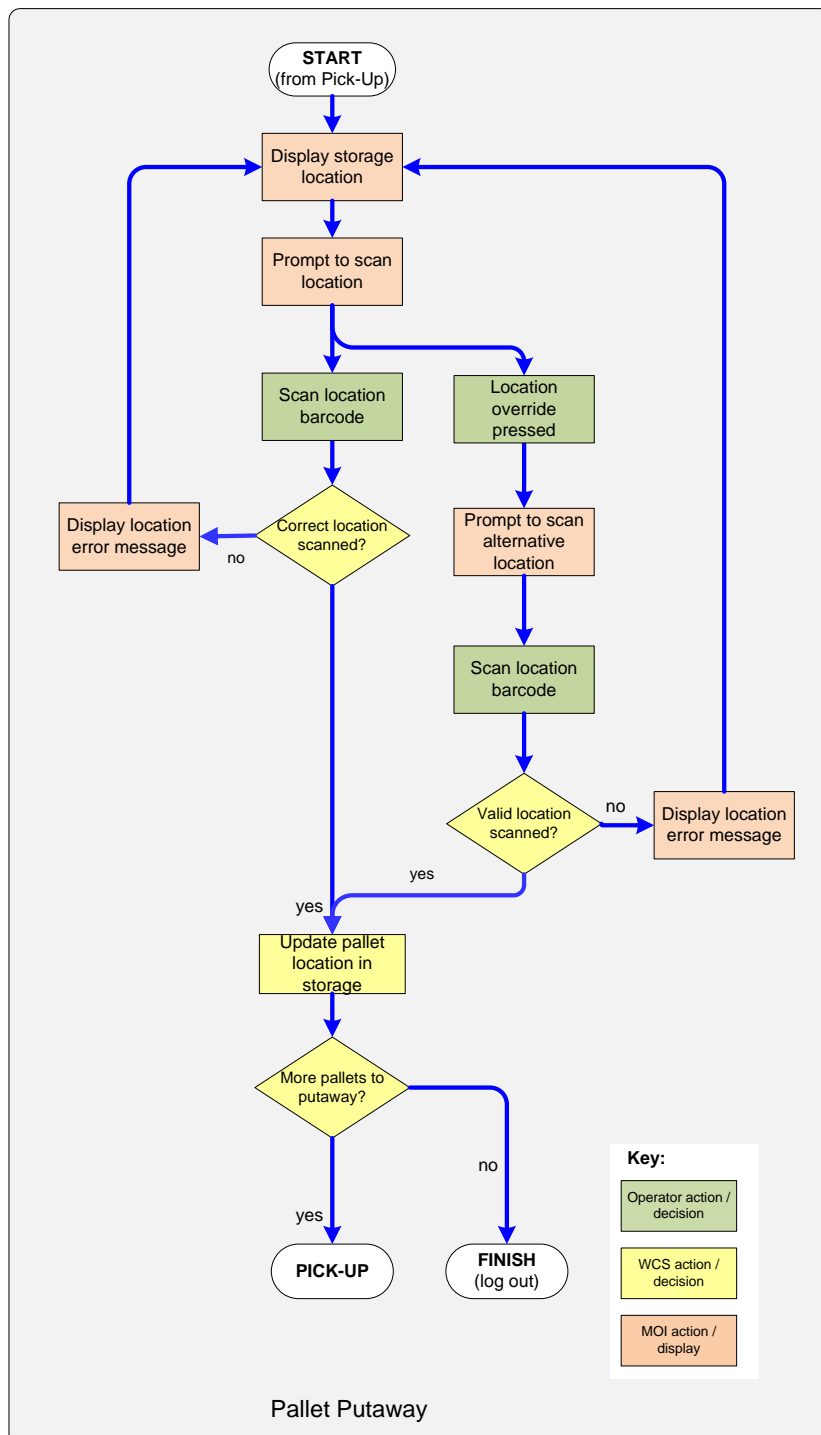
12.6.3.1   Overriding the Recommended Storage Location

WCS always recommends a storage location. However, the putaway operator can override the recommended location by selecting the 'Options' function on the RF device and scanning a location barcode.

DEMATIC   DAI

If an invalid location barcode is scanned, an error message is displayed and the original recommended location is displayed.

If the SKU associated with the pallet is not valid for storage in the scanned location (e.g. different client/brand), an error message is displayed and the original recommended location is displayed.

12.6.3.2   Confirmation of Putaway

When the operator scans a valid location barcode, the pallet and location details are updated and the pallet is considered to have been stored.

12.6.4   Pallet Putaway Exceptions

12.6.4.1   Location Full

A location full exception occurs if there is already a pallet in a rack location when the operator arrives there. This should only happen if an operator has previously deposited a pallet in a different location to the one that was confirmed.

The putaway operator confirms the exception by selecting the 'Location Full' function key. WCS then selects an alternative location in the aisle using the rules defined in section 12.6.2 and prompts the operator to go to this location.

If there are no other suitable storage locations within the aisle, the pallet to a P&D location where an alternative storage aisle is selected and a tramming task created to there.

The location where the exception has occurred is flagged as containing an unknown pallet so that the pallet can be retrieved for identification at a later time.

12.7   Case Putaway

The putaway instruction sequence is different for loose case putaway. The putaway operator picks up a pallet but then deposits individual cases from the pallet into loose case storage locations.

12.7.1   Storage Strategy Configuration

There is no system-driven storage strategy in VNA case shelving. The operators are responsible for selecting the locations for storage of cases. However, WCS aids the putaway operator by recommending storage locations based on location capacity. This is described in more detail below.

12.7.2   Location Capacity

The maximum number of cases that can be stored in a manual rack location is configurable on WCS, as is the maximum volume of stock in the location. When selecting a storage location for a case, WCS does not exceed either of the configured maximums in a location. Note, however, that an operator may choose to exceed the configured capacity of a location when storing cases.

12.7.3   WCS Selection of Storage Location

WCS always selects a location which has fewer than the configured maximum number of cases currently stored in it, and which is at least one case below the configured maximum volume. Selection is a two-step process:

- The closest rack column to the South end of the aisle which contains a location with space is selected.
- The lowest rack location which has space for at least one case is selected.

12.7.4   Operator Putaway Sequence

Each case rack location has a configured putaway sequence number. When a putaway operator has confirmed that a pallet has been picked up, WCS determines the putaway sequence for the pallet contents.

WCS selects a storage location for each case using the rules defined above. The operator is then sent to each selected storage location in ascending order of putaway sequence number.

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12.7.5   Operator Instruction Sequence

The main operator instruction sequence for case storage is shown below. Note that this does not show all exceptions – these are described in the subsequent sections.
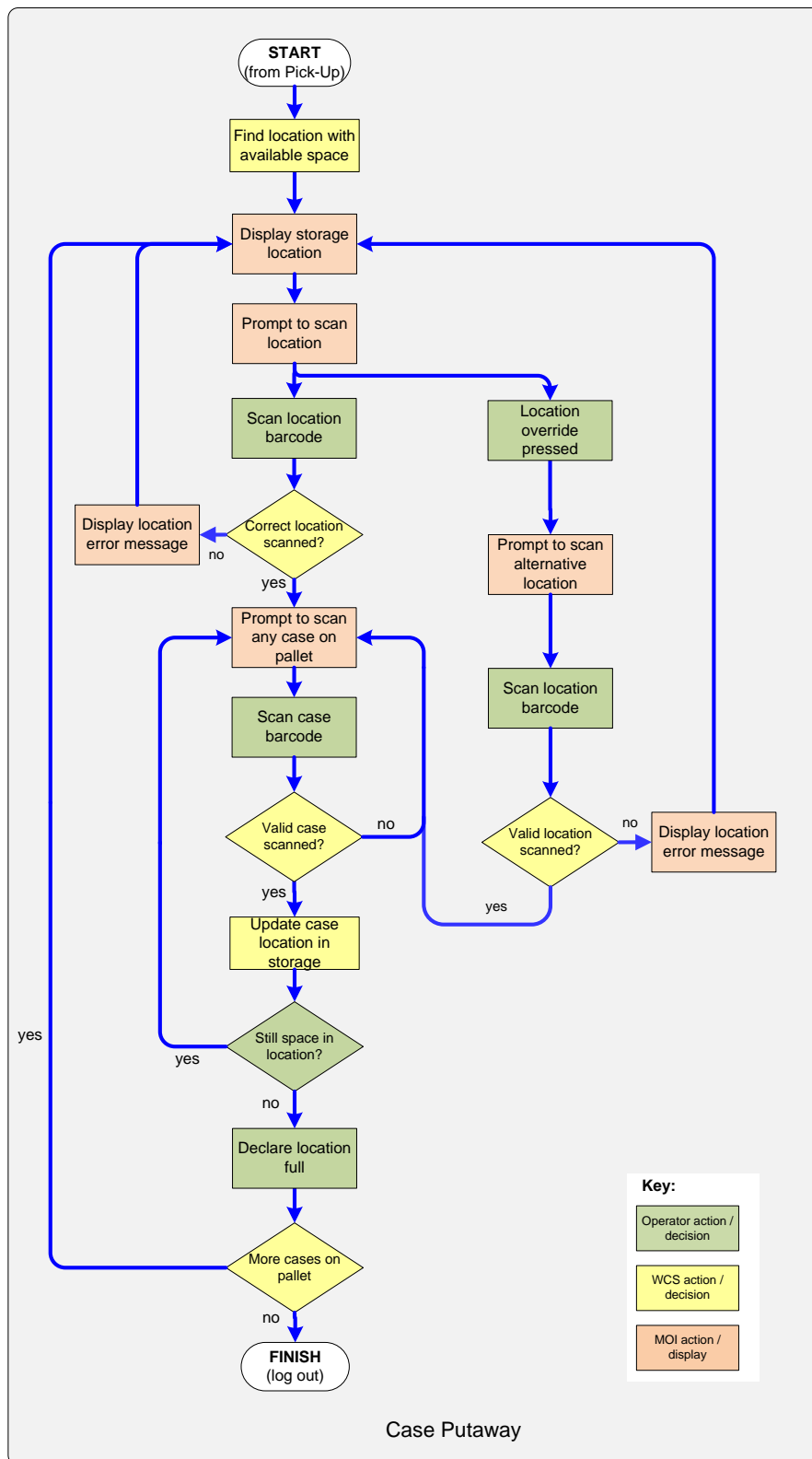
Case Putaway

12.7.5.1   Overriding the Recommended Storage Location

WCS always recommends a storage location. However, the putaway operator can override the recommended location by selecting the 'Options' function on the RF device and scanning a location barcode.

If an invalid location barcode is scanned, an error message is displayed and the original recommended location is displayed.

12.7.5.2   Confirmation of Putaway

When the operator scans a valid location barcode, WCS then prompts the operator to scan a case. Any case of any SKU can be scanned.

When a valid case has been scanned, the case and location details are updated and the case is considered to have been stored.

12.7.5.3   Continuing at the Same Location

By default, WCS expects a putaway operator to continue storing cases in the current location until it is declared full. When the previous case has been confirmed to have been stored (see above), WCS then prompts the operator to scan the next case to be stored in the same location. This process continues until the operator declares the location to be full.

12.7.5.4   Location Full

The putaway operator may declare a location to be full at any time by selecting the 'Location Full' key. WCS then finds the next location to be used for storage (see section 12.7.3) and prompts the operator to go to it and scan the location barcode. The putaway process then continues, as normal, at the new location.

12.7.5.5   Case Putaway Completion

When all known items on a pallet have been stored, the operator is prompted to confirm that the pallet is empty. If the operator confirms that the pallet is not empty, the WCS prompts the operator to scan each remaining case on the pallet.

As each case is scanned, WCS displays the current expected location of the case. This allows the operator to manually correct any local errors (e.g. the case was scanned into a location but was not physically put there).

When all cases remaining on the pallet have been scanned, the operator is prompted to confirm that the pallet is still not empty. If the pallet is not empty, the operator is prompted to take it to Manual QA for further investigation. This is a manual process and is not controlled by WCS.

If the pallet is empty (the normal situation), the operator must add the empty pallet to a pallet stack outside the aisle. This function is not under WCS control.

12.7.5.6   Early Putaway Completion

It is possible that a pallet may be physically empty before it is logically empty (e.g. receiving error, storage error). The operator may select the 'Confirm Pallet Empty' function at any time. If there are cases logically remaining on the pallet, the operator is warned that some cases have not been stored and is prompted to confirm that the pallet is empty.

If the pallet is confirmed empty, the cases which were logically on the pallet are made *missing* and an event is logged.

12.8 Related Elements

12.8.1 Operations Management Screens

There is a specific OM screen showing all current pallet putaway tasks.

12.8.2 MOI Functions

The table below shows the MOI functions specific to Pallet Putaway.

Function	Description	Menu Level	Section
Pallet Putaway	Used to store pallet stock	Top Level	12.5

12.8.3 LOI Functions

There is no LOI associated with Pallet Putaway.

12.8.4 Operational Events

Section 21.2 defines the general format of Operational Events. The table below defines the information that is logged in addition to the standard details for the specific Pallet Putaway Operational Events.

Event	Trigger	Fields
PUT_COLLECT	When a putaway operator picks up a pallet from a P&D or from Receiving (for direct putaways)	Pallet Id
PUT_PLT_STORE	When a putaway operator stores a pallet in a pallet location	Pallet Id, Location Id, SKU, Quantity
PUT_CASE_STORE	When a putaway operator stores a case in a case location	Case Id, Pallet Id, Location Id, SKU, Quantity
PUT_PLT_OVERRIDE	When a putaway operator overrides the recommended storage location for a pallet of a SKU	Pallet Id, Recommended Location Id, Selected Location Id, SKU, Quantity
PUT_CASE_OVERRIDE	When a putaway operator overrides the recommended storage location for a case of a SKU	Pallet Id, Case Id, Recommended Location Id, Selected Location Id, SKU, Quantity
PUT_EARLY_COMPLETE	When a case putaway operator confirms that a pallet is unexpectedly empty. An event is logged for each missing case on the pallet.	Pallet Id, Case Id, SKU, Quantity

12.8.5 Statistics

The table below defines the statistics that are maintained for Pallet and Case Putaway.

Name	Index	Comments
Case Stored	Manual Aisle	Incremented once per case per putaway
Pallet Stored	Manual Aisle	Incremented once per pallet per putaway

12.8.6   Alarms and Alerts

The table below defines the alarms and alerts that are associated with putaway functions. They are displayed on the WMS Alarms page.

Alarm	Description	Drill Down
Putaway Task Too Long	A putaway task has been in progress for more than 'n' (configurable) minutes.	To a list of overdue putaway tasks.
Putaway Not Started	A pallet has been waiting on a P&D for putaway for more than 'n' (configurable) minutes.	To a list of overdue putaway pallets.

12.8.7   Configuration Parameters

The table below lists the configuration parameters that are used to control the Pallet and Case Putaway functions.

Parameter Name	Function	Values	Section
Manual Storage Strategy	Defines the pallet storage strategy for manual locations	BRAND GROUPING / BRAND SPREADING	12.6.1
Location Selection Strategy	Defines the location selection strategy for manual locations	BRAND GROUPING / BRAND SPREADING	12.6.2

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13   REPLENISHMENT

13.1   Replenishment Overview

Replenishment is the process by which stock is transferred to a pick area from a storage location outside that pick area.

There are only two types of replenishment within the DC:

- Manual pick area: replenishment to a manual pick location from a manual storage location
- GTP pick area: replenishment to decant (possible via a decant staging area) from a manual storage location. At decant the stock is transferred to totes which are fed into the storage multishuttle

There is no requirement for replenishment to the hanging pick area, as all hanging storage locations can be picked from.

WCS determines whether replenishment is required for a SKU based on the quantity of stock in the pick area, the unpicked orders known to WCS (whether released for picking or not), and predicted future orders.

13.2   Replenishment to Manual Pick Area

WCS considers for each semimechable SKU:
- Quantity of stock that fits in a pick location in manual area
- Quantity of stock to be picked in manual area to satisfy orders known to WCS

and for each nonmechable SKU:
- Quantity of stock that fits in a pick location in manual area
- **[a]** Quantity of stock picked in manual and GTP areas over the previous n days (where n ranges from 1 to 28, configurable by brand)
- **[b]** Quantity of stock to be picked in manual area to satisfy orders known to WCS
- **[c]** Predicted quantity of stock to be picked in manual area in the subsequent n days to satisfy orders unknown to WCS, as transmitted by the Host in the EXS message (where n ranges from 1 to 28, configurable by brand)

The relative weighting for each of values **[a]**, **[b]** and **[c]** is configurable by brand.

The result is that WCS maintains for each SKU:
- Number of dynamic pick locations required in manual area
- Minimum quantity of stock to be stored in manual pick location(s)
- Maximum quantity of stock to be stored in manual pick location(s)

The number of dynamic pick locations required in the manual area for the SKU will exceed 1 only to satisfy orders known to WCS.

There is no replenishment of mechable SKUs to the manual pick area.

WCS is responsible for the selection of manual pick locations in which the SKU is nailed, subject to the rules defined in Section 2.3.2.

13.3   Replenishment to GTP Pick Area

WCS considers for each semimechable SKU:

- Quantity of stock to be picked in GTP area to satisfy orders known to WCS

and for each mechable SKU:
- **[a]** Quantity of stock picked in manual and GTP areas over the previous n days (where n ranges from 1 to 28, configurable by brand)
- Number of different orders picked in manual and GTP areas over the previous n days (where n ranges from 1 to 28, configurable by brand)
- **[b]** Quantity of stock to be picked in GTP area to satisfy orders known to WCS
- Number of different orders to be picked in GTP area to satisfy orders known to WCS
- **[c]** Predicted quantity of stock to be picked in GTP area in the subsequent n days to satisfy orders unknown to WCS, as transmitted by the Host in the EXS message (where n ranges from 1 to 28, configurable by brand)

The relative weighting for each of values **[a]**, **[b]** and **[c]** is configurable by brand.

The result is that WCS maintains for each SKU:
- Minimum quantity of stock to be stored in GTP area
- Minimum number of totes containing stock to be stored in GTP area
- Maximum quantity of stock to be stored in GTP area
- Maximum number of totes containing stock to be stored in GTP area

There is no replenishment of nonmechable SKUs to the GTP area.

13.4 Replenishment Management

A WCS overview screen allows a supervisor to view a summary and list the outstanding replenishment tasks of each type.

The overview screen highlights priority replenishments, where there is insufficient stock in the manual pick locations / GTP area to satisfy all the outstanding orders known to WCS, and an alarm is raised on the WCS status bar.

The WCS configuration settings which are used to make the calculations described in Sections 13.2 and 13.3 may be amended, subject to user security and logging. WCS continuously recalculates replenishment tasks to take account of any such changes.

13.5 Replenishment Process

An operator using an HLOP is guided by a WCS MOI through the process.

The operator has an empty pallet on which to put the cases being replenished. Each pallet is used to replenish either pick locations in the manual area, or the GTP area – i.e. manual and GTP replenishment takes place separately.

Configuration settings determine the maximum number of cases, total volume and total weight that WCS plans to be replenished on a single pallet. If any of these parameter values is set too high, there is a possibility that an operator prematurely declares a replenishment pallet full as described in Section 13.6.2, which could delay a priority replenishment.

WCS plans the cases to be replenished on the pallet, preferring priority replenishments and then the storage locations with the highest pick path sequence. WCS then plans the sequence in which these cases are to be picked, based on the pick path configured to their existing storage locations.

The operator applies a pre-printed LP to the empty pallet and scans the LP on the MOI.

WCS directs the operator to the first location from which replenishment is to take place.

The operator may choose to scan the storage location barcode or the LP of the stock pallet in the location as confirmation that the operator is at the correct location.

The stock pallet may hold cases of different SKUs. WCS displays the details (SKU, description, colour, size, total quantity of cases to pick) of the stock required to be removed from the location.

WCS instructs the operator how many cases are to be transferred from the storage location onto the replenishment pallet. The operator scans each case LP to confirm it has been transferred onto the pallet. WCS rejects the scan if the case contains the wrong SKU.

WCS then directs the operator to the next location from which replenishment is to take place.

When the pallet is full, WCS instructs the operator to take it to the nearest P&D location. The operator scans the location barcode to confirm the pallet has been dropped there. This pallet will subsequently be handled by a trammer as described in Section 8.

WCS then plans another replenishment pallet and directs the operator to the first location.

13.6   Replenishment Exceptions

13.6.1   Exception: Stock Pallet Problem

The operator may be unable to confirm that all the instructed cases have been transferred from the stock pallet in the storage location onto the replenishment pallet, because of a problem with the stock pallet.

Possible problems are:
- No pallet is in the expected location
- Wrong pallet in the expected location
- Insufficient cases in the expected location
- Unable to scan case LP

WCS instructs the operator to scan the storage location barcode. WCS rejects all other scans until the operator scans the correct storage location barcode.

WCS then instructs the operator to scan a case LP again.

If the operator is unable to scan a case LP that satisfies WCS, the operator can select the Bypass option. The stock that WCS believed to be in the location of the required SKU becomes Held.

WCS then directs the operator to the next location from which stock is to be transferred onto the current replenishment pallet.

13.6.2   Exception: Pallet Full

If the operator believes it is not possible to place any more cases on the replenishment pallet, the operator selects the Pallet Full option. WCS then instructs the operator to take the pallet to the nearest P&D location as normal.

WCS is likely to include in the next planned replenishment pallet the storage locations which were missed because of the prematurely full pallet.

13.7 Related Elements

13.7.1 Operations Management Screens

There is an OM screen showing all outstanding replenishment tasks, summarised by type and by manual storage aisle.

13.7.2 MOI Functions

The table below shows the MOI functions specific to replenishment.

Function	Description	Menu Level	Section
Replenishment	Used to perform any replenishment tasks	Top Level	13.5
Bypass	Reports a problem with a stock pallet	Replenishment Options	13.6.1
Pallet Full	Reports a replenishment pallet to be prematurely full	Replenishment Options	13.6.2

13.7.3 LOI Functions

There is no LOI associated with replenishment.

13.7.4 Operational Events

Section 21.2 defines the general format of Operational Events. The table below defines the information that is logged in addition to the standard details for the specific replenishment Operational Events.

Event	Trigger	Fields
REPLEN_START	When a replenishment operator scans the LP of an empty replenishment pallet	Replenishment Pallet LP
REPLEN_PICK	When a replenishment operator confirms a case transferred from a stock pallet onto a replenishment pallet	Replenishment Pallet LP, Stock Pallet LP, Location Id, Case LP, SKU, Quantity
REPLEN_BYPASS	When a replenishment operator bypasses a pick in order to move on to the next storage location	Replenishment Pallet LP, Stock Pallet LP, Location Id, SKU
REPLEN_PALLET_FULL	When a replenishment operator reports a replenishment pallet to be prematurely full	Replenishment Pallet LP
REPLEN_DROPDOWN	When a replenishment operator drops a built replenishment pallet at a new location	Replenishment Pallet LP, Location Id

13.7.5 Statistics

The table below defines the statistics that are maintained for replenishment.

Name	Index	Comments
Replenishment Cases Picked	Manual Aisle	Incremented once per case picked

Replenishment Pallets Dropped Down	Manual Aisle	Incremented once per replenishment pallet dropped down, provided at least 1 case on pallet

13.7.6   Alarms and Alerts

The table below defines the alarms and alerts that are associated with replenishment functions. They are displayed on the WMS Alarms page.

Alarm	Description	Drill Down
Priority replenishment outstanding	There are outstanding replenishment tasks where the GTP area or manual pick location does not hold enough stock to satisfy all the orders known to WCS *to be despatched today?*	List of outstanding priority replenishment tasks

13.7.7   Configuration Parameters

The table below lists the configuration parameters that are used to control the replenishment functions.

Parameter Name	Function	Values	Section
Max Replenishment Pallet Cases	Defines the maximum number of cases that WCS plans onto a replenishment pallet	1..100	13.5
Max Replenishment Pallet Volume	Defines the maximum volume of cases that WCS plans onto a replenishment pallet	100..100,000 cm^3	13.5
Max Replenishment Pallet Weight	Defines the maximum weight of cases that WCS plans onto a replenishment pallet (g)	1..100,000	13.5

14 MANUAL PICKING

14.1 Picking Overview

This section covers the picking of stock from manual pick locations to satisfy specific orders.

This comprises:
- Full case picking, whereby the stock is despatched from the DC in the same case in which it arrived
- Split case picking, whereby individual units of stock are picked from cases and into pick cartons in which they will be despatched from the DC

Each manual storage location is configured to be one of:
- A full case pick location
- A split case pick location
- Not a pick location

A location cannot be used for both full case and split case picking, because the splitting of a case results in its LP being lost.

