

HelloFresh

Barleben, Germany
The Hybrid Line

Dematic iQ

Software Functional Specification V2.9
2023-10-25



We **Optimize** Your Supply Chain

DEMATIC

© 2021 Dematic Corp. All rights reserved.

No part of this document may be reproduced or transmitted in any form or by any means, electronic or mechanical, for any purpose, without the express written permission of Dematic Corp.

This document contains confidential information, trade secrets and/or know-how which is the property of Dematic Corp., and may not be disclosed to any third party without the written permission of Dematic Corp. Product and company names herein may be the trademarks of their respective owners.

Hereinafter Dematic Corp. shall be written as Dematic and refers to any Dematic entity within the global Dematic group of companies.

Dematic Corp.
507 Plymouth Avenue
Grand Rapids, MI 49505
616-913-6200
800-530-9153
www.dematic.com

Release Dates

Version	Release Date	Description	Authored By / Revised By
0.1	19-Oct-2021	Initial Release	Global Software Center of Excellence
0.2	01-Nov-2021	Adjustment of COE version according to proposal	E.Alalami
0.3	22-Dec-2021	Modifications according SFS Workshops	E.Alalami
0.4	24-Jan-2022	Release for internal review	E.Alalami
1.0	31-Jan-2022	Rework after internal review	E.Alalami
1.1	16-Feb-2022	Rework after customer review	E.Alalami
2.0	11-Mar-2022	Rework after common review with customer	E.Alalami
2.1	17-Mar-2022	Rework after customer review	E.Alalami
2.2	18-Mar-2022	Rework after customer review	E.Alalami
2.3	21-April-2022	Small changes and error corrections based on Feedback of HelloFresh and Software Designer	E.Alalami
2.4	07-July-2022	Changes after verification of the simulation results and review of PM	E.Alalami
2.4.1	05-Okt-2022	Rework of version 2.4 after clarification of open points	E.Alalami
2.5	15-Nov-2022	New Version after further clarification	E.Alalami
2.6	23-Dec-2022	Redefine whole system balancing 9.15.6.1 and picking area balancing 9.15.6.2	E.Alalami
2.7	21-Feb-2023	Small changes which agreed during FAT or commissioning or determined by previous review: - Height check in BoL - Weight check in DMS - Login QC workstations	E.Alalami
2.8	15-May-2023	Add the expected file name format of manual uploaded host messages	E.Alalami
2.9	25-Oct-2023	Changes agreed during rampup: - change workstation status "Closed with clear down to storage" to "Closed with clear down" - change the criteria of determination of HL QC workstation -Specify the order release preconditions which cannot be ignored by manually order release	E.Alalami

Contents

1	Introduction.....	8
1.1	Document Overview.....	8
1.1.1	Purpose	8
1.1.2	Target Groups.....	8
1.1.3	Scope	9
1.2	Responsibilities	10
1.3	Workshops.....	11
1.3.1	Procedure	11
1.4	Glossary.....	12
1.5	Acceptance Certificate	16
2	System Characteristics	17
2.1	Purpose	17
2.2	Physical Layout.....	17
2.3	Physical Components	18
2.3.1	Carton Erecting, labeling and printing recipes	18
2.3.2	Cool Pouch insertion.....	19
2.3.3	Ice and Add-on Area	20
2.3.4	Picking Area.....	22
2.3.5	Lidding, dispatch and recirculation	24
2.3.6	Sortation area	25
2.3.7	Mealkit Storage - Multishuttle	26
3	Warehouse Organization.....	28
3.1	Purpose	28
3.2	Structural Elements of Warehouse Organization.....	28
3.2.1	Location	29
3.2.2	Aisle/Level	29
3.2.3	Area	29
3.2.4	Facility	29
3.2.5	Zone	29
3.2.6	Storage Control.....	29
3.2.7	Location Type	30
3.2.8	Storing Conditions.....	30
3.2.9	Structural Elements of HelloFresh Warehouse (except MealKit Buffer).....	31
3.3	Administration of Warehouse Structure	33
4	Loading and Transportation Equipment	34
4.1	Purpose	34
4.2	Handling of Load Units within Dematic iQ Optimize	34
4.2.1	Load Unit	34
4.3	Load Unit Types.....	35