Picking the manual element of orders uses the same equipment as for the putaway process described in Section 12.

Manual picks are released for picking according to the rules described in Section 9.4.

The removal of stock from manual storage locations to supply manual pick locations and the GTP area is considered to be Replenishment and is described in Section 13.

14.2 Full Case Picking

This is the process whereby cases of stock are picked from manual pick locations onto pallets.

The manual pick locations contain a stock pallet holding cases of a single SKU. The stock pallet has its own LP. The cases do not have individual LPs.

The order processing configuration table described in Section 9.3.1 specifies whether these cases will be despatched from the DC by the pick pallet or by individual case. The despatch method is configurable by brand and order type, so this allows a new store order for a particular brand to leave the DC with the cases on a pallet, while an ordinary indent order is despatched as individual cases.

If the despatch method is by pallet, then cases of different SKUs can be picked onto the same pallet, provided they are to be despatched to the same store.

If the despatch method is by case, then cases for different stores can be picked onto the same pallet, provided they are of the same SKU.

The operator uses a reach truck with an RF device which runs a WCS MOI.

14.2.1 Order Start

An operator using a WCS MOI selects Full Case Picking, applies a pre-printed LP to an empty pallet and scans the LP on the MOI.

WCS calculates the highest priority order or orders to be picked onto the pallet, and whether the despatch method is by pallet or by case.

14.2.2   Picking Process

The WCS MOI directs the operator to go to a specific pick location. This is the pick location with the lowest pick walk sequence number of all the picks for the pallet.

WCS instructs the operator to scan the LP of the stock pallet in the location as confirmation to WCS that the operator is picking from the correct pallet.

WCS displays the details (SKU, description, colour, size, total quantity of cases to pick) of the picks to be performed from the location.

The operator is not required to scan the SKU, but should perform a visual check for each case that the SKU is correct.

The operator inputs on the MOI the actual number of cases taken from the pick location and placed on the pallet. The operator can input a smaller quantity picked than instructed by WCS; if this happens then the next pick instructed by WCS will be for the remaining quantity. The operator cannot input a larger quantity than instructed by WCS.

The operator must ensure that the LP of the stock pallet remains with that pallet unless it has been picked to empty.

If one or more picks are required from the same location, WCS displays the details of the next outstanding pick.

If the next outstanding pick is from a different location, then WCS directs the operator to move to that location.

When there are no more cases to be picked onto the pallet, WCS instructs the operator to take it to a case labelling WIP. The operator scans the location barcode to confirm the pallet has been dropped there.

The pallet will subsequently be handled at a case labelling location as described in Section 18.2.2.

14.2.3   Picking Exceptions

14.2.3.1   Exception: Stock Shortage

If the operator is unable to find any stock of the correct SKU in the pick location, the operator selects the No Stock option. WCS then holds all stock that it thought was in the location with the Stock Shortage exception.
WCS returns the affected picks to a *released* state, to be reserved from an alternative location if possible.

The operator is then directed to the location for the next outstanding pick.

An alert is raised on the OM status line for the held stock. This alert remains until a supervisor investigates the problem and either removes the hold from the stock, or deletes the stock from WCS.

14.2.3.2   Exception: Wrong SKU

If the operator sees that the SKU of some or all of the stock in the pick location is not as described on the MOI screen, the operator selects the Wrong SKU option. WCS then holds all the stock in the location with the Wrong SKU exception as a reason.

WCS returns the affected picks to a *released* state, to be reserved from an alternative location if possible.

The operator is then directed to the location for the next outstanding pick.

An alert is raised on the OM status line for the held stock. This alert remains until a supervisor investigates the problem and either removes the hold from the stock, or deletes the stock from WCS.

14.2.3.3   Exception: Stock Damaged

If the operator finds stock of the correct SKU in the pick location but sees that it is damaged, the operator selects the Stock Damaged option. WCS then holds all the stock in the location with the Stock Damaged exception as a reason.

WCS returns the affected picks to a *released* state, to be reserved from an alternative location if possible.

The operator is then directed to the location for the next outstanding pick.

An alert is raised on the OM status line for the held stock. This alert remains until a supervisor investigates the problem and either removes the hold from the stock, or deletes the stock from WCS.

14.2.3.4   Exception: Pallet Full

If the operator sees that the pallet is already so full that a single case of the stock to be picked is unable to fit on the pallet, the operator selects the Pallet Full exception.

This may follow on from a part pick confirmation as described in Section 14.2.2.

WCS returns the remaining picks for the pallet to a *released* state, to be picked onto a subsequent pallet.

The operator is then directed to take the pallet to the nearest P&D station.

This exception cannot be selected if WCS believes the pallet to be empty.

14.3   Split Case Picking

This is the process whereby individual units of stock are picked from cases in manual pick locations, into pick cartons on pick trolleys.

The operator uses a pick trolley with an RF device which runs a WCS MOI.

14.3.1   Order Start

An operator using a WCS MOI selects Split Case Picking and scans a pick trolley.

WCS calculates the highest priority DU to be picked on the trolley and indicates to the operator the approximate carton size for that DU (large, medium, small, or oversize if a single item is too large to fit into a carton).

The operator affixes a pre-printed LP to the pick carton, then scans it and loads the carton onto the first available slot on the trolley. If WCS has already indicated that the DU is too large to fit in a carton, the operator instead scans the pre-printed LP and places it on the first available slot on the trolley.

WCS then calculates the next DU to be loaded on the trolley. The calculation is:
- The highest priority DU requiring a pick from the same pick location as any of the DUs already loaded on the pick trolley
- Otherwise, the highest priority DU requiring a pick from a pick location in the same aisle as any of the DUs already loaded on the pick trolley
- Otherwise, the highest priority DU

The addition of DUs to the pick trolley stops if any of the following is true:
- There are no more released DUs to be added
- The configurable maximum number of DUs that can be loaded on a single pick trolley *Max Manual Pick Trolley Slots* has been reached
- The configurable maximum volume of picks that can be loaded on a single pick trolley *Max Manual Pick Trolley Volume* has been reached
- The configurable maximum weight of picks that can be loaded on a single pick trolley *Max Manual Pick Trolley Weight* has been reached
- The operator selects the Trolley Full option instead of scanning another pick carton

When the pick trolley build has stopped, the operator is guided through the trolley picking process.

14.3.2   Picking Process

The WCS MOI directs the operator to go to a specific pick location. This is the pick location with the lowest pick walk sequence number of all the picks for the trolley.

The operator scans the pick location barcode as confirmation to WCS that the operator is at the correct location.

WCS displays the details (SKU, description, colour, size, quantity to pick) of the first outstanding pick to be performed from the location.

The operator scans the SKU of the item as confirmation to WCS that the correct SKU has been identified.

If the pick is for a quantity greater than 1, the operator inputs on the MOI the actual number of items taken from the pick location. The operator can input a smaller quantity picked than instructed by WCS; if this happens then the next pick instructed by WCS will be for the remaining quantity. The operator cannot input a larger quantity than instructed by WCS.

WCS displays the LP of the pick carton (or the loose LP if the DU is too large to fit into a carton) and the sequence in which it was originally loaded onto the trolley. The operator scans the LP as confirmation to WCS that the stock has been picked and placed in the correct carton. If the DU is too large to fit into a carton, the operator should affix the pre-printed LP to the item and load it onto the correct slot on the pick trolley.

If one or more picks are required from the same location, WCS displays the details of the next outstanding pick.

If the next outstanding pick is from a different location, then WCS directs the operator to move to that location.

When there are no more items to be picked onto the trolley, WCS instructs the operator to take it to a manual packing WIP. The operator scans the location barcode so that the pick cartons and single-item DUs are dissociated from the pick trolley. The pick trolley is now available to be used again.

The functionality at the manual pack station is described in Section 18.5.

14.3.3   Picking Exceptions

14.3.3.1   Exception: Stock Shortage

If the operator is unable to find any stock of the correct SKU in the pick location, the operator selects the No Stock option. WCS then holds all stock of the SKU that it thought was in the location with the Stock Shortage exception.

WCS returns the affected picks to a *released* state, to be reserved from an alternative location if possible.

The operator is then directed to the location for the next outstanding pick.

An alert is raised on the OM status line for the held stock. This alert remains until a supervisor investigates the problem and either removes the hold from the stock, or deletes the stock from WCS.

14.3.3.2   Exception: Stock Damaged

If the operator finds stock of the correct SKU in the pick location but sees that it is damaged, the operator selects the Stock Damaged option. WCS then holds all stock of the SKU in the location with the Stock Damaged exception as a reason.

WCS returns the affected picks to a *released* state, to be reserved from an alternative location if possible.

The operator is then directed to the location for the next outstanding pick.

An alert is raised on the OM status line for the held stock. This alert remains until a supervisor investigates the problem and either removes the hold from the stock, or deletes the stock from WCS.

14.3.3.3   Exception: Carton Full

If the operator sees that the carton is already so full that a single unit of the stock to be picked is unable to fit in the carton, the operator selects the Carton Full exception.

This may follow on from a part pick confirmation as described in Section 14.3.2.

WCS returns the remaining picks for the carton to a *released* state, to be planned into other DUs as described in Section 9.5.7.

The operator is then directed to the location for the next outstanding pick.

This exception cannot be selected if WCS believes the carton to be empty.

14.4 GTP – Manual Merge

The order processing configuration defined for a DU's brand and order type (Section 9.3.1) can specify that the manual picks for a consignment should be performed by an operator onto a trolley loaded with open pick cartons containing the items already picked in the GTP area (including the GTP – GOH merge area) for the consignment.

This allows the items picked in the manual area to be added to the same cartons if possible. Even if the cartons are already full, the GTP cartons and the manual items can easily be packed and despatched together.

If GTP – manual merging does not take place for a consignment, it is a manual process to coordinate the despatch of the packed DUs from these two areas of the DC.

An operator equipped with a WCS MOI and a pick trolley can handle one consignment at a time.

14.4.1 Carton Arrival

Pick cartons from the GTP area a routed onto the finishing line and then onto the despatch sorter. The cartons are not optimised and lidded, and no despatch label is applied to them.

On the despatch sorter, the lack of any despatch label results in the cartons being diverted by default to the despatch reject lane.

If there is more than one carton for the same consignment, WCS aims for them to arrive at the despatch reject lane together but this cannot be guaranteed.

14.4.2 Trolley Build

The operator selects GTP – Manual Merge. The LOI displays a list of the cartons which are ready to be loaded onto the trolley (i.e. all the cartons for the same consignment and order type are in the reject lane).

The operator finds one of these cartons and loads it onto the trolley. The operator scans the carton LP.

WCS accepts the scan provided all of the following are true:
- The LP is known to WCS as a carton
- The carton is expected at the despatch reject lane for GTP – manual merge
- All the other cartons for the consignment and order type are in the despatch reject lane

If WCS accepts the carton LP and there are more cartons for the consignment, the LOI displays a list of these. The operator must load each of these onto the trolley and scan the carton LP. WCS rejects any carton that belongs to a different consignment.

When the trolley build is complete, the operator is guided through the picking process.

14.4.3   GTP – Manual Merge Picking Process

The picking process is essentially the same as the standard split case picking process in the manual area as described in Section 14.3.2. The only difference is that the operator is responsible for deciding whether each picked item is added to an existing carton or to a new, empty carton.

The WCS MOI directs the operator to go to a specific pick location. This is the pick location with the lowest pick walk sequence number of all the picks for the trolley.

The operator scans the pick location barcode as confirmation to WCS that the operator is at the correct location.

WCS displays the details (SKU, description, colour, size, quantity to pick) of the first outstanding pick to be performed from the location.

The operator scans the SKU of the item as confirmation to WCS that the correct SKU has been identified.

If the pick is for a quantity greater than 1, the operator inputs on the MOI the actual number of items taken from the pick location. The operator can input a smaller quantity picked than instructed by WCS; if this happens then the next pick instructed by WCS will be for the remaining quantity. The operator cannot input a larger quantity than instructed by WCS.

The operator then scans the LP of the carton in which the picked stock has been placed. This may be the LP of one of the cartons already on the trolley, or alternatively a pre-printed carton LP if the operator decides to use a new carton. If the item is too large to fit into a carton, the operator should affix the pre-printed LP to the item and load it onto the pick trolley.

WCS rejects the scan of a carton LP if adding the picked items to it would exceed the maximum contents weight for the DU type.

If one or more picks are required from the same location, WCS displays the details of the next outstanding pick.

If the next outstanding pick is from a different location, then WCS directs the operator to move to that location.

When there are no more items to be picked onto the trolley, WCS instructs the operator to take it to a manual packing WIP. The operator scans the location barcode so that the pick cartons and single-item DUs are dissociated from the pick trolley. The pick trolley is now available to be used again.

The functionality at the manual pack station is described in Section 18.5.

14.4.4   Exceptions

14.4.4.1   Carton Missing

If the operator cannot find at the despatch reject lane <u>any</u> carton that the LOI is listing as ready to load onto the trolley, the operator selects the No Cartons option. WCS sets *missing* all the TMs in the list.

If the operator subsequently scans the LP of a missing carton, its location is updated back to the despatch reject lane.

14.4.4.2 Picking Exceptions

The Stock Shortage (Section 14.3.3.1) and Stock Damaged (Section 14.3.3.2) exceptions possible during the standard split case picking process are also available during the GTP – manual merge process.

14.5   Related Elements

14.5.1   Operations Management Screens

There is a specific OM screen showing all outstanding manual picks, summarised by aisle, brand and order type.
There is a specific OM screen showing all outstanding GTP – manual merge picks, including the state of the GTP cartons

14.5.2   MOI Functions

The table below shows the MOI functions specific to manual picking.

Function	Description	Menu Level	Section
Full Case Picking	Used to perform manual full case picks	Top Level	14.2
Exception	Used to report an exception during full case picking	Full Case Picking	14.2.3
Split Case Picking	Used to perform manual split case picks	Top Level	14.3
Trolley Full	Reports no more DUs to be loaded onto pick trolley	Split Case Picking	14.3.1
Exception	Used to report an exception during split case picking	Split Case Picking	14.3.3
GTP – Manual Merge	Used to perform manual split case picks along with cartons picked in the GTP area	Top Level	14.4
Exception	Used to report an exception during GTP – manual merge	GTP – Manual Merge	14.4.4

14.5.3   LOI Functions

There is no LOI associated with manual picking.

14.5.4   Operational Events

Section 21.2 defines the general format of Operational Events. The table below defines the information that is logged in addition to the standard details for the specific Manual Picking Operational Events.

Event	Trigger	Fields
MANUAL_LOAD	When a manual picker adds a carton or single-item DU to a trolley	Trolley Id, Carton Id
MANUAL_PICK	When a manual picker confirms a pick (full case or split case)	Trolley Id, Location Id, SKU, Quantity, Order Id, Carton Id
MANUAL_PICK_EXCEPTION	When a manual picker reports an exception when issued with a pick	Trolley Id, Location Id, SKU, Quantity, Order Id, Carton Id, Exception

MANUAL_DROP	When a manual picker drops the pallet or trolley at the end of the pick walk	Trolley Id, Location Id

14.5.5   Statistics

The table below defines the statistics that are maintained for Manual Picking.

Name	Index	Comments
Manual Pallets Built	1	
Manual Cases Picked	Manual Aisle	Incremented once per case picked (full case)
Manual Trolleys Built	1	
Manual Items Picked	Manual Aisle	Incremented once per item picked (split case)

14.5.6   Alarms and Alerts

The table below defines the alarms and alerts that are associated with manual picking functions. They are displayed on the WMS Alarms page.

Alarm	Description	Drill Down
Manual stock held	There is stock stored in a manual location with one or more hold state set	List of stock

14.5.7   Configuration Parameters

The table below lists the configuration parameters that are used to control the manual picking functions.

Parameter Name	Function	Values	Section
Max Manual Pick Pallet Cases	Defines the maximum number of cases that can be planned and picked onto a pick pallet	1..1000	14.2.1
Max Manual Pick Pallet Volume	Defines the maximum total volume of cases that can be planned and picked onto a pick pallet	100..100,000 cm^3	14.2.1
Max Manual Pick Pallet Weight	Defines the maximum total weight of cases that can be planned and picked onto a pick pallet	1..100 kg	14.2.1
Max Manual Pick Trolley Slots	Defines the maximum number of DUs that can be loaded onto a pick trolley	1..20	14.3.1
Max Manual Pick Trolley Volume	Defines the maximum total volume of DUs that can be loaded onto a pick trolley	100..100,000 cm^3	14.3.1
Max Manual Pick Trolley Weight	Defines the maximum total weight of DUs that can be loaded onto a	1..100 kg	14.3.1

Parameter Name	Function	Values	Section
	pick trolley		

DEMATIC

15 DECANT

15.1 Decant

Stock that has been delivered to the warehouse in cases needs to be decanted to tote at the WCS decant stations.

15.1.1 Decant Station

WCS controls 16 dedicated decant stations. Each decant station has two pallet positions from which items can be decanted. Each pallet position has a unique barcode to allow confirmation of pallet delivery. Each decant station is equipped with a touch screen LOI (PC-based Local Operator Interface) with an attached barcode scanner.

Any decant station can be used to receive any inbound cases.

15.1.2 Decant Station Configuration

A decant station can be configured to be in or out of service.

When a station is in service, WCS delivers to the two pallet positions pallets containing stock that needs to be decanted.

When a station is not in service, WCS does not deliver pallets to the two decant pallet positions.

An operator is warned before trying to log in to an out of service station where there is no work outstanding.

15.1.2.1 Decant Pallet Positions

The individual pallet positions within a decant station can be switched in or out of service. If both pallet positions at a station are out of service then the station is effectively out of service.

WCS delivers pallets for decanting only to positions that are in service.

Stock which is already on a pallet position when it is switched out of service is still available for decant at the station.

15.1.3 Decant Process Overview

Key:

Operator action / decision	(green)
WCS action / decision	(yellow)
LOI action / display	(orange)

Flow:

START (log in) → Scan stock case → Scan unit to confirm SKU → Scan next target tote → Tote already in use?
- yes → Reject tote → (back to Scan next target tote)
- no → WCS assumes tote is empty → Show expected case qty & max tote fill (which may be less than a full tote)
  - 'Transfer all' (only possible if all fits) → WCS transfers full qty from case to tote → Tote ready for induct
  - Enter transfer quantity → WCS transfers entered qty from case to tote → Tote ready for induct → Case is now empty?
    - no → (back to Scan next target tote)
    - yes → FINISH (log out)

15.1.4 Scan Stock Case

To start the decant process, the operator scans the case which contains the stock to be transferred into one or more totes.

If WCS did not expect the case to be scanned at the decant station, the case remains available for decant subject to the rules applying to unexpected cases found on the pallet as described in Section 15.5.5.

The LOI shows the expected contents of the stock case (SKU & quantity).

The operator is then requested to scan one unit from the case to verify it is the correct SKU. If it is not then the case must not be decanted. Section 15.5.1 describes further.

15.1.5 Identify Target Tote

Once a stock case has been identified, the operator scans a target tote to receive the incoming stock. The tote must be empty of stock.

If the tote contains a divider because it was previously used as a compartmentalised tote as described in Section 17.4.2, the operator should remove the divider.

The target tote would normally be a tote which has been retrieved from the storage multishuttle to the empty tote buffer (Section 15.4), but any valid tote barcode that is unknown to WCS is accepted as an empty tote.

WCS will not accept a tote as being an empty if it is already in use elsewhere (this needs to be investigated outside of the decant operation).

15.1.6 Tote Capacity (by weight)

It is normally desirable to fill stock totes to capacity, taking account of any tendency for textiles to expand after unpacking. However, the tote must not be filled beyond a weight limit for the automation equipment.

WCS subtracts the weight of an empty tote (configurable) from the maximum allowed tote weight to determine the maximum weight of stock permitted to be decanted into it.

This maximum weight of stock is then converted to the maximum number of units permitted in the tote by dividing by the SKU's unit weight, then rounding downwards.

If the maximum number of units permitted in the tote is fewer than the number of units expected in the case, a prominent warning is shown on the LOI indicating the maximum number of units that can be transferred (and the 'transfer all' option is disabled).

15.1.7 Partial Case Transfer

In some situations (e.g. single case of small items such as jewellery), the entire case may fit in a tote but WCS may require that the contents are decanted into more than one tote. In this situation, the required decant quantity is shown with a prominent warning on the LOI indicating the maximum number of units that can be transferred (and the 'transfer all' option is disabled).

15.1.8 Transfer Stock to Tote

Once the source stock case and target tote have been identified the operator chooses how much of the stock is to be transferred. The options are:-

- The full case contents (no counting required)
- A specified number of units (not exceeding the expected stock case quantity, and not exceeding any lower maximum as described in sections 15.1.5 and 15.1.7)

Note that the option for transferring the full case is not presented if it would cause the maximum weight of a tote to be exceeded.

WCS then logically transfers the indicated quantity of stock from the case to the tote.

If the stock case is not logically empty then the remaining quantity is shown on the LOI. If this quantity is incorrect then the operator should handle an exception (Section 15.4).

15.1.9 Tote Complete

The operator is then prompted to induct the tote onto the automation.

If the stock case is now exhausted, it is liable to be deleted from the WCS database after a period of time defined by configuration parameter *EmptyCaseDeleteHours*.

Otherwise the case remains available for further decant operations.

15.1.10 Correcting a Quantity Error

An operator may detect a problem with a tote after it has been confirmed, e.g. the quantity entered was incorrect.

In this situation, the operator can select the 'Options' function on the LOI and then 'Correct Quantity' provided the case record still exists in the WCS database (see Section 15.1.9). The operator is prompted to scan the tote barcode and can then adjust the quantity of stock in the tote.

An equal and opposite adjustment takes place to the quantity of stock remaining in the case, i.e. the total stock quantity does not change. The operator is not permitted to adjust the quantity of stock in the tote above the maximum that WCS originally required to be decanted.

DEMATIC

15.2   Tote Induct

A stock tote is typically now inducted onto the automation.

Once inducted, after passing the initial scanner the tote's stock state is set to *active* (no change in inventory levels or status) and it is routed by WCS towards the SWAP station located on the main decant conveyor loop.

The SWAP station is described in Section 5.1.

The following diagram indicates the main flows for totes in the decant area:
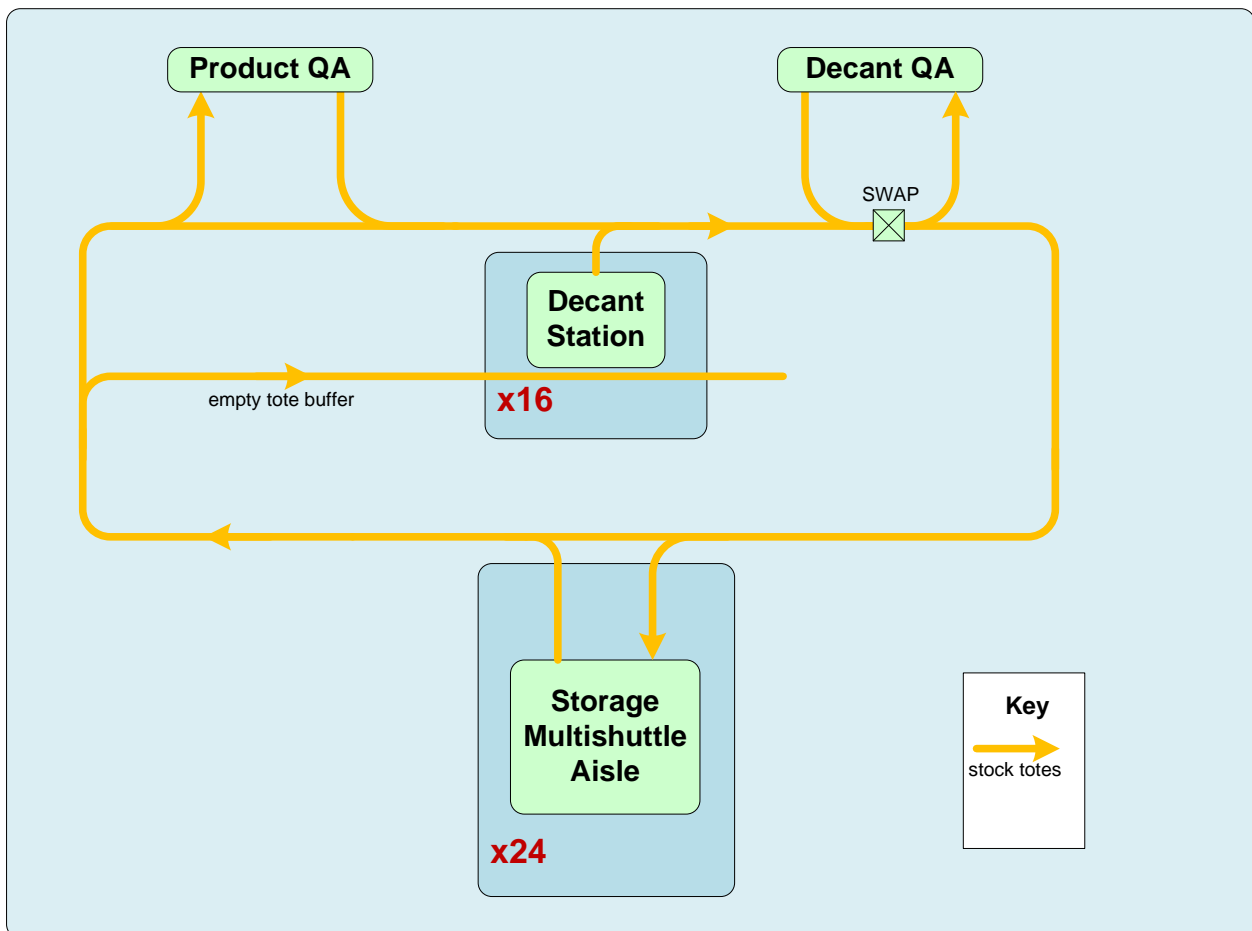
15.3   Pallet Empty

When the final case on a decant pallet has been decanted, the operator is requested to confirm that the pallet is now empty. If the pallet is confirmed to be empty, the empty pallet is deleted by WCS. The physical pallet must be manually removed but this is not under WCS control.

Exceptions associated with emptying decant pallets are described below in the exceptions section.

15.4   Empty Tote Buffer

The empty tote buffer supplies the decant stations with totes empty of stock for use in the decant process.

DEMATIC

The conveyor system regularly updates WCS regarding the fullness of the empty tote buffer. WCS automatically retrieves totes empty of stock located in the storage multishuttle to top up the empty tote buffer.

WCS considers the existing workload of the elevators and shuttles in the storage multishuttle when selecting which totes should be retrieved to the empty tote buffer. If these workloads permit, WCS prefers to retrieve a tote which is empty of stock but which contains a divider. Such a tote has previously been compartmentalised, containing stock of two different SKUs (see Section 17.4.2).

15.5 Decant Exceptions

15.5.1 Exception: Wrong SKU in Case at Decant

After scanning a case, if the operator is unable to scan a unit barcode that matches the expected SKU then the operator may indicate 'wrong SKU' on the LOI.

In this scenario, the operator is prompted to take the case to the Decant Sin Bin where the problem can be manually resolved. No further operations can be performed on the case until the hold state is manually removed.

In the scenario that there is some of the correct SKU in the case together with some units of the wrong SKU, WCS allows for the possibility of receiving the correct SKU as normal and subsequently indicating 'wrong SKU' for the remainder. Only the quantity that had not been confirmed as decanted is then changed to a hold state which can only be manually removed.

If an incorrect SKU is detected only after decant (i.e. after the stock has been transferred from case to tote) then a supervisor may use WCS OM inventory management facilities to adjust the quantity in the tote, although its link to the original case may have been lost by that point.

15.5.2 Exception: Stock Shortage in Case

If the decant operator observes that there are fewer units in the stock case than the LOI is indicating then they may indicate the fact by selecting 'wrong quantity' on the LOI. This can be done either when the case is first scanned or after some (or all) of the units present have been decanted.

The operator is prompted to enter the number of units still present in the stock case (including the possibility of zero).

WCS then sends WMS a stock adjustment message (Section 4.7.1) indicating the shortfall, together with the ID of the SKU and an appropriate reason code.

15.5.3 Exception: Excess Stock in Case

If the decant operator observes that there are more units in the stock case than the LOI is indicating then this must be handled outside of the decant operation. The operator indicates 'excess stock' on the LOI and is prompted to take the case to the Decant Sin Bin.

If the stock case has already been partially decanted then it may be desirable to check any other totes that received stock from this case before deciding how best to handle the excess units. WCS flags all totes that received stock from this case. They can be retrieved to the Product QA station for investigation.

15.5.4   Exception: Damaged Stock in Case

If the operator observes that one or more units in the stock case are damaged then the operator may first elect to decant any units that are satisfactory. The operator may subsequently indicate 'damaged stock' on the LOI for the remaining quantity and is prompted to take the case to the Decant Sin Bin.

WCS then logically moves the case to the Decant Sin Bin and holds the contents until the problem has been manually resolved.

15.5.5   Exception: Decant Pallet Not Empty

If the operator observes that a decant pallet is not physically empty when it is logically empty, this may indicate that the pallet contained additional unknown case(s).

The operator is prompted to scan each case that is still on the pallet.

If the case is unknown to WCS, it must be taken to the Decant Sin Bin.

If the case contains a SKU that is nonmechable, it must be taken to the Decant Sin Bin.

Otherwise, the case's location is updated to be at the station and the case is now eligible for decant.

15.5.6   Exception: Case Not Required at Decant

If a case containing a nonmechable SKU is scanned at decant, the operator is told that the case is not required at decant. As this is an exception condition, WCS does not automatically relocate the case. The operator is prompted to take the case to the Decant Sin Bin.

15.5.7   Exception: Pallet Unexpectedly Empty

As the operator is in control of which cases are decanted from a pallet, WCS cannot automatically detect if a case on a decant pallet has become missing.

The decant LOI provides a function for the operator to declare a pallet as empty. Any stock of an internal SKU is automatically deleted at this point. If WCS expects the pallet still to contain one or more cases, the operator is asked to confirm that the pallet is empty. On confirmation, any cases logically remaining on the pallet are made missing and an event is logged.

15.5.8   Exiting the Exceptions Dialogue

Having entered the exceptions dialogue, the operator may decide that the exception can be resolved without system action. In this case, the operator can exit the exceptions dialogue by selecting the 'exit' key.

15.6   Related Elements

15.6.1   Operations Management Screens

There is a specific OM screen showing the current status and occupancy of all decant stations.

15.6.2   MOI Functions

There is no MOI functionality associated with decant.

15.6.3   LOI Functions

The table below shows the LOI functions specific to decant.

Function	Description	Menu Level	Section
Decant	Used to decant stock from case into tote	Top Level	15.1
Pallet Empty	Used to declare a decant pallet to be empty	Options	15.5.7

15.6.4   Operational Events

Section 21.2 defines the general format of Operational Events. The table below defines the information that is logged in addition to the standard details for the specific Decant Operational Events.

Event	Trigger	Fields
DEC_CASE_ADDED	Transfer of stock from a case to a tote	Tote Id, Case Id, SKU, Quantity
DEC_TOTE_FULL	Confirmation of completion of decant into a tote	Tote Id
DEC_QTY_ADJUST	Operator-requested quantity change	Tote Id, SKU, Old Quantity, New Quantity
DEC_WRONG_SKU	Wrong SKU confirmed to be in a case	Case Id, Expected SKU, Actual SKU
DEC_STOCK_SHORT	Quantity in case smaller than expected	Case Id, SKU, Quantity Short
DEC_STOCK_OVER	Quantity in case greater than expected	Case Id, SKU, Quantity Over
DEC_STOCK_DAMAGE	Damaged stock found in case	Case Id, SKU, Quantity Damaged
DEC_PLT_NOT_EMPTY	Unexpected case found on a decant pallet	Pallet Id, Case Id, SKU
DEC_CASE_MISSING	Expected case not found on a decant pallet	Pallet Id, Case Id, SKU, Quantity

15.6.5   Statistics

The table below defines the statistics that are maintained for Decant.

Name	Index	Comments
Case Decanted	Station 1..16	Incremented when case has been emptied
Tote Filled	Station 1..16	Incremented when decanted completed into a tote

15.6.6   Alarms and Alerts

The table below defines the alarms and alerts that are associated with the Decant process. They are displayed on the WMS Alarms page.

Alarm	Description	Drill Down
Case Not Decanted	A case at decant has not been	List of TMs

	decanted after *Case Not Decanted Hours* hours (configurable)	
Case in Sin Bin	The Decant Sin Bin contains one or more cases	List of TMs in Decant Sin Bin
Empty Tote Buffer Shortage	There is a shortage of empty totes to supply the empty tote buffer (Section 15.4)	

15.6.7   Configuration Parameters

The table below lists the configuration parameters that are used to control the Decant functions.

Parameter Name	Function	Values	Section
Case Not Decanted Hours	Number of hours after which Case Not Decanted alarm should be raised	0..168	16.1.1
Empty Case Delete Hours	Number of hours after which empty case records can be deleted from the WCS database	0..168	15.1.9

16   GOODS-TO-PERSON AREA

16.1   GTP Area Overview

The Goods-to-Person (GTP) area comprises 24 Dematic RapidPick 1:1 pick stations.

Totes are fed to each pick station from a dedicated aisle of the storage multishuttle.

Cartons are fed to each group of 8 pick stations by a carton erector machine, and by an order buffer comprising 2 multishuttle aisles.

A GTP station is used to pick units of stock out of the tote (on the right) and put them into the target pick carton (on the left). A simple WCS-driven LOI touchscreen indicates the number of units to be transferred. There may be multiple compartments in the stock tote, in which case WCS indicates the compartment from which the units should be picked.

A pushbutton is used to indicate normal pick completion. An alternative dialogue is used on the LOI screen in the event that the stock tote has been emptied or following any exception condition.

The following diagram indicates the main flows for totes and cartons in the GTP area:
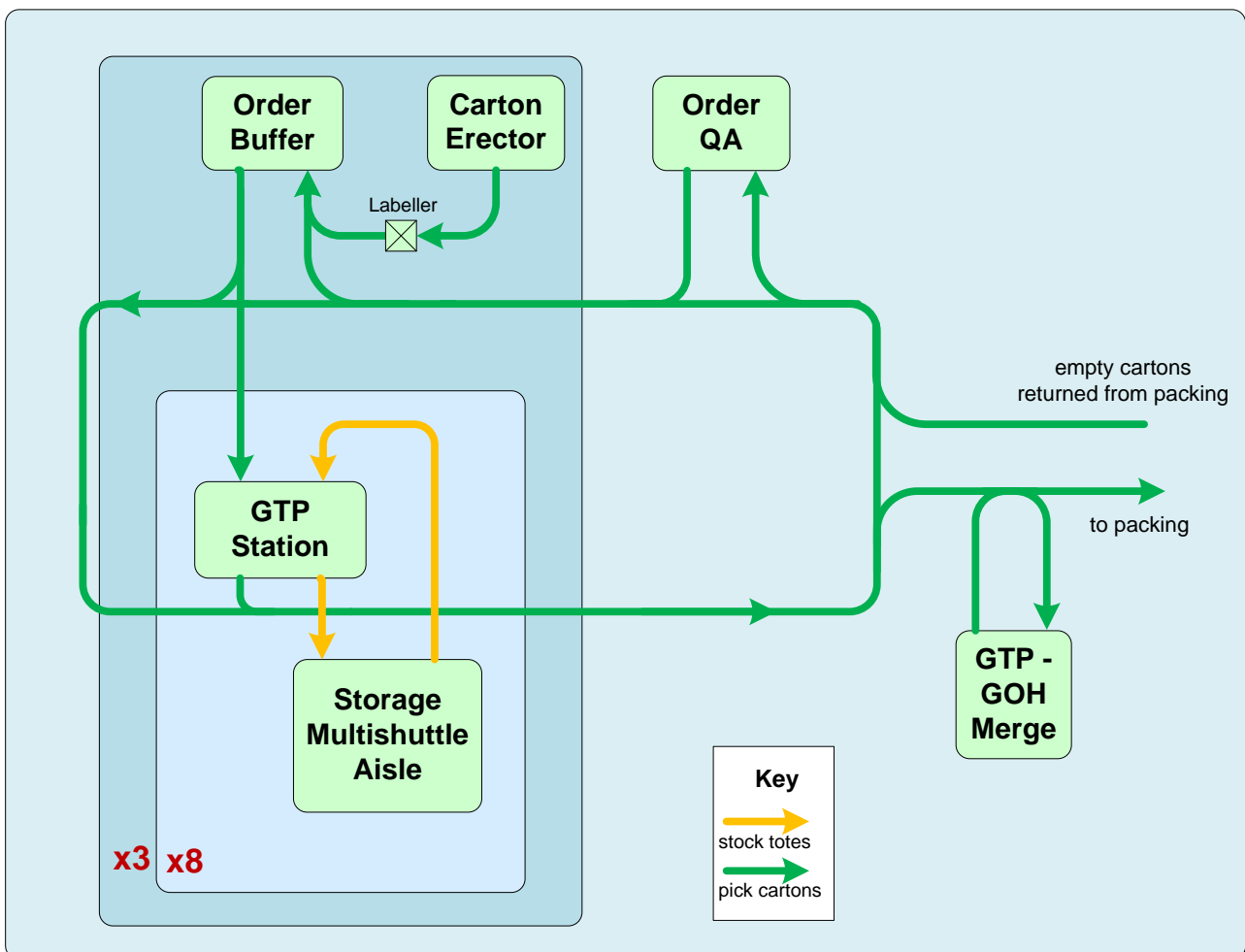
16.1.1   GTP Station Mode

Each station is manually configured into one of the following modes via an OM screen, subject to user authorisation. This is separate from whether or not anyone is currently logged in.

Mode	Meaning
Available	The station is available for WCS to use for normal picking operations.
	WCS may choose not to use the station. WCS does not use more stations for picking than the maximum specified by configuration parameter *GTP Stations In Use*
Stock check	In use only for stock checking operations
Out of Service	No more totes or cartons will be retrieved to the station. Any totes or cartons already in transit to the station will be sent away.
	Any pick instruction already issued to an operator at the station is allowed to be performed

The remainder of this main section covers GTP picking operations. Stock checking operations at a GTP station are covered in Section 4.10.

16.1.2   Logging In and Out

Before any instructions are given an authorised operator must log in to the station LOI. An operator may be logged in to only one station at a time.

An operator is warned before trying to log in to an out of service station.

The operator may log out at any time. Any instructions that were unconfirmed at time of logging out are assumed not to have performed.

16.2   Provision of Pick Cartons

A supply of empty pick cartons in both medium and large sizes is required for picking new DUs into. This supply is made up of:

- Empty cartons which have previously been picked into, but the contents have been despatched in a different TM (typically a satchel).

  If a pack station operator (see Section 17) believes a pick carton is suitable to be reused, the operator places it on the conveyor which returns it to the GTP area.

  WCS routes the carton to the order buffer which holds the fewest empty cartons of the same size

- Empty cartons which have been newly created by the carton erector.

  There is one carton erector serving each order buffer. Each erector is able to create both medium and large cartons, on request by WCS.

  WCS aims to maintain a minimum number of empty cartons of both sizes in each order buffer, as defined by the configuration parameters *Min Medium Cartons In Order Buffer* and *Min Large Cartons In Order Buffer*.

The minimum number of empty cartons that WCS requests to be erected each time is defined by configuration parameter *Min Carton Request Qty*. Setting this parameter to a higher value improves throughput at the carton erector.

A barcode LP is applied to two opposite sides of each new carton after creation. The barcode is the carton's ID and is generated by WCS from a predetermined range.

WCS routes the newly created carton into the associated order buffer. In the event of a fault with one of the carton erector machines, it is possible for WCS to supply an order buffer with empty cartons from one of the other erector machines.

16.3   Pick Carton and Stock Tote Delivery

WCS delivers pick cartons from the order buffer multishuttle to the put position on the left at the station.

WCS delivers stock totes from the storage multishuttle to the pick position on the right at the station.

WCS is responsible for coordinating the delivery of cartons and totes to the station so that a matching carton is in position in the put position to receive stock from the totes.

WCS is responsible for delivering the stock totes in sequence, if a sequence was specified by the Host for the picks in the order.

On two opposing sides of each stock tote are a barcode indicating the tote ID and an identifier of the side. From the scanned barcode reported by the conveyor system, WCS knows the orientation of the tote and therefore where any compartments in the tote are positioned from the viewpoint of the operator.

16.4   Pick Operation

16.4.1   Pick Instruction

With a stock tote and pick carton in position, the LOI shows:

- (If there are multiple compartments in the stock tote) The compartment in the tote from which the stock should be picked
- A very prominent pick quantity

and less prominently:

- Tote ID
- Tote (compartment) contents (SKU, description, colour, size, quantity)

16.4.2   Split Pick Quantity

A configuration parameter defines the maximum quantity that WCS can instruct the operator to pick.

If more than this is required to satisfy the order, WCS splits the original pick into separate picks from the same tote into the same carton. Consecutive pick instructions from the same tote into the same carton are for a different quantity.

For example, if the configuration parameter defining the maximum instructed pick quantity is set to 5, then a pick of 20 items from a single tote into a single carton is split into separate pick instructions for 5, 4, 5, 4, then 2 items.

16.4.3   Pick Confirmation

In normal operation, the picker takes the indicated number of units from the stock tote and places them into the pick carton, pressing the confirmation button to confirm successful completion.

WCS also allows for confirmation of pick complete on the LOI screen.

16.4.4   Part Pick Confirmation

The operator can confirm that some of the instructed quantity has been picked by adjusting the displayed value downwards and then confirming that quantity picked. This can be done on either the RapidPick pushbutton or on the WCS LOI screen.

It is not possible to increase the displayed value above the instructed pick quantity.

WCS then displays the remaining quantity to pick. The operator may perform this pick, or if this is not possible then the operator can report an exception as described in Section 16.6.

16.4.5   Stock Tote Emptied

After pick confirmation and if WCS believes the tote is now empty of stock (i.e. ignoring any divider separating individual compartments), the behaviour at the station is determined by the value of configuration parameter *GTP Tote Empty Confirm*.

If the parameter is set to TRUE, then the GTP operator is required to respond to an on-screen prompt asking for confirmation (or otherwise).

If the operator unexpectedly reports that the tote is not empty of stock, the tote is flagged for further investigation. It will be subsequently routed from the storage multishuttle to the product QA station.

If the parameter is set to FALSE, then the tote is considered to be empty and is routed accordingly. If the tote actually contains stock, this will be discovered on an attempt to reuse the tote during the decant process

Regardless of the response, the stock tote is sent away from the station as described in Section 16.7.7.

16.5   Next Pick

Following completion of a pick operation, WCS can send away the stock tote, the pick carton, or both.

Under normal circumstances there is minimal delay before the next tote or carton arrives and the operator is presented with a new pick instruction.

16.6   GTP Station Exceptions

If the operator is unable to perform the pick, the operator presses the Problem button on the LOI screen.

This displays a new screen offering a button for each possible exception. The operator can press one or more buttons to flag the appropriate reason(s) why the pick could not be performed. If any of these buttons is pressed a second time, the exception is unflagged.

When the operator has flagged all the appropriate reasons, the operator presses the Send Away button to release the pick carton and/or stock tote as appropriate. Alternatively, the operator presses the Back button to return to the main pick instruction screen.

Some of these exceptions are also available to an operator performing a stock checking function at a GTP station as described in Section 4.10.7.

16.6.1   Exception: Stock Shortage

If the operator sees that the stock tote (or compartment) is empty, the operator flags the Stock Shortage exception.

This may follow on from a part pick confirmation as described in Section 16.4.4.

When the operator presses the Send Away button, WCS places a hold on the stock with the Stock Shortage exception as a reason. The tote can be retrieved to the product QA station later for further investigation.

WCS returns the affected picks to a *released* state, to be reserved from an alternative tote if possible.

Unless the carton requires a pick from the next stock tote, it is sent away from the station.

16.6.2   Exception: Wrong SKU

If the operator sees that the SKU of some or all of the stock in the tote is not as described on the LOI screen, the operator flags the Wrong SKU exception.

When the operator presses the Send Away button, WCS places a hold on the stock in the tote with the Wrong SKU exception as a reason. The tote can be retrieved to the product QA station later for further investigation.

WCS returns the affected picks to a *released* state, to be reserved from an alternative tote if possible.

Unless the carton requires a pick from the next stock tote, it is sent away from the station.

16.6.3   Exception: Stock Damaged

If the operator sees that the stock in the tote is damaged, the operator flags the Stock Damaged exception.

When the operator presses the Send Away button, WCS places a hold on the stock in the tote with the Stock Damaged exception as a reason. The tote can be retrieved to the product QA station later for further investigation.

WCS returns the affected picks to a *released* state, to be reserved from an alternative tote if possible.

Unless the carton requires a pick from the next stock tote, it is sent away from the station.

16.6.4   Exception: Item Too Large

If the operator sees that a single unit of the stock in the tote is too large to fit in the carton, even if the carton were empty, the operator flags the Item Too Large exception.

When the operator presses the Send Away button, WCS places a hold on all stock of the SKU (i.e. not only in this tote) with Check Dimensions as a reason. The tote can be retrieved to the product QA station later for further investigation.

Until WCS receives updated dimensions for the SKU from the Host:

- An alert is raised on the WCS status bar

- No more DUs containing the SKU are started for picking, although picking continues into this and any other DUs for which picking has already started

Unless the carton requires a pick from the next stock tote, it is sent away from the station.

When WCS receives an updated SKU Master Update message from the Host for the SKU, all the affected DUs are eligible to be replanned as described in Section 9.5.7.

16.6.5   Exception: Carton Full

If the operator sees that the carton is already so full that a single unit of the stock in the tote is unable to fit in the carton, the operator flags the Carton Full exception.

This may follow on from a part pick confirmation as described in Section 16.4.4.

When the operator presses the Send Away button, the carton is considered fully picked and is routed accordingly (see Section 16.7.8).

WCS returns the remaining picks for the carton to a *released* state, to be planned into other DUs as described in Section 9.5.7.

Unless the next carton requires a pick from the stock tote, the tote is sent away from the station.

This exception cannot be flagged if WCS believes the carton to be empty.

16.7   GTP Station – Behind the Scenes

This section summarises the WCS processes which work in the background to supply the GTP stations with pick cartons and stock totes.

16.7.1   Stock Reservation for Pick Carton

To satisfy the picks in each DU that are required to be picked in the GTP area, WCS reserves stock from specific totes as described in Section 9.6. This is a continuous process which recalculates stock reservations if circumstances change.

16.7.2   Pick Carton Assignment to GTP Station(s)

A carton must be assigned to a GTP station before the carton can be retrieved from the order buffer multishuttle to the station, and before the stock totes to be picked from at the station can be retrieved from the storage multishuttle.

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WCS tries to assign another DU to a station whenever the number of totes reserved to cartons already assigned to the station drops below the value of configuration parameter *Min Totes Assigned To GTP Station*.

WCS considers the DUs for which the next pick (or series of picks) is reserved from stock in totes that are currently in the module of the storage multishuttle associated with the GTP station. If all the totes are available and not currently reserved to other DUs, then this DU is eligible to be assigned to the station.

From the list of eligible DUs, WCS typically selects the DU for the consignment with the highest pick priority and for which the stock is predominantly stored in the aisle of the storage multishuttle associated with the GTP station. WCS may override this rule to optimise system throughput.

If WCS cannot find an eligible DU whose reserved stock is located in the storage multishuttle module associated with the GTP station, then WCS selects a DU whose reserved stock is located in other modules of the storage multishuttle.

If no items have yet been picked for the DU, then it is likely that there is no carton assigned to it. WCS assigns a carton to the DU as described in Section 16.7.3.

This does not necessarily cause the carton or totes to be immediately retrieved from their respective multishuttles to the GTP station. The number of cartons assigned to the station and the number of totes reserved to those cartons are typically greater than the physical capacities of the conveyors to the GTP station.

16.7.3   Pick Carton Assignment to DU

WCS assigns a specific empty pick carton of the correct size to each DU that is to be picked into at one or more GTP stations. There is a supply of empty cartons in all the order buffer multishuttles as described in Section 16.2.

If the DU is to be despatched from the DC as a medium carton, then WCS selects a medium carton. Otherwise, WCS selects a large carton. If the carton is to be used to batch-pick a number of single-unit orders then WCS selects a large carton.

WCS selects the empty carton from those in the order buffer which serves the GTP station where the first pick is to be performed. Some of the empty cartons in the order buffer may have previously been picked into a number of times, with the contents packed into satchels at pack stations. WCS records the number of times each pick carton has been returned empty from packing.

The configuration parameter *Prefer Reused Carton For Despatch* determines whether WCS selects the empty carton that has been returned from packing the most times, or the fewest times, when assigning a carton to a DU that will be despatched from the DC in the carton.

16.7.4   Stock Tote Transfer to Associated Storage Multishuttle Aisle

The assignment of pick cartons to GTP stations as described in Section 16.7.2 can result in stock located in an aisle of the storage multishuttle being reserved to be picked at a GTP station associated with a different aisle of the storage multishuttle. The tote containing the stock must therefore be transferred to the multishuttle aisle associated with the GTP station.

If the origin aisle and destination aisle are in the same module of the storage multishuttle, then inter-aisle transfer locations can be used to move the tote to the destination aisle provided all the necessary shuttle equipment on the tote's level is available and in service.

If inter-aisle transfer locations cannot be used, then WCS generates a relocation move so that the tote is retrieved from the storage multishuttle, round the main decant loop and back into the storage multishuttle using the putaway rules described in Section 16.8.3.

16.7.5   Pick Carton Retrieval to GTP Station

A carton can be retrieved from the order buffer multishuttle to a station provided the following criteria are all met:
- All the totes containing stock to be picked into the carton at the station are available in the associated aisle of the storage multishuttle
- There are fewer cartons in transit to the station than the appropriate in transit limit
- The station is available for use as described in Section 16.1.1
- There is capacity for the carton on leaving the GTP station either in its expected next destination or in any of the order buffer multishuttles

From the cartons satisfying these criteria, WCS typically selects a carton for an order with the highest pick priority. WCS may override this rule to optimise system throughput.

WCS issues an instruction to the multishuttle system for the selected carton to be picked up and retrieved to the GTP station. If the criteria above continue to be met, then WCS repeats the process.

16.7.6   Stock Tote Retrieval to GTP Station

Once a pick carton in transit from an order buffer to a GTP station has passed the point on the conveyor at which it cannot be overtaken by other cartons in transit to the same station, the sequence in which it will arrive at the GTP station in relation to other cartons is fixed.

WCS can therefore begin to retrieve from the storage multishuttle the stock totes from which items will be picked into the carton at the station. This is subject to the following conditions:
- There are fewer totes already in the process of being retrieved to the GTP station than the value of configuration parameter *Max Totes To GTP Station*
- All the totes for the carton to arrive at the station immediately before this carton are already being retrieved

The value of configuration parameter *Max Totes To GTP Station* is typically set higher than the number of totes that can physically fit on the conveyor between the storage multishuttle dropdown and the GTP station. The additional totes are able to wait on the outfeed level conveyors in the storage multishuttle, or remain in their storage locations until capacity is available.

WCS controls the sequence in which totes arrive at each GTP station. WCS can therefore ensure that the totes for a pick carton all arrive at the station before the totes for the following carton.

WCS also retrieves the totes to the station in sequence so that items are picked into each carton in the sequence specified by the Host when it first transmitted details of the orders to WCS. If a tote loses its place in the sequence, e.g. because of a fault reported on a shuttle in the storage multishuttle, or if a pick does not take place from a tote at the GTP station, e.g. because the station operator reports an exception when performing a pick, then items may be picked into a carton out of sequence.

16.7.7   Stock Tote Routing After Pick

A stock tote leaving a GTP station is always routed back into the associated aisle of the storage multishuttle.

Typically the tote is then either stored in the aisle or transferred to a neighbouring aisle in the same module of the multishuttle.

Alternatively, once the tote is in the multishuttle aisle it can be routed out of the multishuttle onto the main decant conveyor loop subject to the in transit limits described in Section 5.2. From the decant conveyor loop a tote can reach the Product QA station, the empty tote line, or an aisle in another module of the storage multishuttle.

16.7.8   Carton Routing After Pick

When a pick carton is sent away from a GTP station, WCS routes the carton to its next destination.

If there are more items to be picked into the carton in the GTP area, WCS considers the GTP station at which the next pick will take place into the carton. The carton is routed towards that station's associated order buffer. If it is not possible for that order buffer to be used, e.g. because some equipment in the multishuttle is in fault, the carton is temporarily stored in one of the other order buffers.

If there is more than one carton for the consignment and order type in the GTP area, and there are manual picks for the same consignment and order type which are waiting for the GTP – manual merge process (Section 14.4), then the carton is routed to one of the order buffers and remains there until all the other GTP picks for the consignment and order type are either ***picked*** or ***abandoned***.

If a pack list is required to be despatched along with the picked items for the last DU of the order type for the consignment, WCS prefers that whenever possible, the pack list be automatically inserted into a pick carton. If this is the first carton that is fully picked in the GTP area for the consignment and order type, then it is routed to one of the order buffers and remains there until all the other picks for the consignment and order type are either ***packed*** or ***abandoned***.

Otherwise, the carton is eligible to leave the GTP area:

If there are no more items to be picked into the carton in the GTP area but the carton is required in the GTP – GOH merge area (see Section 11.6), the carton is routed there provided all the following conditions are met:
- All the GOH picks for the carton have already been delivered to the GTP – GOH merge area
- There is capacity in the GTP – GOH merge area for a carton to be routed there, taking into account any cartons already in transit (Section 5.2)
- If the carton is required to visit a document inserter on leaving the GTP – GOH merge area, there is at least one document inserter in service to add the paperwork to the carton
- If the carton is required to visit a pack station, there is at least one pack station in service to receive the carton

If not all these conditions are met, the carton is temporarily stored in one of the order buffers until all the conditions are met.

If there are no more items to be picked into the carton in the GTP area and the carton is not required in the GTP – GOH merge area, the carton is routed to a pack station or the finishing line provided all the following conditions are met:

- If the carton is required to visit a document inserter on leaving the GTP area, there is at least one document inserter in service to add the paperwork to the carton
- If the carton is required to visit a pack station, there is at least one pack station in service to receive the carton and with fewer cartons in transit than the configured maximum (Section 5.2)
- If the carton requires sealing and lidding on the finishing line, there are fewer cartons in transit there than the configured maximum (Section 5.2)
- If the carton is required to visit the reject despatch lane to begin the GTP – manual merge process, there are fewer cartons in transit there than the configured maximum (Section 5.2)

If not all these conditions are met, the carton is temporarily stored in one of the order buffers until all the conditions are met.

16.7.9   Document Inserters

There are 2 automatic document inserters available for pick cartons which leave the GTP area towards a pack station or the finishing line.

There is another document inserter on the finishing line as described in Section 18.6.1.
A WCS configuration screen specifies the types of despatch paperwork that can be printed at any document inserter.

WCS diverts a carton to one of the document inserters on the exit from the GTP area if either of the following is true:
- There is paperwork required to be included in the carton when it arrives at a pack station, and the document inserter is configured to print that paperwork and is available
- There is other paperwork required to be despatched with the carton that would normally be added by the document inserter on the finishing line, but the finishing line document inserter is not configured to print it or is not available, and this document inserter is

16.8   Storage Multishuttle

16.8.1   Overview

Details which are common to all multishuttles are specified in Section 3. This section concentrates on details which are specific to the storage multishuttle.

The main flows into the storage multishuttle are:
- Totes into which stock has been decanted
- Totes which have been fully or partly picked from at GTP stations

16.8.2   Multishuttle Layout

The storage multishuttle comprises 24 aisles of tote racking. Within WCS, the aisles are numbered 1 to 24. The aisles are grouped into modules of four aisles.

Each aisle comprises twelve levels. Within WCS, the levels are numbered 1 to 12.

On each level there are 120 bays of storage locations, each bay with a front depth and back depth location on either side of the shuttle. The locations are grouped into shelves of five bays.

There are four inter-aisle transfer locations on each level of each aisle, allowing totes to be transferred between the same level of adjacent aisles within the same module.

16.8.3 Storage Multishuttle Putaway

When a tote is reported on the conveyor from the decant SWAP station or a GTP station, WCS automatically selects a specific destination storage location for it.

Multishuttle location selection is a three-step process:

- Aisle selection within the multishuttle (but the only eligible selection for a tote returning from a GTP station is the station's associated storage aisle)
- Level selection within the aisle
- Location selection within the level

Each aisle and level is eligible for selection only if an eligible storage location exists within it. The rules regarding eligibility are common to the three multishuttles and are defined in Section 3.4.

16.8.3.1 Storage Multishuttle Usage Configuration

A WCS screen allows stock owned by each brand to be configured to one or more specific modules of the storage multishuttle. More than one brand can be configured to use the same module.

When selecting a storage location in the multishuttle for a stock tote on the decant conveyor loop, WCS prefers to select a location in one of the modules configured to the brand which owns the SKU (or SKUs) contained in the tote. If no locations are available in the configured modules, WCS selects a storage location in one of the other modules.

It is possible to configure all six modules of the storage multishuttle to a brand. This behaves the same as if no modules were configured to the brand.

For each brand, the same screen allows configuration as to whether totes containing stock of the same style are grouped into the same module or spread across the different configured modules (or randomly located across the different configured modules).

For each brand, this screen also allows configuration as to whether totes containing stock of the same SKU are grouped into the same module or spread across the different configured modules (or randomly located across the different configured modules).

A tote returning to storage from a GTP station must enter the multishuttle aisle associated with that GTP station. The tote may then be immediately moved towards another aisle if it is required there.

16.8.3.2 Storage Multishuttle Location Selection

The rules determining which of the eligible locations is chosen for a TM are specific to each multishuttle. These are the rules used when selecting a location in the storage multishuttle for a tote.

The first rule is applied to all the eligible storage locations. If the rule reduces the number of eligible locations but at least one location remains, then the next rule is applied to the remaining locations. Any rule which would eliminate all the locations is ignored.

The process continues down the list of rules until only one location remains.

- If the tote contains stock and is required at a specific GTP station, use the module including that station's associated aisle

- If the tote contains stock and is required at a specific GTP station, use that station's associated aisle
- If the tote contains stock, use a module configured to the brand that owns the stock
- If the tote contains stock and the brand that owns the stock is configured to group by style, use the module in which the most totes of that style are stored
- If the tote contains stock and the brand that owns the stock is configured to spread by style, use the module in which the fewest totes of that style are stored
- If the tote contains stock and the brand that owns the stock is configured to group by SKU, use the module in which the most totes of that SKU are stored
- If the tote contains stock and the brand that owns the stock is configured to spread by SKU, use the module in which the fewest totes of that style are stored
- If the tote contains stock, use the aisle in which the fewest totes of that SKU are stored
- Use the module in which there are most empty available locations
- Use the aisle in which there are most empty available locations
- Select an aisle at random
- If the tote contains stock, use the level on which the fewest totes of that SKU are stored in the module
- If the selection is being made at the multishuttle pickup station, and the tote is the second of two totes to be picked up together, then use the same level as the first tote being picked up
- Use the level on which there are most empty locations in the module
- Use the level on which there are most empty locations in the aisle
- Select a level at random
- If the tote is empty, use a front depth location where another empty tote is stored in the corresponding back depth location
- Use a back depth location
- Select a location at random

The rules are applied in order to select a destination storage location for the tote while it is on a conveyor outside the multishuttle, and the rules are applied again at each decision point on the tote's journey as far as the shuttle itself. A rule is ignored if the tote has already passed the final point at which the rule can be applied. For example, once the tote is in the infeed of a specific aisle, rules involving the selection of an aisle are ignored.

16.8.4   Storage Multishuttle Retrieval

WCS continuously checks its database to find totes which are required to be retrieved from the storage multishuttle.

There are 27 possible destinations for totes being retrieved from the multishuttle:

- Each of 24 GTP stations, although any tote in storage can directly access only one of these
- Product QA station
- Empty tote buffer
- Relocation (the tote recirculates round the main decant conveyor loop and returns to storage)

For each of these destinations, configurable maximum and minimum numbers of totes in transit are described in Section 5.2.

WCS continuously counts the number of totes in transit to each destination. This count includes totes for which a retrieval mission has been issued to the multishuttle system but has not yet been actioned.

Of the destinations to which there are fewer totes already in transit than the configured maximum, WCS calculates a value (target minimum totes in transit minus number of totes in transit). The destination with the greatest value, not necessarily a positive value, is considered the most in need of a tote. If the greatest value applies to two or more destinations, one of these is chosen at random.

If any totes are required to be retrieved from the multishuttle to this destination and all equipment en route is available and in service, a mission is issued to the multishuttle system to retrieve the highest priority tote. The process continues again, taking all 27 destinations into account.

If no tote can be found to be retrieved to the destination most in need of a tote, the next destination is considered instead.

16.8.5   Storage Multishuttle Shuffles

It may happen that WCS needs to retrieve a tote from a location where another tote is stored in front of it.

In this situation, WCS creates a shuffle move for the front tote, which is picked up by the shuttle and moved to another storage location nearby in the same aisle and level.

If there are no available locations in the same aisle and level, then WCS creates a relocation move for the front tote. This causes it either to be transferred into an adjacent aisle, or to be retrieved from the multishuttle so that it can recirculate round the main decant conveyor loop and return to the multishuttle using the normal putaway rules as described in Section 16.8.3.

Once there is no tote in the way, WCS instructs the shuttle to pick up the back tote and retrieve it to the outfeed level conveyor.

16.9   Order Buffer Multishuttle

16.9.1   Overview

Details which are common to all multishuttles are specified in Section 3. This section concentrates on details which are specific to the order buffer multishuttle.

The main flows into the order buffer multishuttle are:
- Newly created empty cartons
- Empty cartons returned from packing
- Part-picked cartons

16.9.2   Multishuttle Layout

The order buffer multishuttle comprises six aisles of carton racking. Within WCS, the aisles are numbered 27 to 32. The aisles are grouped into sectors of two aisles. Each sector is served by a carton erector, and serves eight GTP stations.

Each aisle comprises eight levels. Within WCS, the levels are numbered 1 to 8.

On each level there are 20 bays of storage locations, each bay with a front depth and back depth location on either side of the shuttle. The locations are grouped into shelves of five bays. Each location can hold a medium or a large carton.

There are no inter-aisle transfer locations in the order buffer multishuttle.

16.9.3 Order Buffer Multishuttle Putaway

When a carton is reported on the conveyor from a carton erector, a GTP station or the packing area, WCS automatically selects a specific destination storage location for it.

Multishuttle location selection is a three-step process:

- Aisle selection within the multishuttle
- Level selection within the aisle
- Location selection within the level

Each aisle and level is eligible for selection only if an eligible storage location exists within it. The rules regarding eligibility are common to the three multishuttles and are defined in Section 3.4.

16.9.3.1 Order Buffer Multishuttle Location Selection

The rules determining which of the eligible locations is chosen for a TM are specific to each multishuttle. These are the rules used when selecting a location in the order buffer multishuttle for a carton.

The first rule is applied to all the eligible storage locations. If the rule reduces the number of eligible locations but at least one location remains, then the next rule is applied to the remaining locations. Any rule which would eliminate all the locations is ignored.

The process continues down the list of rules until only one location remains.

- If the carton is required at a specific GTP station, use the sector including that station
- If the carton is a newly created empty carton, and all erector machines are available, use the sector served by the erector machine which created the carton
- If the carton is empty, use the sector in which the fewest empty cartons of that size are stored
- Use the sector in which there are most empty available locations
- If the carton is empty, use the aisle in which the fewest empty cartons of that size are stored
- Use the aisle in which there are most empty available locations
- Select an aisle at random
- If the selection is being made at the multishuttle pickup station, and the carton is the second of two cartons to be picked up together, then use the same level as the first carton being picked up
- If the carton is empty, use the level in which the fewest empty cartons of that size are stored
- Use the level on which there are most empty locations in the aisle
- Select a level at random
- If the carton is empty, use a front depth location where another empty carton of the same size is stored in the corresponding back depth location
- Use a back depth location
- Use a location nearest the elevator
- Select a location at random

The rules are applied in order to select a destination storage location for the carton while it is on a conveyor outside the multishuttle, and the rules are applied again at each decision point on the

carton's journey as far as the shuttle itself. A rule is ignored if the carton has already passed the final point at which the rule can be applied. For example, once the carton is in the infeed of a specific aisle, rules involving the selection of an aisle are ignored.

16.9.4   Order Buffer Retrieval

WCS continuously checks its database to find cartons which are required to be retrieved from the order buffer multishuttle.

There are 13 possible destinations for cartons being retrieved from the multishuttle:

- Each of the eight GTP stations in the same sector
- GTP – GOH merge
- Order QA station
- Pack station area
- Finishing line
- Relocation (the carton recirculates round the main order conveyor loop and returns to storage)

For each of these destinations, configurable maximum and minimum numbers of cartons in transit are described in Section 5.2.

WCS continuously counts the number of cartons in transit to each destination. This count includes cartons for which a retrieval mission has been issued to the multishuttle system but has not yet been actioned.

Of the destinations to which there are fewer cartons already in transit than the configured maximum, WCS calculates a value (target minimum cartons in transit minus number of cartons in transit). The destination with the greatest value, not necessarily a positive value, is considered the most in need of a carton. If the greatest value applies to two or more destinations, one of these is chosen at random.

If any cartons are required to be retrieved from the multishuttle to this destination and all equipment en route is available and in service, a mission is issued to the multishuttle system to retrieve the highest priority carton. The process continues again, taking all 29 destinations into account.

If no carton can be found to be retrieved to the destination most in need of a carton, the next destination is considered instead.

16.9.5   Order Buffer Multishuttle Shuffles

It may happen that WCS needs to retrieve a carton from a location where another carton is stored in front of it.

In this situation, WCS creates a shuffle move for the front carton, which is picked up by the shuttle and moved to another storage location nearby in the same aisle and level.

If there are no available locations in the same aisle and level, then WCS creates a relocation move for the front carton. This causes it to be retrieved from the multishuttle so that it can recirculate round the main order conveyor loop and return to the multishuttle using the normal putaway rules as described in Section 16.9.3.

DEMATIC

Once there is no carton in the way, WCS instructs the shuttle to pick up the back carton and retrieve it to the outfeed level conveyor.

16.10   Related Elements

16.10.1   Operations Management Screens

There is a specific OM screen showing the current status of all GTP stations and the outstanding work in all modules, summarised by brand and order type.

16.10.2   MOI Functions

There is no MOI functionality associated with GTP picking.

16.10.3   LOI Functions

The table below shows the LOI functions specific to GTP picking.

Function	Description	Menu Level	Section
GTP Picking	Used to pick stock from totes into cartons	Top Level	16.4
Problem	Used to report a problem during GTP picking	GTP Picking	16.6
Stock Check	Used to verify the contents of stock totes	Top Level	4.10

16.10.4   Operational Events

Section 21.2 defines the general format of Operational Events. The table below defines the information that is logged in addition to the standard details for the specific GTP Picking Operational Events.

Event	Trigger	Fields
GTP_PICK	When a GTP operator confirms a pick	Location, Tote Id, Carton Id, Order Id, SKU, Quantity
GTP_PICK_EXCEPTION	When a GTP operator reports an exception when issued with a pick	Location, Tote Id, Carton Id, Order Id, SKU, Quantity, Exception
GTP_CONFIRM_EMPTY	When a GTP operator performs a stock tote emptiness confirmation	Location, Tote Id, SKU, Pass/Fail

16.10.5   Statistics

The table below defines the statistics that are maintained for GTP picking.

Name	Index	Comments
Items Picked	Station 1..24	Incremented once per item picked (e.g. if 3 items are confirmed picked together, incremented by 3)
Item Pick Accessions	Station 1..24	Incremented once per pick confirmation (e.g. if 3 items are confirmed picked

		together, incremented by 1)
Cartons Picked Into	Station 1..24	Incremented once per carton leaving a GTP station after being picked into
Totes Picked From	Station 1..24	Incremented once per stock tote leaving a GTP station after being picked from
Totes Confirmed Empty	Station 1..24	Incremented once per stock tote leaving a GTP station, WCS expected empty, operator confirmed empty
Totes Unexpectedly Not Empty	Station 1..24	Incremented once per stock tote leaving a GTP station, WCS expected empty, operator stated not empty
Totes Assumed Empty	Station 1..24	Incremented once per stock tote leaving a GTP station, WCS expected empty, no operator confirmation required
Totes Assumed Not Empty	Station 1..24	Incremented once per stock tote leaving a GTP station, WCS expected not empty
Problems By Station	Station 1..24	Incremented once per carton or stock tote leaving a GTP station following one or more exceptions (e.g. if 3 exceptions reported for a stock tote, incremented by 1 for the station)
Problems By Exception	Exception	Incremented once per exception (e.g. if 3 exceptions reported for a stock tote, incremented by 1 for each of the 3 exceptions)

16.10.6 Alarms and Alerts

The table below defines the alarms and alerts that are associated with the GTP picking process. They are displayed on the WMS Alarms page.

Alarm	Description	Drill Down
GTP Station Inactivity	A tote and a carton have been at a GTP station for a pick to be performed for *GTP Inactivity Minutes* minutes (configurable)	List of GTP stations

16.10.7 Configuration Parameters

The table below lists the configuration parameters that are used to control the GTP picking functions.

Parameter Name	Function	Values	Section
GTP Stations In Use	Defines the number of GTP stations that WCS	0..24	16.1.1

Parameter Name	Function	Values	Section
	should plan to use and retrieve pick cartons and stock totes to		
Min Medium Cartons In Order Buffer	Defines the minimum number of empty medium pick cartons to be stored in each order buffer	0..100	16.2
Min Large Cartons In Order Buffer	Defines the minimum number of empty large pick cartons to be stored in each order buffer	0..100	16.2
Min Carton Request Qty	Defines the minimum number of empty pick cartons that WCS should request be erected when the number in an order buffer falls below the minimum defined by *Min Medium Cartons In Order Buffer* or *Min Large Cartons In Order Buffer*	1..100	16.2
Max Totes To GTP Station	Defines the maximum number of stock totes in transit to a GTP station from the associated storage multishuttle aisle	0..20	16.7.6
Min Totes Assigned To GTP Station	Defines the target minimum number of totes to be picked from for cartons assigned to a GTP station	0..200	16.7.2
GTP Tote Empty Confirm	Defines whether the GTP operator must confirm when WCS believes a tote is now empty of stock	TRUE/FALSE	16.4.5
GTP Inactivity Minutes	Number of minutes after which GTP Station Inactivity alarm should be raised	1..1440	16.10.6
Prefer Reused Carton For Despatch	Defines whether WCS prefers cartons returned from packing when assigning a DU to be despatched in a carton	TRUE/FALSE	16.7.1

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17 HOUSEKEEPING

This section describes the housekeeping functionality that is provided in the different warehouse storage areas.

17.1 GOH

There is no specific housekeeping functionality provided in GOH. An operator may relocate any item between storage locations using the manual relocation functionality.

17.2 Manual Storage Areas

Housekeeping is performed in the manual pallet storage areas (both VNA and Wide Aisle) to free up pallet locations by relocating cases from pallets to case shelving. Housekeeping is always manually requested – there is no automatic triggering of housekeeping functionality by WCS.

17.2.1 Requesting Housekeeping

Housekeeping is requested from a WCS OM screen. The user specifies a set of selection criteria to identify those pallets for which housekeeping is required. The possible criteria include:

- The manual storage area requiring housekeeping – either VNA or Wide Aisle.
- Maximum number of cases on a pallet for it to be eligible for housekeeping (e.g. 2).
- Minimum number of consecutive days up to today during which a SKU has not been picked (e.g. 10).

Once the above have been entered, WCS displays a list of all pallets in the selected area which meet the selection criteria. Assuming that the list is acceptable, the operator then confirms that these pallets are to be housekept.

17.2.2 WCS Flagging of Housekeeping Pallets

When the user has confirmed the pallets on which housekeeping is to be performed, WCS flags each pallet as requiring housekeeping. The list of pallets awaiting housekeeping can be viewed via an OM screen. A user can remove the housekeeping flag.

17.2.3 Equipment Used

Housekeeping in both VNA and Wide Aisle is performed using an HLOP. The operator uses an RF device to perform the housekeeping process.

When an operator initially logs on to WCS using an RF device which has a fixed truck type associated with it, the 'Housekeeping' function is only shown on the menu if the truck type is HLOP.

If the operator is not working on a fixed truck type, the 'Housekeeping' function is only shown on the menu if the associated truck type has been confirmed as HLOP.

17.2.4 Housekeeping Travel Sequence

WCS uses the pick walk sequence number configured on all manual locations to determine the housekeeping travel sequence. A housekeeping operator is first directed to the location which has been flagged for housekeeping with the lowest pick walk sequence number.

If more than one location has the same pick walk sequence number, any of these locations may be selected but all locations with the same pick walk sequence number are visited before moving on to a location with a higher pick walk sequence number.

17.2.5   Performing Housekeeping

The housekeeping operator is first directed to collect an empty pallet. After collecting an empty pallet and applying a pre-printed LP to it, the operator is sent to the first location requiring housekeeping.
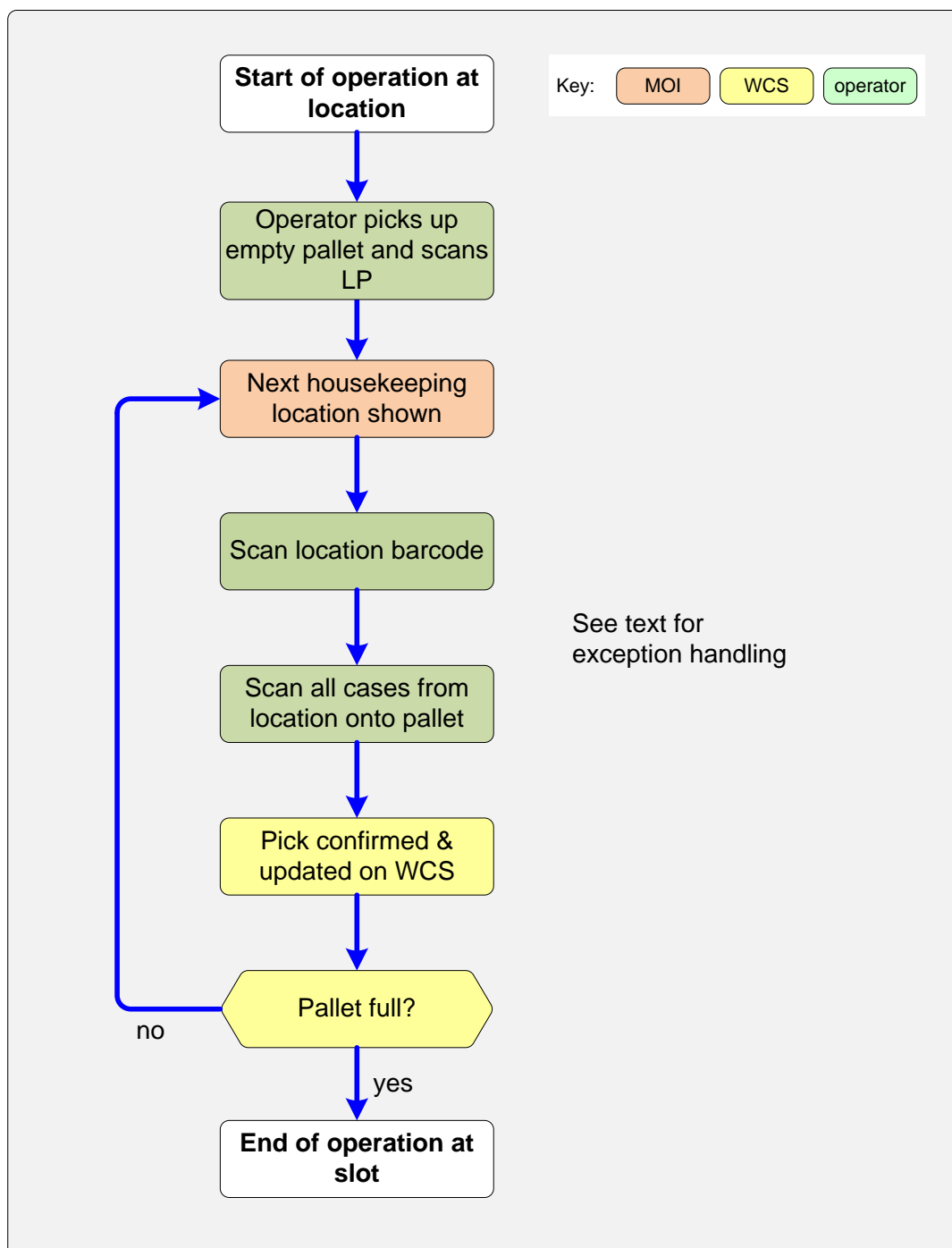
17.2.5.1   Confirming the Housekeeping Location

The operator must scan the location barcode of the prompted location to confirm arrival at the location. If the wrong barcode is scanned, the operator is re-prompted to scan the barcode of the correct location.

17.2.5.2   Collecting Cases

Once the current location has been correctly confirmed, the operator is prompted to scan each case in the location and transfer them to the housekeeping pallet.

17.2.5.3   Confirming the Location is Empty

When all known cases in the location have been scanned, the operator is prompted to confirm that the location is now empty. If the location is confirmed to be empty, the operator is prompted to go to the next housekeeping location.

If the location is not confirmed as empty, the operator is prompted to scan any remaining cases (see section 17.2.5.4).

The operator may also confirm the location to be empty by selecting the 'Location Empty' function from the 'Options' menu. This function is only used if the location is physically empty before it is logically empty (i.e. one or more case is missing). (See section 17.2.5.6)

17.2.5.4   Confirming the Housekeeping Pallet to be Full

The operator may confirm the housekeeping pallet to be full at any time by selecting the 'Pallet Full' option from the 'Options' menu.

Once full, the operator is prompted to go to a (WCS selected) VNA case shelving aisle and perform case putaway. The operation is the same as described in Section 12.7. There is no tramming of the housekeeping pallet between the aisle where it is built and case shelving as the housekeeping operator performs both the pick and put tasks.

17.2.5.5   Exception: Unexpected Case

If the operator scans a case that is not expected to be in the location, WCS checks for the case's current location.

If the case is known to WCS in a different location, it is deleted from its current logical location and 'moved' to the housekeeping pallet.

If the case is not known to WCS, the operator should retain it in the truck so that it can be investigated later.

17.2.5.6   Exception: Missing Case

If the operator confirms a location to be empty before all logical cases have been scanned, WCS prompts for confirmation that the location is really empty. After confirmation has been received, any cases which are still expected to be in the location are made *missing*.

17.2.6   Empty Pallet Removal

Empty pallets may be left in rack locations after picking or housekeeping is performed. A separate RF-driven function is provided for removal of these pallets.

17.2.6.1   Maximum Pallets in a Stack

An operator performing empty pallet removal builds a stack of pallets. The maximum number of pallets allowed in a stack is defined by the configuration parameter *Max Empty Pallets In Stack*.

17.2.6.2   Selecting Pallet Removal

An operator selects the 'Empty Pallet Removal' function from the RF menu to perform empty pallet removals. Empty pallet removal can only be performed by a turret truck in pallet VNA and by a reach truck in wide aisles. The 'Empty Pallet Removal' function is only available on these truck types.

17.2.6.3   Pallet Removal Sequence

WCS displays a list of all the aisles which contain empty pallets. The operator selects one of these aisles.

WCS uses the pick walk sequence number to define the sequence that the empty pallet locations are visited. The operator is prompted to go to a location and scan the location barcode to confirm pallet pick-up. Once the location barcode has been scanned, the pallet is considered to have been removed from the location.

17.2.6.4   Stack Completion

An empty pallet stack is considered to be complete when the number of pallets in the stack has reached the maximum allowed or when there are no more empty pallets awaiting removal in the aisle. In addition, an operator may declare a stack to be full at any time.

When a full stack has been built, the operator is prompted to remove it from the aisle and to confirm on the RF device that the stack has been removed. WCS does not track the location (or existence) of the stack once it has been confirmed to have been removed.

17.2.6.5   Exception: No Empty Pallet

The operator may use the 'Options' menu to confirm that there is no empty pallet in the location. WCS then clears the empty pallet flag for the location.

17.2.6.6   Exception: Unexpected Stock in Location

The operator may use the 'Options' menu to confirm that a location contains stock (i.e. cases on a pallet). In this situation, the operator is prompted to remove the pallet and take it to Manual QA for further investigation. The location is then marked as empty.

17.3   Manual Pick locations

Housekeeping can be performed in the Indent pick locations and in the LSS pick locations.

17.3.1   Indent Housekeeping

Housekeeping for locations where indent is stored and picked is always performed at the pallet level (i.e. relocating pallets). This is because the individual cases on the pallets are not barcoded so cannot be tracked.

17.3.1.1   Requesting Indent Housekeeping

Indent housekeeping is requested via an OM screen. The operator can perform a query against a set of criteria (e.g. all indent pallets with fewer than 'n' cases on them in ground level locations) to display a list of pallets. An 'Action' function is then available to request housekeeping of all pallets in the list. When requested, all pallets in the list are flagged as requiring housekeeping.

17.3.1.2   Performing Indent Housekeeping

Indent housekeeping is performed using a reach truck with an associated RF device. The operator must select 'Indent Housekeeping' from the menu.

When selected, the operator is directed to each indent location which has been flagged for housekeeping, lowest pick walk sequence number first.

The operator must scan the pallet LP to confirm arrival at the location. The operator is then prompted to manually select a new location and scan the location barcode. When a location barcode is scanned, the pallet is considered to have been stored in the location.

The operator is then directed to the nearest location which is flagged for housekeeping.

17.3.2   LSS Pick Location Housekeeping

Housekeeping is performed for LSS pick locations to clear out old loose cases and store them in case shelving. The process is operator selected and driven.

DEMATIC

DAI

Start of operation

Key: MOI | WCS | operator

Operator picks up empty pallet and scans LP

Prompt to scan next housekeeping location

Scan location barcode

See text for exception handling

Scan a case

Confirm SKU

Enter quantity in case

Pallet full? — yes →

no ↓

More cases in location? — yes

no

End of Pallet Build – Putaway to Case Shelving
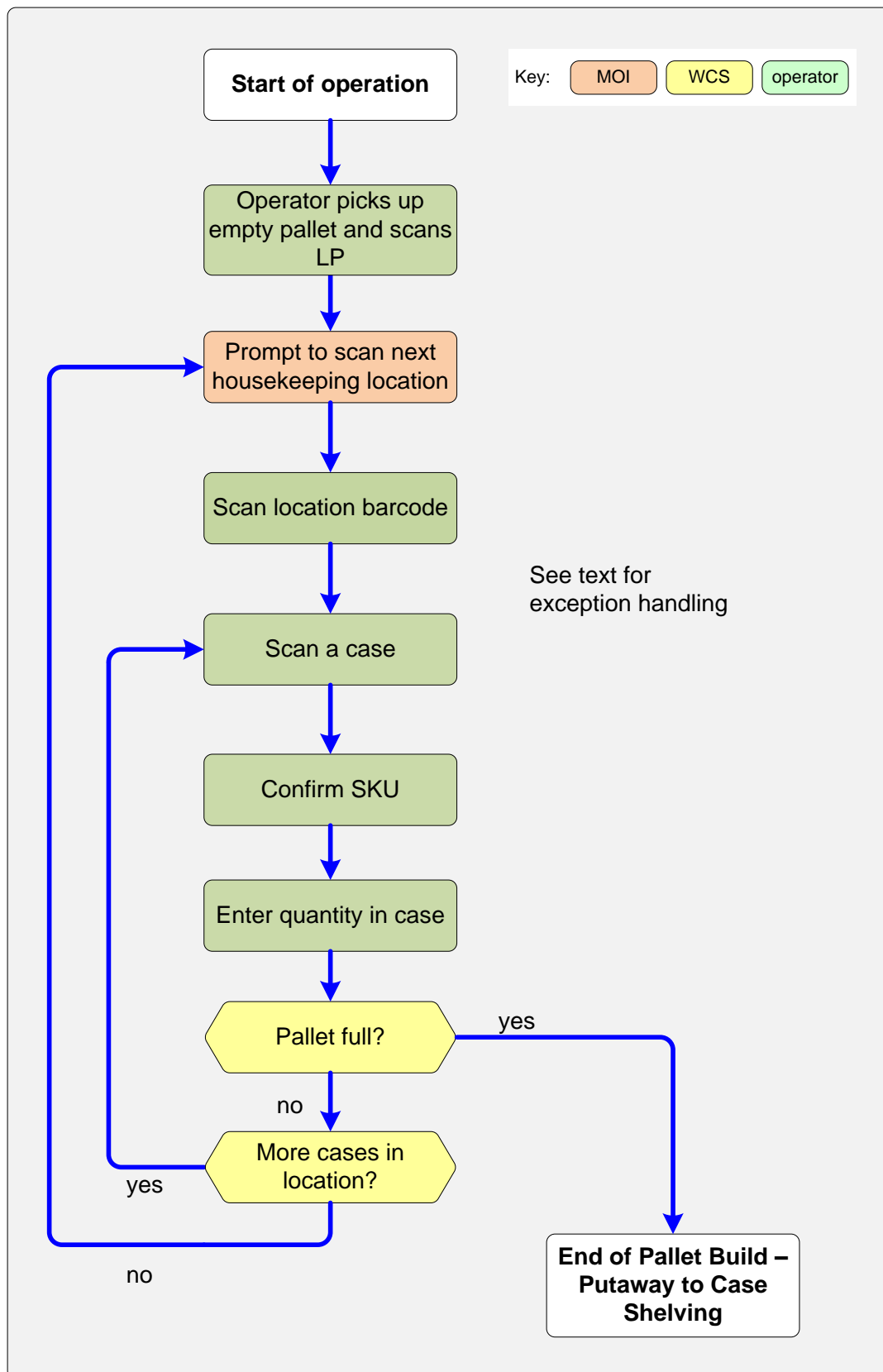
17.3.2.1   Start of Process

The operator selects 'LSS Housekeeping' from the RF device menu. The option is available to operators of all truck types except Turret Trucks.

The operator is prompted to scan the barcode on an empty pallet. This pallet will be used to collect cases from LSS locations before delivering to VNA.

17.3.2.2   Building the Pallet

The operator selects which locations to perform housekeeping from. WCS prompts the operator to visit a location and scan the location barcode to confirm the location. As the location is a pick location, any LP that is still visible on a case will be unknown to WCS.

Once at a location, the operator applies a pre-printed LP to a case if necessary and is prompted to scan the case, confirm the SKU by scanning the SKU barcode and then enter the quantity (in eaches) within the case.

The process continues until the operator declares the pallet to be full.

17.3.2.3   Delivering the Pallet to VNA Case Shelving

Once a pallet has been declared full, if there is an available P&D at one of the VNA case shelving aisles, the operator is prompted to take the pallet there.

If there is no P&D available in VNA case shelving, the operator is prompted to drop the pallet at the P&D of the aisle where the pallet has been built. The pallet is then trammed to the destination VNA aisle when a P&D becomes available.

17.4   Automated Storage Areas

17.4.1   Tote Consolidation

As sales of a SKU decline, it may become necessary to merge the contents of a number of totes of the same SKU into fewer totes to create more storage space in the multishuttle. This is a manual process which is performed at Product QA.

17.4.1.1   Identifying Consolidation SKUs

WCS flags SKUs which it considers can be consolidated. These are SKUs for which there are more uncompartmentalised totes located in the storage multishuttle than the maximum calculated for the SKU as described in Section 13.3, and for which there are two totes whose combined weight and combined volume of stock are below the maximums permitted for a single tote.

An OM user can use the standard SKU Query screen to select some or all of these SKUs. An 'action' function allows tote consolidation to be requested for a specific SKU or for all SKUs in the list.

17.4.1.2   Tote Retrieval for Consolidation

When consolidation is requested for a SKU, WCS retrieves to Product QA all totes which contain only the SKU and which are suitable to be consolidated. The expectation is that the entire contents of a tote will be transferred to another tote.

If the stock in a tote is held for any reason, it is not retrieved for consolidation.

If the stock in any of the totes is reserved for picking, the totes are not retrieved until the picking has been performed.

If consolidation is requested for more than one SKU, the totes for the second SKU are not retrieved until all the totes for the first SKU are in transit to Product QA and are reported at a point on the conveyor system where they cannot be passed by totes of the second SKU. This delay ensures that all suitable totes of a SKU are delivered to Product QA together.

17.4.1.3   Consolidation Process

SKU tote consolidation is performed using the Tote Consolidation function at Product QA. The process is completely manual in that the operator decides which stock to merge into which totes.

The operator begins the process by scanning the destination tote (i.e. the tote into which stock from other totes will be consolidated). The current contents and weight of the stock in the destination tote are displayed.

If the operator is satisfied that this tote is suitable for consolidation, the operator selects the Consolidation action.

The operator is then prompted to scan the tote from which stock will be removed to add into the destination tote. When the tote has been scanned, the quantity in the destination tote is updated to include the additional quantity.

The operator can continue to add the stock from other totes until the destination tote is declared to be complete.

If there are still further totes to be consolidated for the SKU, a new destination tote can be scanned and the process repeated.

Key: LOI | WCS | operator

Start of operation → Prompt to scan destination tote → Scan tote which stock will be added to → Display destination tote id and contents → Prompt to scan tote to be added → Scan tote which will be added to destination tote → Destination tote complete? — no → Display destination tote id and contents; yes → Release destination tote → More totes to consolidate? — yes → Prompt to scan destination tote; no → End of operation

See text for exception handling

17.4.1.4   Exception: Stock Tote Contains Wrong SKU

If the operator scans a tote which does not contain the same SKU as the destination tote, an error message is displayed.

17.4.1.5   Exception: Destination Tote Overweight

If the operator scans a tote whose contents will cause the destination tote to become overweight, an error message is displayed and the transfer is not accepted.

17.4.2   Compartmentalised Totes

Compartmentalised totes are used to store SKUs which have low stock quantities (e.g. end of lines). These totes are created by inserting a divider into a standard tote, to create two compartments. The individual compartments within the totes are not labelled. However, the tote barcode indicates the orientation of the tote, when scanned. This allows WCS screens to identify the separate compartments within the tote as Left and Right.
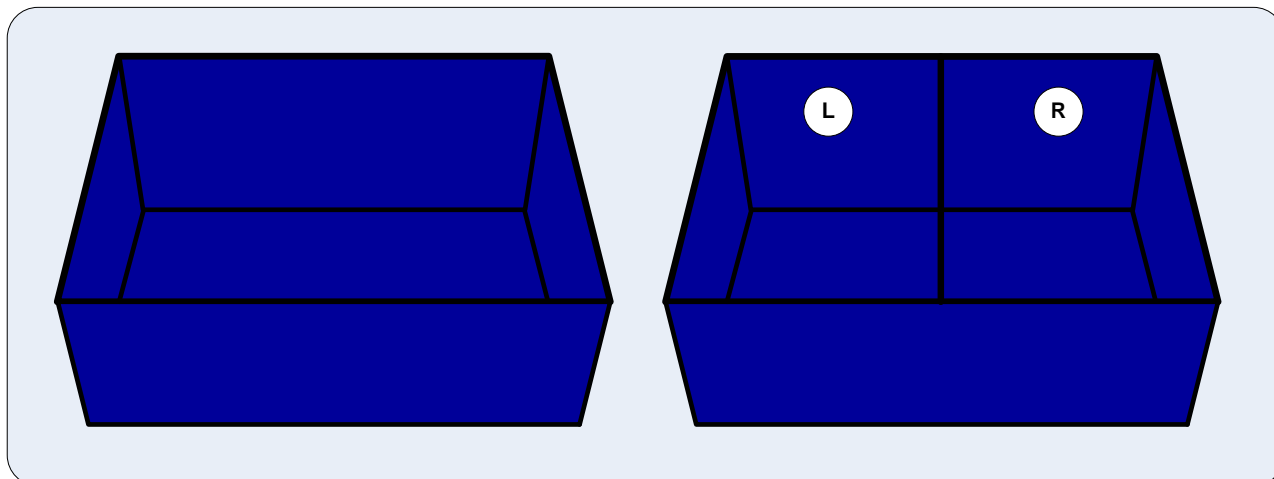
17.4.2.1   Compartment Capacity

The capacity of a compartment is configurable on WCS. The length, width and height (in mm) can be configured and also a useable tolerance (e.g. use 85% of the available volume in a compartment).

17.4.2.2   Identifying SKUs for Compartmentalisation

WCS automatically identifies SKUs which are eligible for storage in compartmentalised totes. A SKU is eligible if the following criteria are met:

- The maximum number of totes to be located in the storage multishuttle calculated for the SKU as described in Section 13.3 is less than 1
- The total volume of stock of the SKU is less than the usable volume of a compartment
- The dimensions of a single item of the SKU fit into a compartment

17.4.2.3   Identifying SKUs for Same Tote

Whilst there may be a number of SKUs which are eligible for compartmentalisation, there are additional rules applied to identify those SKUs that can be stored in the same tote.

SKUs are only eligible for consolidation in the same tote if the following apply:

- The SKUs belong to the same client
- The SKUs belong to the same brand
- The total weight of the stock does not exceed the maximum permitted tote weight

17.4.2.4   Compartmentalisation Process Start

The filling of compartmentalised totes is performed using the Compartmentalise SKU function at Product QA. The screen shows the number of SKUs that are currently eligible for compartmentalisation in the same tote (see section 17.4.2.3) and the maximum number of totes that these can be added to. The operator is first asked to enter the number of compartmentalised totes that are to be created. This number cannot exceed the maximum number of eligible totes.

When requested, WCS identifies sets of two SKUs that can be stored together in a tote and retrieves the totes for these SKUs to Product QA. A 'set' of totes is only retrieved when the previous set has reached the point on the conveyor system where they cannot be passed by totes belonging to a different 'set'.

A 'set' of totes may include one that is already compartmentalised but which has at least one compartment unoccupied.

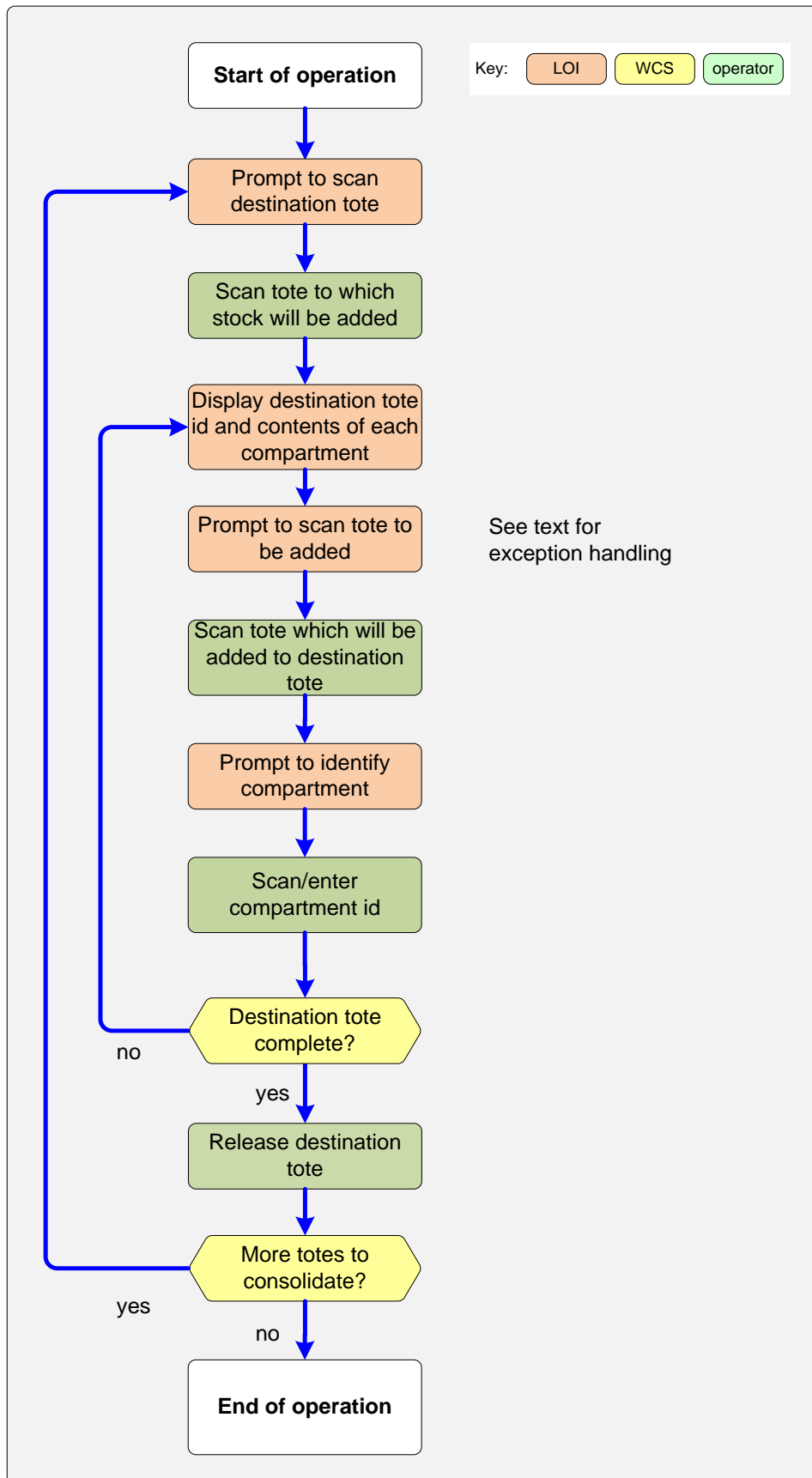### 17.4.2.5   Building the Tote

The operator scans the destination tote (i.e. the tote into which stock from other tote(s) will be added). This can either be an existing compartmentalised tote with at least one empty compartment or an empty compartmentalised tote. The current contents and weight of the stock in each compartment of the destination tote are displayed.

If the operator is satisfied that this tote is suitable for consolidation, the operator selects the Compartmentalise action.

The operator is then prompted to scan the tote from which stock will be removed to add into the destination tote. The tote must contain a SKU which is part of the set for compartmentalising.

When the tote has been scanned, the operator is prompted to identify the compartment into which the stock is to be added. The contents of the destination tote are then updated to include the additional SKU.

The operator can continue to add the stock from other totes in the set until the destination tote is declared to be complete.

DEMATIC

DAI

Key: LOI | WCS | operator

Start of operation

Prompt to scan destination tote

Scan tote to which stock will be added

Display destination tote id and contents of each compartment

Prompt to scan tote to be added

See text for exception handling

Scan tote which will be added to destination tote

Prompt to identify compartment

Scan/enter compartment id

Destination tote complete?

no

yes

Release destination tote

More totes to consolidate?

yes

no

End of operation

17.4.2.6   Exception: Incompatible SKU

If the SKU in a scanned tote cannot be stored in the existing part-filled tote, an error message is displayed.

17.5   Related Elements

17.5.1   Operations Management Screens

The following specific OM screens are available to support housekeeping.

OM Screen	Description	Section
Manual Housekeeping Request	Identifies manual locations eligible for housekeeping and allows request to perform housekeeping	17.2.1
Indent Housekeeping Request	Identifies indent locations eligible for housekeeping and allows request to perform housekeeping	17.3.1.1
Consolidation SKU Query/Request	Identifies SKUs which could be consolidated and allows request to consolidate	17.4.1.1

17.5.2   MOI Functions

The table below shows the MOI functions specific to Housekeeping.

Function	Description	Menu Level	Section
Manual Housekeeping	Performs housekeeping in the manual storage areas	Housekeeping	17.2.5
Empty Pallet Removal	Performs empty pallet removal in the VNA and wide aisle storage areas	Housekeeping	17.2.6.2
Indent Housekeeping	Performs housekeeping in the Indent storage locations	Housekeeping	17.3.1.2
LSS Housekeeping	Performs housekeeping in the LSS storage locations	Housekeeping	17.3.2.1

17.5.3   LOI Functions

There are no LOI functions specific to Housekeeping.

17.5.4   Operational Events

Section 21.2 defines the general format of Operational Events. The table below defines the information that is logged in addition to the standard details for the specific Housekeeping Operational Events.

Event	Trigger	Fields
HSK_LOC_EMPTY	When a storage location has been emptied	Location
HSK_SKU_CASE_MOVED	When a case of a SKU has been removed from a manual location	Location, SKU, Case Id, Qty in Case
HSK_EMPTY_REMOVE	When an empty pallet has been removed from a manual location	Location
HSK_CONSOL_TOTE	When stock is consolidated from one tote into another	To Tote ID, From Tote ID, SKU, Quantity Moved, Quantity in Consol

		Tote
HSK_COMPART_TOTE	When stock is moved into a compartmentalised tote	Comp Tote ID, From Tote ID, SKU, Quantity

17.5.5   Statistics

The table below defines the statistics that are maintained for Housekeeping.

Name	Index	Comments
HSK Location Housekept	1..No of Aisles	Incremented once per housekept location
HSK Empty Pallet Removed	1..No of Aisles	Incremented once per empty pallet removal
HSK Tote Consolidated	1	Incremented when a consolidation tote is created
HSK Compartment Tote	1	Incremented when a compartmentalised tote is created

17.5.6   Alarms and Alerts

There are no alarms and alerts associated with the Housekeeping process.

17.5.7   Configuration Parameters

The table below lists the configuration parameters that are used to control the Housekeeping functions.

Parameter Name	Function	Values	Section
Max Empty Pallets In Stack	Defines the maximum number of empty pallets that can be stacked together within an aisle	1..99	17.2.6.1

DEMATIC

DAI

18   PACKING

18.1   Packing Overview

This section describes the processes whereby picked items are transferred into the despatch units in which they will leave the DC, and whereby despatch units are labelled and finished so that they are ready to leave the DC.

There are different processes for:
- GOH stock (Section 18.3)
- Full cases (Section 18.4)
- Satchel packing (Section 18.5.4)
- Stock picked and despatched in cartons (Section 0)

18.2   Pack Locations

18.2.1   GOH Pack Stations

WCS allows for up to 10 GOH pack stations, which are used to apply despatch labels to hanging bags for despatch. Each station is equipped with a WCS touch screen LOI and connected barcode scanner, with a label printer and with access to a document printer.

Bins contained picked stock are delivered to the GOH packing area following the GOH picking process described in Section 11.

18.2.2   Case Labelling Stations

WCS allows for up to 3 case labelling stations, which are used to apply despatch labels to cases and pallets for despatch. Each station is an OMW equipped with a barcode scanner and a label printer.

Cases are delivered to the station on pallets following the full case picking process described in Section 14.2.

18.2.3   Flat Pack Stations

18.2.3.1   Manual Pack Stations

WCS allows for up to 10 manual pack stations, which are used to pack and finish items that have been picked in the manual area.

Each manual pack station is equipped with a WCS touch screen LOI and connected barcode scanner, a document printer and a label printer.

18.2.3.2   Automated Pack Stations

WCS allows for up to 36 pack stations within the automation area. Some of these stations are equipped with an automatic bagging machine.

Each pack station is equipped with a WCS touch screen LOI and connected barcode scanner, and optionally a document printer and/or a label printer.

At the stations with automatic bagging machines, this label printer is connected to the bagging machine so that despatch labels are printed directly onto the satchels. All satchels are the same size.

A WCS configuration screen allows the following to be configured for each automated pack station:
- In / out of service – if the station is in service then WCS can route cartons to the station, even if no operator is logged in to WCS there
- Carrier/s – one or more carriers can be configured to the station. WCS does not route to the station any cartons containing DUs to be despatched by any other carriers
- Brand/s – one or more brands can be configured to the station. WCS does not route to the station any cartons containing orders for any other brands
- Whether the station is equipped with a document printer
- Whether the station is equipped with a label printer
- Whether the station is equipped with a card printer
- Whether DUs planned to be despatched as satchels can be routed there
- Whether DUs planned to be despatched as cartons can be routed there
- Whether DUs which require gift wrapping can be routed there
- Whether DUs which require bagging individually can be routed there
- Whether cartons with no valid destination pack station can be routed there

Pick cartons from the GTP area and the GTP - GOH merge area whose contents should be despatched in satchels, along with any DUs to be despatched as cartons but which require manual intervention, are routed by WCS to a specific station matching the defined configuration.

An operator is warned before trying to log in to an out of service station where there is no work outstanding.

18.3   GOH Pack Process

Bins contained picked stock are delivered to the GOH packing area following the GOH picking process described in Section 11. They are not routed to specific pack stations.

The operator scans a bin LP on a GOH pack station LOI to begin the process. Provided the contents of the bin are expected in GOH packing, WCS issues a print instruction for the despatch label on the label printer at the station.

The entire contents of the bin are bagged together. The operator affixes the despatch label to the bag.

If any additional paperwork is required to be despatched with the stock, WCS issues a print instruction for this on the document printer configured to the station.

The operator is able to reprint the despatch label or any other paperwork until the next bin LP is scanned (a suitably-privileged OM user can reprint these at any time).

The bag and its contents are logically moved to a WIP location, awaiting loading onto a trailer (Section 19.7). The bin is now eligible to be reused for another putaway or picking operation.

18.4   Case Labelling Process

Cases are delivered to the station on pallets following the full case picking process described in Section 14.2.

DEMATIC

If the order processing configuration described in Section 9.3.1 specifies that the cases are to be despatched individually, then each case requires its own despatch label (although multiple cases may be physically loaded for despatch together on a pallet).

If the order processing configuration specifies that the cases are to be despatched by pallet, then the pallet requires a despatch label and the individual cases do not.

The operator scans the LP of the pallet on an OM screen. If WCS recognises the ID scanned as a pallet onto which full case picking has taken place as described in Section 14.2, an Action to print the despatch labels for the pallet is available to a suitably-privileged user.

The process when the Action is selected differs between cases to be despatched individually and cases to be despatched by pallet.

18.4.1   Despatch by Case

WCS issues a print instruction to the selected label printer for a number of despatch labels, one for each case on the pallet. A header label is printed before the despatch labels, containing with a human-readable description of the pallet and its contents. A footer label is printed after the despatch labels, containing a barcode which uniquely identifies the footer.

The operator applies a despatch label to each case. The contents of each case are identical, so there is no requirement for a specific label to be applied to a specific case.

When the operator has applied a label to each case, the operator scans the footer label barcode on the OM screen. WCS sets the cases eligible for despatch.

It is a manual operation to load the labelled cases onto the despatch sorter. Alternatively, the pallet can be taken to the appropriate despatch lane.

18.4.2   Despatch by Pallet

WCS issues a print instruction to the selected label printer for a single despatch label for the pallet. A header label is printed before the despatch label, containing with a human-readable description of the pallet and its contents. A footer label is printed after the despatch label, containing a barcode which uniquely identifies the footer.

The operator applies the despatch label to the pallet. All the cases on the pallet are to be despatched to the same destination, so there is no requirement for each case to be labelled.

When the operator has applied the label to the pallet, the operator scans the footer label barcode on the OM screen. WCS sets the pallet eligible for despatch.

It is a manual operation to take the pallet to the appropriate despatch lane. The cases are not labelled so should not be loaded onto the despatch sorter.

18.4.3   Case Labelling Exceptions

Any discrepancy between the number of TMs for despatch and the number of despatch labels printed should be investigated manually. If it is clear that one or more case is missing, then the operator may choose to abandon part of the pick (see Section 9.8.4).

18.5 Manual & Automated Pack Station Process

The packing process is effectively the same at pack stations in the manual area and the automation area.

The operator scans a pick carton LP on the LOI to begin the process. There is no requirement for the carton to be scanned at the pack station that WCS routed it to.

If WCS recognises the scan as a carton which contains one or more orders to be packed individually in satchels and then returned to the carton, then the individual bagging process (Section 18.5.1) takes place.

Otherwise, if WCS recognises the scan as a carton which contains one or more items to be gift wrapped, and the configuration of the pack station allows the carton to be handled there, then the gift wrapping process (Section 18.5.2) takes place.

Otherwise, if WCS recognises the scan as a carton which contains multiple DUs to be despatched individually as satchels, and the configuration of the pack station allows the carton to be handled there, then the multiple-DU satchel packing process (Section 18.5.3) takes place.

Otherwise, if WCS recognises the scan as a carton which contains a single DU to be despatched as a satchel, and the configuration of the pack station allows the carton to be handled there, then the single-DU satchel packing process (Section 18.5.4) takes place.

Otherwise, if WCS recognises the scan as a carton for which the carton itself is the despatch unit, and the pack station is a manual pack station, then the single-DU carton packing process (Section 18.5.5) takes place.

Otherwise, the carton can be walked to another pack station or to the Finishing QA station.

18.5.1 Individual Bagging

This section refers to stock picked into a carton for which each individual order is to be packed in a satchel and then returned to the carton. It is expected that this will be the process for orders of order type Click 2 Collect Bags.

Individual bagging takes place at defined automated pack stations. It can in theory also take place at a manual pack station, if an unexpected carton is scanned there.

There may be multiple orders picked into the carton. The Host may have specified that a returns slip is to be despatched with each order. As the following process relies on returns slips to identify individual orders, an order that requires individual bagging but does not require a returns slip will be the only order picked into the carton.

Any returns slips will normally already have been added to the carton by one of the document inserters on the exit from the GTP area. If WCS knows that these have not been added but the pack station is equipped with a document printer, WCS issues a print instruction to the document printer for each of the outstanding returns slips. If there is no document printer at the station to print any outstanding returns slips then the carton cannot be handled at the station.

18.5.1.1 Individual Bagging Process

When WCS is satisfied that individual bagging can take place for the pick carton, the operator is prompted to scan one of the returns slips in the carton to identify the first order to be handled. (If

there is no returns slip in the carton then this step is not required as the picked items are all for the same order.)

Once the order being handled is known, WCS issues a print instruction for the satchel label on the label printer at the station. If the station is equipped with an automatic bagging machine, this label is automatically printed onto a satchel which is inflated to allow the picked stock and any returns slip to be inserted.

If a packing instruction has been configured for the order's brand and order type (Section 9.3.1) then this is displayed on the LOI and remains visible while the order is handled at the station.

The pack station LOI displays details of the order and lists (SKU, description, colour, size, quantity) each item picked into the carton for the order.

The operator retrieves the items for the order from the carton and scans the SKU of each. If there are multiple units of the same SKU picked for the order, the operator scans the SKU of each unit individually. The LOI display updates to indicate each item scanned. WCS rejects a scan if the SKU is not required for the order.

When the final item for the order is scanned, WCS prompts the operator to confirm that the items and any returns slip have been placed in the satchel and that the satchel is labelled and sealed. The operator is reminded that the satchel should not leave the station. If there are outstanding orders picked into the carton then the operator is prompted to scan the next returns slip.

Once the satchels for all the orders are confirmed labelled and sealed, the operator is prompted to confirm that all the satchels are placed in the carton.

If this is the final carton of the order type in the consignment and the Host has specified that a pack list should be included, then WCS issues a print instruction to the document printer if at a manual pack station, or if the document inserter on the finishing line is not configured for this.

The operator at an automated pack station in then instructed to place the open carton onto the takeaway conveyor. The carton will arrive next at the document inserter on the finishing line.

At a manual pack station, WCS issues a print instruction for the despatch label on the label printer at the station. The operator lids and seals the carton, and applies the despatch label to the top. If any other labels are required to be applied to the carton, the operator confirms to WCS when these have been applied.

It is a manual operation to load the sealed and labelled carton onto the despatch sorter.

18.5.2   Gift Wrapping

This section refers to stock picked into a carton for which the Host has specified at least one item should be gift wrapped. This is expected to be possible only for ecommerce orders.

Gift wrapping takes place at automated pack stations that are configured to be able to perform the process. It can also take place at a manual pack station.

If the Host has specified a gift message for at least one item in the carton, the pack station must also be equipped with a card printer.

The items picked into the carton form all or part of a single order. The items are to be despatched from the DC in the carton.

The Host may have specified that a returns slip is to be despatched with the order. If so, then at a manual pack station that is equipped with a document printer, WCS issues a print instruction to the document printer for the returns slip. If there is no document printer at the manual pack station to print any returns slip then the carton cannot be handled at the station. From an automated pack station, a returns slip can be added to the carton by the document inserter on the finishing line.

18.5.2.1   Gift Wrapping Process

If a packing instruction has been configured for the order's brand and order type (Section 9.3.1) then this is displayed on the LOI and remains visible while the order is handled at the station.

The pack station LOI displays details of the order and lists each item (SKU, description, colour, size, quantity) picked into the carton.

The operator retrieves the items from the carton and scans the SKU of each. If there are multiple units of the same SKU, the operator scans the SKU of each unit individually. The LOI display updates to indicate each item scanned. WCS rejects a scan if the SKU is not required for the order.

If the Host has specified gift wrapping for the item, WCS indicates this to the operator. The operator should wrap the individual item. If the Host has also specified a gift message for the item, WCS issues a print instruction for this message on the card printer at the station. The operator should attach the card to the wrapped item. The operator must confirm to WCS that the gift wrapping operation has been performed for the item.

If multiple units of the same SKU require gift wrapping, they should be wrapped separately. There may be multiple lines in the order for the same SKU – this will be the case if the lines have different gift wrapping requirements or different gift messages. It is not possible for a gift message to be printed on a card for an item that is not also gift wrapped.

When the final item has been handled, the operator is prompted to confirm that all the items and any returns slip are placed in the carton.

If this is the final carton of the order type in the consignment and the Host has specified that a pack list should be included, then WCS issues a print instruction to the document printer if at a manual pack station, or if the document inserter on the finishing line is not configured for this.

The operator at an automated pack station in then instructed to place the open carton onto the takeaway conveyor. The carton will arrive next at the document inserter on the finishing line.

At a manual pack station, WCS issues a print instruction for the despatch label on the label printer at the station. The operator lids and seals the carton, and applies the despatch label to the top. If any other labels are required to be applied to the carton, the operator confirms to WCS when these have been applied.

It is a manual operation to load the sealed and labelled carton onto the despatch sorter.

18.5.3   Multiple-DU Pick Cartons

This section refers to cartons containing multiple DUs to be despatched individually as satchels.

Such packing takes place at defined automated pack stations. It can in theory also take place at a manual pack station, if an unexpected carton is scanned there.

Multiple orders are batched together to be picked into the same carton according to the rules described in Section 9.7.2. Although those rules restrict multiple-DU order batching to orders which require a single unit to be picked, the packing process described here does not preclude larger orders from being handled.

As the following process relies on returns slips to identify individual orders, the Host will have specified that a returns slip is to be despatched with each order.

The returns slips will normally already have been added to the carton by one of the document inserters on the exit from the GTP area. If WCS knows that these have not been added but the pack station is equipped with a document printer, WCS issues a print instruction to the document printer for each of the outstanding returns slips. If there is no document printer at the station to print any outstanding returns slips then the carton cannot be handled at the station.

18.5.3.1   Multiple-DU Pick Carton Process

When WCS is satisfied that the multiple-DU packing process can take place for the pick carton, the operator is prompted to scan one of the returns slips in the carton to identify the first order to be handled.

Once the order being handled is identified, WCS issues a print instruction for the despatch label on the label printer at the station. If the station is equipped with an automatic bagging machine, this label is automatically printed onto a satchel which is inflated to allow the picked stock and the returns slip to be inserted.

If a packing instruction has been configured for the order's brand and order type (Section 9.3.1) then this is displayed on the LOI and remains visible while the order is handled at the station.

The pack station LOI displays details of the order and lists (SKU, description, colour, size, quantity) each item picked into the carton for the order.

The operator retrieves the items for the order from the carton and scans the SKU of each. If there are multiple units of the same SKU picked for the order, the operator scans the SKU of each unit individually. The LOI display updates to indicate each item scanned. WCS rejects a scan if the SKU is not required for the order.

When the final item for the order is scanned, WCS prompts the operator to confirm that the items and the returns slip have been placed in the satchel and that the satchel is labelled and sealed.

The operator places the filled and sealed satchel on the takeaway conveyor from an automated pack station, then scans the next returns slip to move on to that order.

When all the expected items have been packed, the operator confirms to WCS that the carton is now empty.

The satchels will subsequently be transferred into cages as described in Section 18.7.

If the operator at an automated pack station believes that the empty pick carton is fit to be reused, the carton is placed on a takeaway conveyor and routed back to the GTP area for storage in one of the order buffer multishuttles as described in Section 16.9.3.

18.5.4 Single-DU Satchel Packing

This section refers to stock picked into a carton for which the entire stock should be despatched in a single satchel. It is expected that only ecommerce orders can be despatched in satchels.

Satchel packing takes place at automated pack stations. It can in theory also take place at a manual pack station, if an unexpected carton is scanned there.

The items picked into the carton form all or part of a single order.

The Host may have specified that a returns slip is to be despatched with the order. If so, the returns slip will normally already have been added to the carton by one of the document inserters on the exit from the GTP area. If WCS knows that the returns slip has not been added but the pack station is equipped with a document printer, WCS issues a print instruction to the document printer for the outstanding returns slip. If there is no document printer at the station to print any outstanding returns slip then the carton cannot be handled at the station.

18.5.4.1 Single-DU Satchel Packing Process

When WCS is satisfied that the single-DU satchel packing process can take place for the pick carton, WCS issues a print instruction for the satchel label on the label printer at the station. If the station is equipped with an automatic bagging machine, this label is automatically printed onto a satchel which is inflated to allow the picked stock and any returns slip to be inserted.

If a packing instruction has been configured for the order's brand and order type (Section 9.3.1) then this is displayed on the LOI and remains visible while the order is handled at the station.

The pack station LOI displays details of the order and lists each item (SKU, description, colour, size, quantity) picked into the carton. The operator is not required to scan each item, but should perform a visual check.

WCS prompts the operator to confirm that the items and any returns slip have been placed in the satchel and that the satchel is labelled and sealed.

The operator places the filled and sealed satchel on the takeaway conveyor from an automated pack station. The satchel will subsequently be transferred into a cage as described in Section 18.7.

When all the expected items have been packed, the operator confirms to WCS that the carton is now empty.

If the operator at an automated pack station believes that the empty pick carton is fit to be reused, the carton is placed on a takeaway conveyor and routed back to the GTP area for storage in one of the order buffer multishuttles as described in Section 16.9.3.

18.5.5 Single-DU Carton Packing

This section refers to stock picked into cartons for which the carton itself is the despatch unit and for which no gift wrapping is required.

Pick cartons from the manual pick area are handled at a manual pack station.

Pick cartons from the GTP area, including the GTP - GOH merge, are routed automatically to the finishing line. There is therefore no need for this process to take place at an automated pack station.

18.5.5.1 Single-DU Carton Packing Process

If a packing instruction has been configured for the order's brand and order type (Section 9.3.1) then this is displayed on the LOI and remains visible while the order is handled at the station.

The pack station LOI displays details of the order and lists each item (SKU, description, colour, size, quantity) picked into the carton. The operator is not required to scan each item, but should perform a visual check.

If the Host has specified a returns slip should be included in the carton, then WCS issues a print instruction to the document printer.

If this is the final carton of the order type in the consignment and the Host has specified that a pack list should be included, then WCS issues a print instruction to the document printer.

At a manual pack station, WCS issues a print instruction to the label printer for the despatch label. If any other labels are required to be applied to the carton, the operator confirms to WCS when these have been applied.

It is a manual operation to load the sealed and labelled carton onto the despatch sorter.

18.5.6 Manual & Automated Pack Station Exceptions

18.5.6.1 Exception: Stock Shortage

If the operator is unable to pack all the expected contents of a carton because one or more items are missing, the operator can flag the Stock Shortage exception on the LOI.

The operator should return all the unpacked items to the carton and destroy any label and paperwork already printed for unpacked items.

The carton is placed on a takeaway conveyor from an automated pack station and is returned to the GTP area for investigation by an operator at the order QA station.

18.5.6.2 Exception: Surplus Stock

If the operator discovers more stock in the pick carton when all the expected items have been packed, the operator can flag the Surplus Stock exception on the LOI. The operator scans the SKU of the unexpected SKU and places it in a local problem area. It is a manual operation to investigate the contents of this problem area later.

The operator confirms to WCS when the carton is empty, so that it can be reused as normal.

If a pick carton contains unexpected stock and is also short of some stock, the Stock Shortage exception should be flagged so that the carton contents can be investigated further.

18.5.6.3 Exception: Stock Too Large For Satchel

If the operator at a satchel pack station finds that the picked items are unable to fit inside a satchel, the operator can flag the Too Large For Satchel exception.

The operator should return all the unpacked items to the carton and destroy any satchel, label and paperwork already printed for the items.

Provided only one DU is affected, the carton is routed from an automated pack station to a document inserter and then to a lidder so that the carton becomes the physical despatch unit. If more than one DU is affect, the carton is routed to the Finishing QA station for manual correction.

At a manual pack station the operator can follow the normal carton packing process.

18.6 Finishing Line

Pick cartons from the GTP area, including the GTP – GOH merge, which have not been routed to a pack station reach the finishing line conveyor.

Pick cartons which have been routed to a pack station but which have been returned to the conveyor to be despatched in the carton also reach the finishing line conveyor.

18.6.1 Document Inserter

Cartons on the finishing line first arrive at a divert to an automatic document inserter.

A WCS configuration screen specifies the types of despatch paperwork that can be printed at any document inserter.

WCS diverts a carton to the document inserter if there is any paperwork that is to be despatched in the DU and which has not already been inserted, provided the document inserter is configured to print it. If there is paperwork required which the document inserter is not configured to print, the carton will be diverted to the Finishing QA station.

There are also 2 document inserters at the exit from the GTP area as described in Section 16.7.9.

18.6.2 Finishing Line SWAP Station

A carton next arrives at a SWAP station where it is weighed and validated. WCS may decide to divert the carton to the Finishing QA station here.

Details of the decisions taken at the finishing line SWAP station are provided in Section 5.1.2, and details of the possible actions that can be performed at any QA station are provided in Section 2.6.

18.6.3 Carton Lidders

There are up to 4 carton lidders, each of which can handle one size of carton (medium or large).

A WCS configuration screen allows the following to be configured for each lidder:
- Availability – WCS routes a carton only to a lidder that is set available
- Carton size – WCS routes a carton only to a lidder that is configured to handle the size of the carton. It is a manual process to ensure that the WCS configuration matches the carton size that the lidder is capable of handling
- Lid colour – each lidder can handle two colours of lids. WCS routes a carton only to a lidder that is configured to handle a lid of the colour specified by the order processing configuration described in Section 9.3.1

WCS routes each carton for despatch to a specific lidder. The lidder reduces a carton to its minimum size and applies a lid of the appropriate colour.

If there is no available lidder configured for a carton, the carton waits on the main conveyor until a lidder is available.

18.6.4 Label Applicators

There are 2 label applicators. WCS routes each carton for despatch to a label applicator.

Here WCS issues a print instruction to the lidder for the despatch label, which is applied to the top of the carton. Optionally either a Pack List Enclosed label or a Signature Required label can also be applied.

The existing carton ID barcodes on opposite sides of the carton remain intact.

The lidded and labelled cartons are routed onwards to either the despatch buffer multishuttle or the despatch sorter.

18.7 Cage Build

The satchel packing process described in Section 18.5.4 results in sealed and labelled satchels ready for despatch.

It is a manual operation to transfer satchels to be despatched by the same carrier into a cage. The process can also be used to transfer cases and cartons into the same cages.

An operator using a WCS MOI selects Cage Build and scans a pre-printed LP barcode to identify the cage. The LP may be known to WCS as a cage that already contains other TMs. WCS does not accept the scan if it is not a valid cage LP, or if the cage has already been loaded onto a trailer.

The cage LP identifies the carrier for which the cage is to be used. WCS configuration settings allow specification of the range of cage LPs to be used for each carrier.

After identifying the cage, the MOI operator scans the despatch label of each TM to be transferred into the cage. WCS accepts each scan provided all of the following are true:
- The despatch label is known to WCS as a satchel, case or carton
- The contents of the TM are to be despatched by the carrier that is configured to the cage
- The despatch unit is to leave the DC under the scanned label (i.e. it is not a satchel that is to be despatched inside a pick carton)
- All the DUs in the TM have already been confirmed packed and physically ready to leave the DC
- The configurable maximum number of TMs in a cage has not been reached
- The calculated weight of the TM does not cause the configurable maximum weight of the contents of a cage to be exceeded
- The cage has not been loaded onto a trailer

When there are no more TMs to be transferred into the cage, the cage can be manually wheeled to a despatch lane to be loaded onto a trailer as described in Section 19.7.

The cage build process results in one or more TM records being contained by a parent cage TM record, and is essentially the same as the Despatch Pallet Build operation described in Section 19.6.

18.8 Related Elements

18.8.1 Operations Management Screens

There is a specific OM screen allowing configuration of automated pack stations and showing the current volume of work at each.

18.8.2 MOI Functions

The table below shows the MOI functions specific to packing.

Function	Description	Menu Level	Section
Cage Build	Used to transfer packed TMs into a cage	Top Level	18.7

18.8.3 LOI Functions

The table below shows the LOI functions specific to packing.

Function	Description	Menu Level	Section
GOH Packing	Used to pack the contents of a GOH bin	Top Level	18.3
Flat Packing	Used to pack into satchels or back into the pick carton	Top Level	18.5

18.8.4 Operational Events

Section 21.2 defines the general format of Operational Events. The table below defines the information that is logged in addition to the standard details for the specific Packing Operational Events.

Event	Trigger	Fields
GOH_BIN_BAGGED	When an operator bags the contents of a GOH bin	Order Id, Bin Id, Despatch Label
CASE_LABELLED	When an operator confirms a despatch label applied to a case	Order Id, Pallet Id, Despatch Label
PALLET_LABELLED	When an operator confirms a despatch label applied to a pallet	Order Id, Despatch Label
SATCHEL_PACKED	When a satchel is confirmed packed by an operator	Location, Order Id, Despatch Label
CARTON_LIDDED	When a lid is automatically applied to a carton	Location, Carton Id
CARTON_LABELLED	When a despatch label is confirmed automatically applied to a carton	Location, Carton Id, Despatch Label
CAGE_TM_TRANSFER	When an operator transfers a packed TM into a cage	Cage Id, Despatch Label, Carrier, Order Id

18.8.5 Statistics

The table below defines the statistics that are maintained for packing functions.

Name	Index	Comments
Bins Bagged	1	Incremented once per GOH bin bagged
Cases Labelled	1	Incremented once per case

		confirmed labelled
Pallets Labelled	1	Incremented once per pallet confirmed labelled
Cartons At Pack Station	Pack location	Incremented once per carton scanned
Satchels Packed	Pack location	Incremented once per satchel packed
Cartons Lidded	Lidder	Incremented once per carton lidded
Cartons Labelled	Labeller	Incremented once per carton labelled
Cage Opened	1	Incremented once when first TM transferred into empty cage
Cage TMs Transferred	1	Incremented once per TM transferred into cage

18.8.6   Alarms and Alerts

The table below defines the alarms and alerts that are associated with packing. They are displayed on the WMS Alarms page.

Alarm	Description	Drill Down
Carton without pack station	There is a carton in transit to packing but no pack station configured to accept it	List of cartons

18.8.7   Configuration Parameters

There are no specific configuration parameters associated with packing.

The table below lists the configuration parameters that are used to control packing functions.

Parameter Name	Function	Values	Section
Max Cage TMs	Defines the maximum number of TMs that can be transferred into a cage	1..10,000	18.7
Max Cage Contents Weight	Defines the maximum weight of TMs that can be transferred into a cage	1..1,000 kg	18.7

19 DESPATCH

19.1 Storage in or Bypass of Despatch Buffer

Lidded and labelled pick cartons from the GTP area containing orders whose despatch buffer flag is set are routed into the despatch buffer multishuttle. These cartons remain in the despatch buffer until an OM user manually requests some or all of them to a despatch lane.

Pick cartons containing orders whose despatch buffer flag is not set bypass the despatch buffer and are routed directly onto the despatch sorter and thence to a despatch lane.

Cartons picked in the manual area and full cases for despatch can be manually loaded onto a conveyor which leads onto the despatch sorter. These cartons and cases are then routed to a despatch lane.

19.2 Despatch Lane Configuration

There are ten despatch lanes, including a reject lane. Each of these can be configured to accept cartons and cases for despatch.

A suitably-privileged OM user may use the standard DU Query screen to build a group of criteria which together define the cartons and cases that could be routed down a despatch lane. An action on the DU List screen allows the despatch criteria group to be saved.

Up to 100 despatch criteria groups can be saved. Each can be set active or inactive and a specific despatch lane configured against it. The despatch criteria groups can be sorted into a priority sequence.

This configuration is applied to cartons which arrive on the despatch sorter direct from the lidders and labellers, and to cartons and cases which have been manually loaded onto the despatch sorter (i.e. the configuration does not apply to cartons that have been retrieved from the despatch buffer).

WCS looks through the list of active despatch criteria groups in descending priority sequence until one is found whose criteria match the DU. The DU is routed to the despatch lane configured for the criteria group.

If there is no active despatch criteria group configured whose criteria match the DU, the DU is routed to the reject lane.

19.3 Request from Despatch Buffer

A suitably-privileged OM user may use the standard DU Detail, DU List, TM Detail or TM List screens to request one or more pick cartons be retrieved from the despatch buffer to a specific despatch lane.

It is possible for the criteria which determine the DU List to be derived from one of the despatch criteria groups described in Section 19.2. The despatch criteria group does not need to be active, and the cartons do not need to be requested to the same despatch lane as configured for the despatch criteria group.

The user may request a minimum and maximum number of cartons to be retrieved. If the maximum number is fewer than the total number of pick cartons in the despatch buffer which match the user's specified criteria, then WCS attempts to retrieve cartons which make up complete

orders. If this is not possible then WCS retrieves as many cartons as possible, without exceeding the specified maximum.

When the cartons to be retrieved have been identified, WCS issues retrieval requests for the large cartons first, followed by the medium cartons. Note that this does not guarantee however that all the large cartons will arrive at the selected despatch lane before all the medium cartons.

The despatch lane configuration rules described in Section 19.2 are not applied to cartons retrieved from the despatch buffer.

A request for a carton to be retrieved from the despatch buffer may be abandoned up to the point at which WCS issues the instruction to the multishuttle system for the carton to be picked up.

19.4 Despatch Buffer Multishuttle

19.4.1 Overview

Details which are common to all multishuttles are specified in Section 3. This section concentrates on details which are specific to the despatch buffer multishuttle.

The flows into the order buffer multishuttle are:
- Lidded and labelled pick cartons awaiting despatch

19.4.2 Multishuttle Layout

The despatch buffer multishuttle comprises two aisles of carton racking. Within WCS, the aisles are numbered 25 and 26.

Each aisle comprises 13 levels. Within WCS, the levels are numbered 1 to 13.

On each level there are 130 bays of storage locations, each bay with a front depth and back depth location on either side of the shuttle. The locations are grouped into shelves of five bays. Each location can hold a medium or a large carton.

There are no inter-aisle transfer locations in the despatch buffer multishuttle.

19.4.3 Despatch Buffer Multishuttle Putaway

When a carton successfully passes through a carton lidder and is not required to be routed to a despatch lane immediately, WCS automatically selects a specific destination storage location for it.

Multishuttle location selection is a three-step process:

- Aisle selection within the multishuttle
- Level selection within the aisle
- Location selection within the level

Each aisle and level is eligible for selection only if an eligible storage location exists within it. The rules regarding eligibility are common to the three multishuttles and are defined in Section 3.4.

19.4.3.1 Despatch Buffer Multishuttle Location Selection

The rules determining which of the eligible locations is chosen for a TM are specific to each multishuttle. These are the rules used when selecting a location in the despatch buffer multishuttle for a carton.

The first rule is applied to all the eligible storage locations. If the rule reduces the number of eligible locations but at least one location remains, then the next rule is applied to the remaining locations. Any rule which would eliminate all the locations is ignored.

The process continues down the list of rules until only one location remains.

- Use a location in front of another carton of the same size and for the same order
- Use the aisle in which there are most empty available locations
- Select an aisle at random
- If the selection is being made at the multishuttle pickup station, and the carton is the second of two cartons to be picked up together, then use the same level as the first carton being picked up
- Use the level on which there are most empty locations in the aisle
- Select a level at random
- Use a back depth location
- Use a location nearest the elevator
- Select a location at random

The rules are applied in order to select a destination storage location for the carton while it is on a conveyor outside the multishuttle, and the rules are applied again at each decision point on the carton's journey as far as the shuttle itself. A rule is ignored if the carton has already passed the final point at which the rule can be applied. For example, once the carton is in the infeed of a specific aisle, rules involving the selection of an aisle are ignored.

19.4.4 Despatch Buffer Multishuttle Retrieval

WCS continuously checks its database to find cartons which are required to be retrieved from the despatch buffer multishuttle.

The only possible destinations for cartons being retrieved from the multishuttle are the ten despatch lanes, including the reject lane.

For each of these destinations, configurable maximum and minimum numbers of cartons in transit are described in Section 5.2.

WCS continuously counts the number of cartons in transit to each destination. This count includes cartons for which a retrieval mission has been issued to the multishuttle system but has not yet been actioned.

Of the destinations to which there are fewer cartons already in transit than the configured maximum, WCS calculates a value (target minimum cartons in transit minus number of cartons in transit). The destination with the greatest value, not necessarily a positive value, is considered the most in need of a carton. If the greatest value applies to two or more destinations, one of these is chosen at random.

If any cartons are required to be retrieved from the multishuttle to this destination and all equipment en route is available and in service, a mission is issued to the multishuttle system to

retrieve the highest priority carton. The process continues again, taking all ten destinations into account.

If no carton can be found to be retrieved to the destination most in need of a carton, the next destination is considered instead.

19.4.5   Despatch Buffer Multishuttle Shuffles

It may happen that WCS needs to retrieve a carton from a location where another carton is stored in front of it.

In this situation, WCS creates a shuffle move for the front carton, which is picked up by the shuttle and moved to another storage location nearby in the same aisle and level. If there are no available locations in the same aisle and level, then WCS retrieves the front carton to the despatch sorter reject lane.

Once there is no carton in the way, WCS instructs the shuttle to pick up the back carton and retrieve it to the outfeed level conveyor.

19.5   Despatch Sorter Routing

Pick cartons and full cases for despatch arrive on the despatch sorter direct from the labellers, retrieved from the despatch buffer multishuttle, and manually loaded onto the infeed conveyor. They all pass through a SWAP station (see Section 5.1) where each TM is weighed and its dimensions captured. WCS records the weight and dimensions but does not validate them or use them in any other way.

WCS routes to a specific despatch lane each TM reported on the sorter. If the TM is a carton that has been retrieved from the despatch buffer multishuttle, the despatch lane is the one selected by the user when requesting the carton from the despatch buffer as described in Section 19.3. If the TM has not been retrieved from the despatch buffer multishuttle, the despatch lane configuration described in Section 19.2 is used to determine the despatch lane for the TM.

If no despatch lane can be determined for a TM, it is routed to the reject lane.

Any case or carton reported on the despatch sorter that is unable to be identified is routed by default to the reject lane. This includes any pick carton from the GTP area into which manual picks are to be added, as a despatch label has not been applied to such a carton.

19.6   Despatch Pallet Build

Pick cartons and full cases that are diverted off the despatch sorter onto a despatch lane can be manually transferred onto a pallet to facilitate the trailer loading process. This is particularly likely on despatch lanes without boom conveyors.

An operator using a WCS MOI selects Despatch Pallet Build and scans a pre-printed LP barcode to identify the pallet. The LP may be known to WCS as a pallet that already contains other TMs. WCS does not accept the scan if is not a valid internal despatch pallet LP, or if the pallet has already been loaded onto a trailer.

The pallet LP identifies the carrier for which the pallet is to be used. WCS configuration settings allow specification of the range of internal despatch pallet LPs to be used for each carrier.

DEMATIC

After identifying the pallet, the MOI operator scans the despatch label of each TM to be transferred onto the pallet. WCS accepts each scan provided all of the following are true:

- The despatch label is known to WCS as a case or carton
- The contents of the TM are to be despatched by the carrier that is configured to the pallet
- All the DUs in the TM have already been confirmed packed and physically ready to leave the DC
- The configurable maximum number of TMs on a despatch pallet has not been reached
- The reported weight of the TM does not cause the configurable maximum weight of the contents of a despatch pallet to be exceeded
- The pallet has not been loaded onto a trailer

There is no requirement for all the TMs on a pallet to have been diverted onto the same despatch lane, or any despatch lane.

When there are no more TMs to be transferred onto the pallet, the pallet can be loaded onto a trailer as described in Section 19.7.

The despatch pallet build process results in one or more TM records being contained by a parent pallet TM record, and is essentially the same as the Cage Build operation described in Section 18.7.

19.7   Trailer Loading

Trailer loading is the process whereby TMs for despatch are transferred onto the vehicle on which they will leave the DC.

A trailer must be open on WCS for TMs to be loaded onto it.

When all the TMs that are to be despatched on the trailer have been loaded onto it, the trailer can be closed on WCS to generate despatch documentation and update the Host.

19.7.1   Trailer Opening

An OM user may view the standard Despatch Lane Location Details screen to view details of the trailer which is currently open at a despatch lane, and any TMs at the lane or in transit there.

If there is already an open trailer at the despatch lane, that trailer must be closed (see Section 19.7.3) before another trailer can be opened there.

If there is no open trailer at a despatch lane, an 'Action' function is available to suitably-privileged users to open the trailer there.

The OM user inputs the trailer ID. WCS does not expect the trailer ID to match a specific format, so cannot validate the user input.

WCS rejects the trailer ID if that trailer is already open at another despatch lane.

The OM user then selects from a dropdown list the carrier that owns the trailer.

The trailer is now open and eligible for TMs to be loaded onto it. TMs for despatch may already have been diverted into the despatch lane, or be in transit to the despatch lane, independently of the opening of the trailer.

19.7.2   Loading Process

An operator using a WCS MOI selects Loading and scans the location barcode at the despatch lane.

If there is no open trailer at the despatch lane, WCS reports an error.

If there is an open trailer at the despatch lane, WCS accepts that this is the trailer onto which the operator is loading TMs. WCS allows more than one MOI operator at a time to load TMs onto the same trailer.

After identifying the despatch lane, the MOI operator scans the LP of each TM to be loaded onto the trailer. WCS accepts each scan provided all of the following are true:
- The trailer is still open
- Either:
    - The LP is known to WCS as the despatch label of a TM, or
    - The LP is known to WCS as a parent TM containing one or more other TMs
- The contents of the TM are all to be despatched by the carrier that is configured to the trailer
- All the DUs in the TM have already been confirmed packed and physically ready to leave the DC
- The TM is not already on a closed trailer

There is no requirement for all the TMs on a trailer to have been diverted onto the same despatch lane, or any despatch lane. Hanging and flat TMs can be loaded onto the same trailer.

If the despatch label of a TM is scanned that was previously contained in a parent TM, it is removed from the parent TM and permitted to be loaded onto the trailer by itself. The remaining contents of the parent TM are unaffected.

19.7.3   Trailer Closure

An OM user may view the standard Despatch Lane Location Details screen to view details of the trailer which is currently open at a despatch lane, and any TMs at the lane or in transit there.

If there is an open trailer at a despatch lane, an 'Action' function is available to suitably-privileged users to close the trailer there. Before closing a trailer, a user should investigate any TMs which WCS believes to be in the despatch lane or in transit to the despatch lane.

When the trailer becomes closed, WCS sends a Vehicle Closure message to the Host for each DU loaded onto the trailer. If no TMs were loaded onto the trailer then no Vehicle Closure message is sent.

19.7.4   Despatch Paperwork

The despatch paperwork for a closed trailer can be requested by an OM user. The user selects the document printer to which WCS sends the report.

	Despatch Manifest		14 Dec 2016			
Trailer ID	ABC12345		**Carrier**		ABC	
			Total Weight		316.9 kg	

Cage Id	Pallet Id	Satchels	Cartons	Cases	Bags	Weight
1111		345				23.4 kg
2222		456	1			45.6 kg
	1234567890			20		56.7 kg
	2345678901		2	15		67.8 kg
Loose			345	10	20	123.4 kg
etc…						

19.8 Related Events

19.8.1 Operations Management Screens

There is a specific OM screen showing all despatch lanes and a count of TMs in transit to each.
There is a specific OM screen listing and allowing configuration of despatch criteria.
Standard TM, DU and location OM screens provide visibility of despatch functions.

19.8.2 MOI Functions

The table below shows the MOI functions specific to despatch.

Function	Description	Menu Level	Section
Despatch Pallet Build	Used to transfer packed TMs onto a pallet	Top Level	19.6
Loading	Used to load packed TMs onto a trailer	Top Level	19.7

19.8.3 LOI Functions

There is no LOI associated with despatch operations.

19.8.4 Operational Events

Section 21.2 defines the general format of Operational Events. The table below defines the information that is logged in addition to the standard details for the specific Despatch Operational Events.

Event	Trigger	Fields
DESP_LANE_CONFIG	When a user changes the configuration of a despatch lane	Location, Old configuration, New configuration
PALLET_TM_TRANSFER	When an operator transfers a packed TM	Pallet Id, TM Id,

		Carrier, Consignment Id
TRAILER_OPEN	When a user opens a trailer for despatch	Location, Trailer Id, Carrier
TRAILER_TM_LOAD	When an operator loads a TM onto a trailer	Location, Trailer Id, Carrier, TM Id
TRAILER_CLOSE	When a user closes a trailer for despatch	Location, Trailer Id, Carrier

19.8.5   Statistics

The table below defines the statistics that are maintained for Despatch.

Name	Index	Comments
Despatch Sorter TMs	1	Incremented once per TM arriving on despatch sorter
Despatch Lane Diverts	Despatch Lane	Incremented once per TM diverted off despatch sorter onto despatch lane
Despatch Pallets Opened	1	Incremented once when first TM transferred onto empty despatch pallet
Despatch Pallet TMs Transferred	1	Incremented once per TM transferred onto pallet
Trailer TMs Loaded	Despatch Lane	Incremented once per TM scanned and loaded onto a trailer (e.g. if a cage containing 100 satchels is scanned, incremented by 1; if a carton is scanned, incremented by 1)
Trailer Despatch TMs Loaded	Despatch Lane	Incremented once per despatch TM loaded onto a trailer (e.g. if a cage containing 100 satchels is scanned, incremented by 100; if a carton is scanned, incremented by 1)
Trailers Closed	Despatch Lane	Incremented once per trailer closed

19.8.6   Alarms and Alerts

The table below defines the alarms and alerts that are associated with despatch functions. They are displayed on the WMS Alarms page.

Alarm	Description	Drill Down
Carton without despatch lane	There is a carton in transit to the despatch sorter (despatch buffer flag not set) but no despatch lane configured to accept it	List of cartons

DEMATIC

DAI

19.8.7   Configuration Parameters

The table below lists the configuration parameters that are used to control despatch functions.
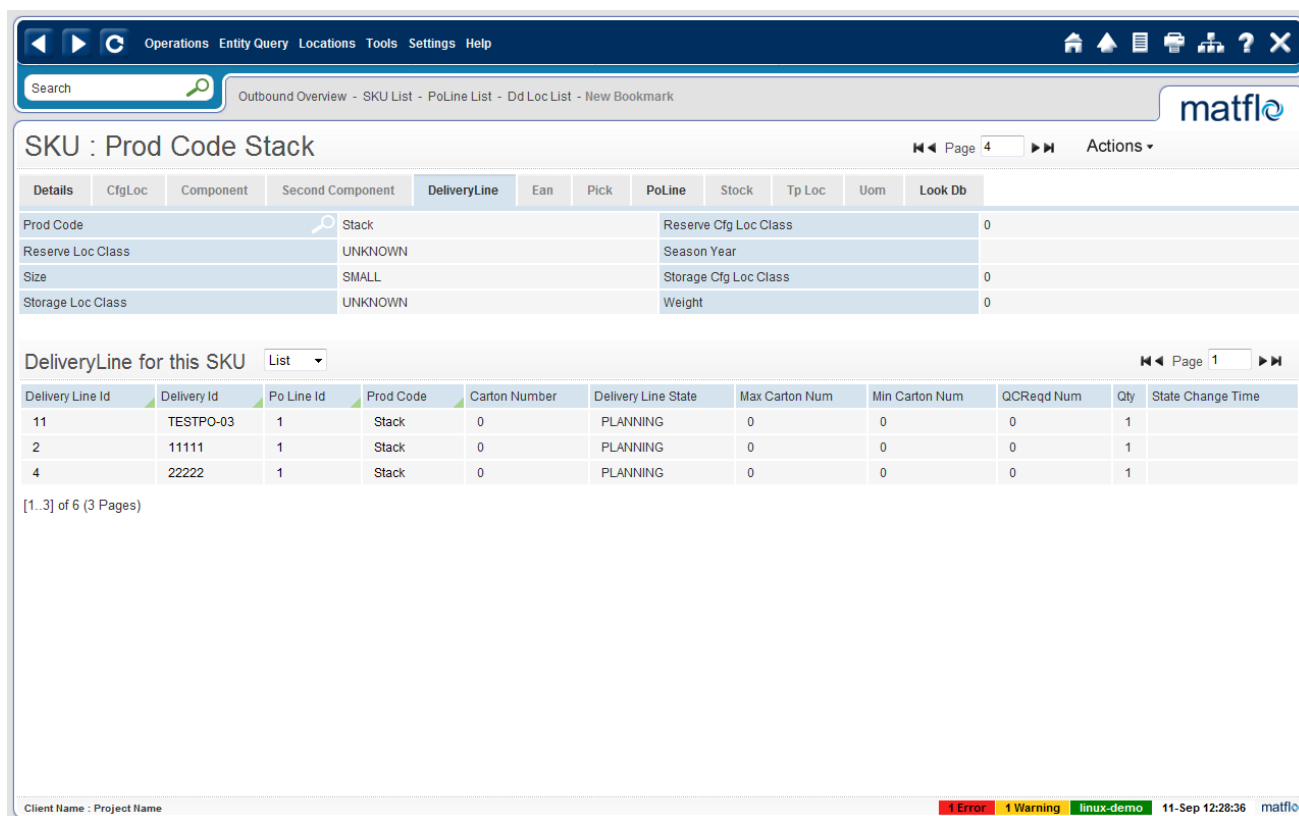
Parameter Name	Function	Values	Section
Max Despatch Pallet TMs	Defines the maximum number of TMs that can be transferred onto a despatch pallet	1..1,000	19.6
Max Despatch Pallet Weight	Defines the maximum weight of TMs that can be transferred onto a despatch pallet	1..1,000 kg	19.6

DEMATIC

20 OPERATIONS MANAGEMENT SCREENS

20.1 OM Screens Overview

The Operations Management (OM) screens provide a consistent user-friendly operator interface using Microsoft Internet Explorer web browser.

20.1.1 Sample Screen Layout

- Access to the screens and functions is provided through the menu bar at the top of the screen.
- The status line at the bottom of the screen highlights important abnormal conditions (see section 20.1.5)
- Where appropriate, the data shown on a screen is live-updating
- Short cuts are provided to related screens

20.1.2 Access Security

Security checks are normally made on attempts to perform specific functions, but can also be applied to access to specific screens even if used in a "view-only" mode.

Each user known to the system has a UID (User Identification). This in turn defines a pre-determined set of user privileges i.e. whether specific functions are available to the user or not. Users may optionally belong to "user groups" (up to 20 groups). Privileges may be granted or denied at the group or user level. A setting at the user level overrides the setting at the group level.

The security mechanism is described in detail in section 20.3.

20.1.3   Queries and List Screens

The content of a list screen is controlled via a query. The query allows selection of data by various criteria, and also controls the sorting of the list.

Any specified criteria are logically "AND"ed together, i.e. for an entry to be added to the list, all the specified criteria must be met.

Some lists allow an action to be performed on all of the items on that list e.g. it is possible to call out a list of stock totes from the storage multishuttle.

Contents of list screens can be exported in CSV format, e.g. for import into Excel.

Note that complex queries and reports are best generated on the MI system (Section 21.4).

20.1.4   Printed Reports

The screen dump facility allows the current contents of the screen to be sent to a printer.

Printed reports are also available through the OM screens. For example, most list screens print a report containing all of the entries on the list. These reports can be requested at any time.

20.1.5   Status line

The status line is a live-updating bar that appears at the bottom of every OM screen. In normal operation the status line shows the following:

Number of current alarm conditions	Links directly to alarm summary screen
Number of current warning conditions	
Whether or not user is logged in	
WCS server name	
WCS date & time	

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Certain abnormal conditions are highlighted only when they occur, for example:-

Indicator	Conditions displayed	Explanation
System Mode	Standalone	WCS is not running in dual mode
Running State	System Unknown	An internal WCS state that should not appear – await restart
	System Starting	WCS is starting up
	Standby Failed	WCS is re-creating a backup database on the live machine so that it can run in Standalone mode
	Standby Recovering	WCS is returning to dual operation and is updating the database on the standby machine
	System Paused	WCS has paused – will continue shortly
	System Shutdown	WCS has been shut down under the control of an operator – await restart
	System Failed	WCS has automatically shut down after detecting an irrecoverable error condition – await restart
Link down	Host	WCS cannot communicate with the corresponding machine
	GTP controller	
	Case conveyor controller	
	Multishuttle controller	
Miscellaneous Conditions	Exception	Outstanding exception in multishuttle
	IP Device	WCS cannot see (ping) a network-connected device

20.2   OM Screens List

The following sections illustrate the general hierarchy of the Operations Management screens. They do not show, however, the many short cuts between screens. For example, wherever a TM is displayed on a list, selecting it displays the details screen for that TM.

Unless stated otherwise, each list screen has an associated query screen to generate the list.

Each "view" screen has the facility to change the manually editable fields of whatever is being viewed, subject to user security.

DEMATIC

DAI

20.2.1 Inventory Screens

Category	Screen	Comments
SKU	View SKU	SKU header, stock of the SKU, picks for the SKU
	Query/List	
Stock	Summary	Overview of stock (inventory) broken down by state. Plus links to commonly-used pre-defined inventory queries
	View Stock	Stock Header
	Query/List	
	Local Stock Creation	WCS-Local stock only
	Stock Transfer	Facility to move a quantity of stock from one TM to another with no net adjustment.
TM	Summary	Move state summary
	View TM	TM Header + contents
	List	

20.2.2 Orders Screens

Category	Screen	Comments
Orders	Summary	Overview of orders broken down by state. Plus links to commonly-used pre-defined order/pick queries.
	View Order	Order header, DUs for the order, picks for the order
	Query/List	
Picks	View Pick	
	Query/List	
DUs	Summary	Overview of DU states
	View DU	DU header + picks for the DU
	List	

20.2.3 Location Screens

Category	Screen	Comments
Hanging Locations	Summary	Overview of aisles
	View Location	
	List	
Manual Locations	Summary	Overview of aisles, including fill percentages
	View Location	
	List	
Multishuttles	Summary	Including fill percentages
	View Location	
	List	
GTP Stations	Overview	Summary across all GTP area
	Station	Specific station view/configure
	Position	Specific position view/configure

DEMATIC

20.2.4 DC Management Screens

Category	Screen	Comments
System Status Overview		'At-a-glance' overview of key WCS status information
Alarm and Alert Overview		
Workload Summary		An overview of outstanding WCS-related DC workload broken down by operation/area

20.2.5 Material Flow Screens

Category	Screen	Comments
Equipment State		
Exceptions		
Case MHE		Start / stop material flow

20.2.6 Tools Screens

Category	Screen	Comments
Operational Event Log	List	
System Tools		Mainly for diagnostics & support
Text Logs	Alarm / Event	
Communications Logs	Host	
	MHE Controllers	
Statistics	List	

20.2.7 Settings Screens

Category	Screen	Comments
Client configuration		Local settings for OM screens
Server configuration	Log classes	Sets attributes related to stock transaction logging
	Printers	Physical printer attributes including re-direction facility
	Printer functions	Allocation of print functions to physical printers
Devices		Monitoring of TCP/IP connected devices
Parameters	Details	
	List	
Users	User Details	
	User List	
	User Query	
	Group Details	
	Group List	
	Group Query	

20.2.8   Help Screens

Category	Screen	Comments
About		Brief details of OM software build
Online user guide		

20.2.9   Location Specific Screens (LOIs)

These screens are designed to provide specific operational features required in particular areas, i.e. they provide features designed to run on LOIs rather than general-purpose OM screens.

Location	Comments
Decant stations	One per decant station. Section 15
GTP stations	One per GTP station. Section 16
GOH pack stations	One per GOH pack station. Section 18.2
Manual & automated pack stations	One per flat pack station. Section 18.2.3

20.3   User-Based Security

Access to various facilities within WCS is controlled on a user privilege basis. In order to use the system screens (OM, LOI and MOI) a user must enter an ID and a password, or optionally on LOIs and MOIs scan a barcode. This determines the level of access allowed to that user.

A high level user normally configures lower level users on the system. Most users are barred from creating new users.

The main attributes of a User are:

User Attribute	Meaning
UID	A unique User ID. It is not considered secret
Password	The password is considered secret to the user and is never displayed or printed
User barcode	Unique user barcode ID (can be used on LOIs and MOIs for login)
Name / contact details	Free-format string that can be used to hold user's full name, extension number etc. as required
Description	Free-format string that can be used to hold other details of the user
Enabled flag	Y/N flag allows a user to be enabled or disabled (by a supervisor with the appropriate authority)
User Group(s)	The user group (or groups) to which a user belongs
Function Privileges	The functions allowed to be performed by this user

20.3.1   Function Access Levels

Many functions that can be performed on WCS are protected from abuse via a mechanism of user identification and privilege allocation, i.e. each user has each function enabled or disabled. In addition, the fact that a user has performed a secure operation is logged as an audit trail.

For each user, each function is set to one of:

DEFAULT	The setting for the function for this user is determined by the setting in the corresponding User Group(s) definition (see below). If the setting is changed for the group then the new setting automatically applies to the user. This is the usual setting for most functions for most users
GRANT	The function is enabled and the user is allowed to grant or deny the function to other users. This setting is normally only used for relatively few senior users
ON	The function is specifically enabled for the user, but the user cannot grant or deny the function to other users
OFF	The function is specifically disabled for the user
INVISIBLE	Similar to OFF except the user is not even allowed to be aware of the function's existence, e.g. when viewing privilege settings on screens

When a new user is defined all the functions are initially set to DEFAULT. Individual user overrides may then be applied if required.

20.3.2   User Groups

For convenience of setting up new users and to allow switching of functions on a group basis, each user may be designated as belonging to (up to) three User Groups.

Each User Group has a customer-defined name (e.g. Maintenance Supervisor, Picker).

Each group has a setting for each of the possible security functions. This becomes the default setting for all users belonging to that group (i.e. the setting used for a user if their setting for a function is set to DEFAULT). Where a user belongs to more than one group then the default setting for a function is the highest of the settings in each of those function groups. If a user does not belong to any group then DEFAULT is equal to OFF.

In the User Group table, each function is set to GRANT, ON, OFF or INVISIBLE. These are described above.

20.3.3   Creation and Amendment of Users & Groups

The creation and amendment of users and groups are themselves secured functions subject to logging.

20.3.3.1   Creating & Amending User Groups

When creating or amending a group, a user may only change the settings for functions for which the user GRANT access. Therefore, without GRANT access the user is not allowed to switch them on or off.

To create or delete a group the user must have "Create Group" access.

For convenience, a new group may be copied from an existing group and then amended if required. If the group copied from has functions enabled for which the user does not have GRANT access then those functions are automatically set to OFF for the new group. The settings of individual functions may be changed at any time subsequently by a user who has GRANT access to the function.

20.3.3.2   Creating and Amending New Users

When creating or amending a user, a user may only change the settings for functions for which the user has GRANT access. The user is not allowed to change the function settings for the user's own user record.

To create or delete another user, a user must have "Create User" access.

For convenience, a new user may be copied from an existing user and then amended if required. In the new user record, all functions for which the creating user does not have GRANT access are automatically switched OFF.

The settings of individual functions for the user may be changed at any time subsequently by a user who has GRANT access to the function.

20.3.4   Determining if a User has Function Access

When WCS needs to check if a user is allowed to perform a particular function, the user record for that function is checked.

If it is set to GRANT or ON then the function is allowed.

If it set to OFF then it is not allowed.

If it is set to DEFAULT then WCS examines the settings for the function in each of the groups to which the user belongs. If the function is set to GRANT or ON in any of the groups then the function is allowed.

20.3.5   User Identification by Username & Password

When a user attempts to gain access to a secure facility (primarily on OM screens), if the required privilege is not available to the user then access to the facility is denied.

A user who is logged in to WCS should log out before leaving the screen unattended. If the user neglects to do so then, as a fall back protection, the user is automatically logged out after a timeout period. The timeout is controlled by a configuration parameter (seconds without keyboard activity).

Passwords expire after a configurable number of days. To renew a password a user must change it. Once the password has expired, any attempt to log in to WCS forces a password change. A forced password change requires the user to confirm identity by entering the old password. The new password is entered twice to verify that no typing mistakes were made. Once accepted, the life of the password is renewed.

Passwords may also be changed at any time through the User List screen.

20.3.6   Password Controls

WCS provides single-factor authentication (i.e. user name & password) with the following features:-

- Password change frequency control – no less often than every x days and no more often than every y days (x & y configurable e.g. 90 & 1)

- Minimum password length (length configurable e.g. 8)

- Encryption of stored passwords

- Enforced password complexity rules

- Denial of re-use of previous n passwords (n is configurable e.g. 10)

- Masking/suppression of password printing/display

- Administrator-assigned or changed passwords to be changed by user on first login

- User tar pit (automatic temporary suspension) for x minutes after n unsuccessful login attempts (x and n configurable e.g. 30 minutes suspension after 6 failed login attempts)

20.3.7   User Identification by Barcode

On LOIs and MOIs, a user can log in by scanning a personal user barcode (configured against the user). There is no requirement to enter a password.

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21 MANAGEMENT INFORMATION

21.1 Overview

21.1.1 Management Information Data Types

Management information falls into two basic categories:

Live	Information held on the WCS Application Server used for the immediate day-to-day operation of WCS. This information is viewed using OM screens and reports provided as part of the WCS application.
Historical (short term)	Certain short-term historical data (~30 days) may be viewed via OM screens.
Historical (long term MI)	Longer term historical data is transferred to a separate management information server (MIS) where it is made available for longer term querying and analysis using 'standard' open database and report generation tools.

This main section focuses on the historical data.

21.1.2 Historical Data Categories

Event Log	Time-tagged event-based records providing an audit trail that can be queried by various keys. Described in Section 21.2.
Statistical Counts	Time-slot-based counters providing performance and availability information that can be viewed and summarized in a variety of ways. Described in Section 21.3.

21.2 Event Log

The event log holds a sequence of time stamped events generated on the application server.

Each entry in the event log has the following structure:

Field	Description
Date & Time	When the event was logged
Log Class	The type of event being reported
User ID	Where relevant
Additional data associated with the log class	Different data held for each class

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21.2.1 Sample Event Log Query Screen

21.2.2 Sample Event Log List Screen

WCS provides facilities to view and query the Event Log on WCS (up to 30 days) via OM screens. This includes the facility to create an 'audit' trail report by any of the event attributes (e.g. trace the progress of an order or the movements of a particular TM). This facility is only intended for non-

intensive queries over short time periods (e.g. 1 day). More intensive queries and queries over a longer period the information can be made via the MI server.

The event log is particularly useful for tracking e.g. order-related problems as it can be queried in to extract an audit trail by any combination of the data keys (e.g. order ID & SKU).

For example, the event log could initially be queried to show all events associate with a particular order ID. Having extracted a full audit trail for the order then the query could be refined e.g. to track just one SKU or a particular despatch TM (including who picked it, when and at which station). Similarly, an investigative search could be extended for example to investigate other orders which were picked in the same station at around the same time.

21.3   Statistical Counts

WCS maintains running statistical counts on key operations and availabilities. These are updated in memory on WCS and written to disk once a minute.

The main purpose of the statistics is to provide high-level performance and availability information where a detailed event-based audit trail is not necessary or would generate too much data to store and analyse.

21.3.1   Counts Structure

Each statistical counter has a name. It may be indexed in order to hold multiple values.

For example, count name Case Stored is indexed by aisle number 1..n, where n is the number of manual aisles.

To aid in viewing the counts, they are grouped together into related areas.

The counts themselves reflect nominal 1 minute periods but are more meaningful when viewed by summation over longer periods, e.g. hourly or daily.

21.3.2   Count Viewing Types

WCS allows for different methods of interpreting the counts. The count view type is pre-configured in the count file index and affects how the data is subsequently displayed if viewed on WCS.

Count View Type	Meaning
Absolute	A simple counter, i.e. the number of times the operation occurred in the one minute period. The count can either be displayed raw or converted to a rate (e.g. hourly, daily).
Relative	Intended for viewing as a percentage ratio against another pre-defined entry. Typically used to measure availability of a resource by taking the ratio of count of availability against the *Availability Checks* count (though other ratios are allowed for).

21.3.3   Updating Counts

How and when counts are incremented varies from count to count. Any WCS process can update the appropriate counts. In most cases a count (in the current time slot) is incremented every time a particular operation occurs, e.g. a case is put away in a manual aisle.

21.3.4 WCS Viewing Facilities

Via an OM screen WCS provides the facility to view counts summed over a nominated time band (i.e. a start and end time) or at a specified frequency (e.g. hourly). Counts with an index can also be viewed summed across their index values (e.g. cases putaway summed across all manual aisles).

Statistics Query

Selection Attribute	Format	Selection Value
Event	Class	= "SCP CASES PICKED"
Index	Integer	
Start Time	Date\Time	
Stop Time	Date\Time	
Frequency (mins)	Integer	= 60
Display Format	Class	
Index Total	Class	= "YES"

where (stats_event = "scp cases picked") and (frequency = 60) and (total_req = "yes")   1..7 of 7

Clear   Run

Statistics List

Log out of the system

Stats Query

Event	SCP CASES PICKED	Index	1 .. 4
Start Time	16-Sep-2008 00:00:00	Display Format	DEFAULT
Stop Time	16-Sep-2008 12:00:00	Frequency (mins)	60
Index Total	YES		

Stats List

Time	Type	Index	Value
16-Sep-2008 00:00:00	SCP AISLE	1	483
16-Sep-2008 00:00:00	SCP AISLE	2	595
16-Sep-2008 00:00:00	SCP AISLE	3	796
16-Sep-2008 00:00:00	SCP AISLE	4	0
16-Sep-2008 00:00:00	SCP AISLE	Total	1874
16-Sep-2008 01:00:00	SCP AISLE	1	1518
16-Sep-2008 01:00:00	SCP AISLE	2	978
16-Sep-2008 01:00:00	SCP AISLE	3	718
16-Sep-2008 01:00:00	SCP AISLE	4	0
16-Sep-2008 01:00:00	SCP AISLE	Total	3214
16-Sep-2008 02:00:00	SCP AISLE	1	1304
16-Sep-2008 02:00:00	SCP AISLE	2	1185
16-Sep-2008 02:00:00	SCP AISLE	3	643
16-Sep-2008 02:00:00	SCP AISLE	4	0
16-Sep-2008 02:00:00	SCP AISLE	Total	3132
16-Sep-2008 03:00:00	SCP AISLE	1	102
16-Sep-2008 03:00:00	SCP AISLE	2	174

where (stats_event = "scp cases picked") and (frequency = 60) and (total_req = "yes")   1..17 of 60

Absolute counts may be displayed either as the sum of the corresponding counts in the period or adjusted to a rate. For example, counts can be displayed at a 5-minute frequency but converted to an hourly rate for viewing.

Relative counts are displayed as a percentage, being the ratio of the sum of the counts in the period against the sum of the corresponding value in the same period. If relative counts are viewed across an index (e.g. all aisles) then an average of the individually calculated values is shown.

21.4   Management Information Server (MIS)

21.4.1   Overview

The Management Information (MI) Server (also sometimes referred to as MIS or the database server) is a physically separate machine from the dual application servers used to execute the main functionality defined in this document. <u>The WCS application functionality remains available even if the MI server is not</u>.

The MI server provides a repository of management information from WCS in an open database format which may be queried using standard reporting tools without impacting on the performance of the application servers.

21.4.2   MI Server Data Categories

The data categories which can be transferred from the WCS application server to the MI server are as follows:-

- Historical event log entries (Section 21.2)
- Historical statistical counts (Section 21.3)
- A near real-time copy of the live WCS application data

21.4.3   Update Mechanism

For all data categories, new or changed records are normally sent from WCS to the MI server once a minute.

21.4.4   Purging/Archiving Mechanisms on the MI Server

The historical records are maintained indefinitely by default. Of course Toll may choose to apply a purging, archiving or compression regime for older information but that is outside of Dematic's supply.

21.5   MI Server Database Details

Full details of the MIS database schemas will be provided at a later date separately from this FDS. These details will allow Toll to create reports based on data held within the MIS.

22 WCS DATA ELEMENTS

This section provides an introduction to the main tables in the WCS database. This is not a complete list as many of the internal tables that are used to provide standard WCS functionality are omitted. Some of the table names may not exactly match the names shown on the OM screens.

22.1 Database Table List

The Maximum Number of Records column indicates the current maximum size of the particular table as will be configured on delivery. These sizes can be increased later, though this may require hardware upgrade. The sizes have been designed to exceed the anticipated utilisation.

Where the Maximum Number of Records value refers to locations it reflects maximum allowances in the WCS database. Due to physical constraints this will typically be greater than the actual number of locations that are available.

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Table	Purpose	Maximum Number of Records	Section
Brand	Definition of characteristics of one of the names under which a client markets its stock	500	9.3.2
Carrier	Definition of characteristics of one of the businesses responsible for transporting stock despatched from the DC	100	
Client	Definition of characteristics of one of the businesses using the DC	100	
Consignment	Record to identify a group of one or more orders that can be picked and despatched together	100,000	9.2.4
DU	Record to identify a group of one or more picks planned into a single TM	500,000	9.2.2
Manual Location	Fixed record representing a configurable location in the GOH or manual area of the DC	100,000	2
Multishuttle Location	Fixed record representing a storage location which can accommodate a single TM. The maximum number of records represents the maximum number of locations in each dimension; not all the locations physically exist	216,320	3
Order	Header record of an order fulfilment request. Created as a result of an ORD message from the Host	100,000	9.2.3
Pick	Order line record, created initially as a result of an ORL message from the Host, then by WCS when an existing order line record is split	1,000,000	9.2.1
PO	Header record for an incoming purchase order. Create as a result of a PAH message from the Host	100,000	6.1
PO Line	Purchase order line record, created as a result of a PAL message from the Host	1,000,000	6.1
Printer	Definition of WCS printer characteristics	100	
SKU	Individual record, normally created as a result of an SMU message from the Host	500,000	4.2
Stock	Record to identify a single quantity of a SKU in one location	5,000,000	4.4
Stock Adjustment Reason	Definition of values to populate an SLA message to the Host for a specific reason and client	1,000	4.7
Store	Destination building owned by a client	1,000	
TM	Unit or container used to store and move stock around the DC	5,000,000	4.3
Truck Type	Definition of characteristics of different types of vehicles used within the DC	100	2.12.1
User	A definition of a user known to WCS. Used as the basis for access security and logging functions	5,000	20.3

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23   HOST-WCS INTERFACE

The following messages are transmitted from the Host to WCS:

Message	Purpose
SMU	**SKU Master Update.** Updates WCS with SKU master details
EXS	**Expected Sales details.** Contains the expected sales forecast for a SKU for future days
PAH	**Pre Advice Header**. Notifies WCS of incoming stock for a particular supplier. Followed by one or more PAL messages (one per pre advice line)
PAL	**Pre Advice Line** detail
ORD	**Order** header. Notifies WCS of an order requirement for a particular customer. Followed by one or more ORL messages (one per order line)
ORL	**Order line** detail

The following messages are transmitted from WCS to the Host:

Message	Purpose
SLA	**Stock Level Adjustment**. Sent when stock quantity changes other than as a result of normal receipt or delivery against an order
SAA	**Stock Availability Adjustment.** Sent when a quantity of stock changes status between Held and Available
PLC	**Pre advice Line Complete.** Sent once WCS has completed receipt of stock for a PO line
PSU	**Pre advice Status Update.** Sent when the status of a PO changes (e.g. closed)
OLC	**Order Line Complete.** Sent once WCS has completed picking and packing of a despatch unit to define its contents
OSU	**Order Status Update.** Sent when the status of an order changes (e.g. planned, despatched)
VEH	**Vehicle Closure.** Sent for each despatch unit on a trailer when the trailer is closed
SBD	**Stock Balance Detail**. Details of WCS stock inventory of all SKUs at a snapshot time

Full details are provided in the WCS Host Interface Specification.

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24 OTHER DETAILS

24.1 Barcode Summary

24.1.1 Location Barcodes

Barcodes are required to uniquely identify locations of the following types:

GOH location	Barcode for each location is configurable
Manual location	
Decant pallet position	Barcode format to be determined
Pick & Drop	
WIP	

24.1.2 TM Barcodes

24.1.2.1 Licence Plates

The TM ID is used as the LP of a TM, with the exception of totes:

TM Type	Number of Digits	Barcode Range	Notes
Manual area trolley	4	1111 – 1199	
GOH Bin	4	5000 – 9999	
Cage	6	100000 – 399999	Separate configurable range for each carrier
Despatch parent pallet	6	800000 – 899999	Used for pallets loaded onto trailers for despatch when TMs on pallet each have a despatch label
Case (indent)	8	40000000 – 40000000	
Storage pallet	8	50000000 – 54999999	
Replenishment pallet	8	55000000 – 59999999	
Manual pick carton	8	60000000 – 69999999	
Auto-labelled pick carton	8	80000000 – 89999999	Generated by WCS Separate ranges for medium cartons and large cartons
Tote	7	9000000 – 9999999	Tote ID
	1	1 – 2	Side ID. Tote barcode consists of tote ID concatenated with side ID
Case (except indent)	10	1100000000 - 3399999999	Separate configurable range for each client

24.1.2.2   Despatch Labels

Despatch label barcodes for TMs are generated by WCS to a specification that is configurable to each carrier.

24.2   End of Day

The hour of the end of day on WCS is defined by a system parameter. At the end of day WCS performs the following actions:

- Pauses the system and takes snapshot backup files of the database
- Removes expired data from the application servers (not the MIS) e.g.
    - Details of complete POs, despatched consignments etc.
    - Stock records with state *gone*
    - Other expired/idle records (e.g. unused SKUs)

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Between versions of this document, changes are normally highlighted using Word's change tracking.