4.3.1	Overview.....	35
4.3.2	Load Unit Type Properties	35
5	Clients and Products	36
5.1	Purpose	36
5.2	Clients and their Products in Dematic iQ Optimize	36
5.2.1	Client	36
5.2.2	SKU (Product) Master Data.....	36
5.3	Handling of Clients.....	37
5.3.1	Main Client.....	37
5.4	SKU Master Data	38
5.4.1	SKU Attributes	38
6	Inventory Management	39
6.1	Purpose	39
6.2	Elements of Inventory Management.....	39
6.2.1	Client	39
6.2.2	Inventory Unit.....	39
6.2.3	Inventory Availability	40
6.2.4	Inventory Distribution in Hybrid Lines - Rack Plan.....	40
6.2.5	Inventory Movement Types / Inventory Movement Reasons	40
6.2.6	Inventory Query	40
6.2.7	Inventory Journal	40
6.3	Inventory Attributes	40
6.4	Inventory Discrimination.....	40
6.4.1	SKU Blueprint Configuration	40
6.5	Notification of Host on Substitution.....	41
7	User and Resource Management.....	42
7.1	User Management	42
7.2	Log In and Out	44
8	Workstation	46
8.1	Pick By Light	48
8.1.1	Bay Color	48
8.1.2	Maxi Pick	49
8.1.3	Bay Display.....	50
9	Business Processes	52
9.1	Carton Erecting	52
9.1.1	QC Workstation:.....	54
9.2	Printing of Recipes	54
9.3	Cool Pouch Insertion.....	56
9.4	Coupon Dispenser	58
9.4.1	Interfaces	58
9.4.2	Coupons data and location:.....	58
9.4.3	Process.....	58
9.5	QC Workstation after Cool Pouch Area.....	59
9.6	Ice Stations	61

9.6.1	QC Ice Picking	62
9.7	Add-On Stations.....	64
9.8	Picking Lanes	66
9.8.1	Out Of Stock in hybrid line area	68
9.9	Scales and weight control Ice, Add-on and Hybrid Line.....	71
9.9.1	Scales weight check process	71
9.9.2	Gross weight for check.....	72
9.10	HelloFresh Pick By Light Solution	72
9.10.1	Central picking with orientation	72
9.10.2	Mark box for QC.....	72
9.10.3	Unmark box for QC	73
9.10.4	Complete pick then mark as out of stock.....	73
9.10.5	Short picking	74
9.10.6	Unmark out of stock	74
9.10.7	Display Workstation status	74
9.11	Quality Check Process on NOK Workstations	75
9.11.1	QC Add-On	75
9.11.2	QC Hybridline	77
9.11.3	Handling of Out Of Stock	79
9.11.4	QC Operation Dialog.....	81
9.12	Emergency Handling in QC Workstation:	96
9.12.1	Quantity change of picked SKU	96
9.12.2	Substitution of SKU.....	96
9.12.3	Damage and full boxes	96
9.13	Lidding and Shipping Labeling	97
9.14	Sortation	98
9.14.1	QC Chute Handling.....	102
9.14.2	Outbound Sorter Screens	103
9.15	Order Processing	109
9.15.1	Order Management.....	109
9.15.2	Order Fulfillment	109
9.15.3	Order Release.....	109
9.15.4	Order Status	111
9.15.5	Minimum cost routing algorithm	112
9.15.6	System Balancing	113
9.16	Meal Kits Storage - Multishuttle.....	114
9.16.1	Purpose	114
9.16.2	Goods Receiving.....	115
9.16.3	Replenishment.....	117
10	System Concept	120
10.1	System Architecture – Network Perspective.....	120
10.1.1	Dematic iQ Server.....	121
10.1.2	Failover Mechanisms	122
10.2	System Architecture – Technical Perspective	123
10.2.1	Layered Architecture	123
10.2.2	Java-based Technology	124
10.2.3	Java Application Server	124
10.2.4	Approved System Configurations	124

10.3	System Architecture – Functional Perspective	125
11	Datawarehouse	128
12	External Interfaces.....	129
12.1	Purpose	129
12.1.1	Host Messages	129
12.2	Monitoring	130
12.2.1	Monitor the current status of all interfaces (Host / Ricoh)	130
12.2.2	Monitor current status of uploads and data transfers.....	130
12.2.3	Manual upload of host files	130
12.2.4	Errors and warning of individual host messages	131
12.2.5	Ability to actively check for the status of messages Interface messages status.....	131
12.2.6	Access the log files for every interface	131
13	Dashboards and Reports	132
13.1	Purpose	132
13.2	Overview.....	132
13.3	Operational Dashboards	133
13.3.1	Cockpit Overview	133
13.3.2	Receiving Overview	133
13.3.3	Storage Overview	133
13.3.4	Picking Overview	133
13.3.5	Shipping Overview	133
13.4	Reports	134
13.5	Facts.....	134
14	Purging and Archiving.....	136
14.1	Purpose	136
14.2	Overview.....	136
15	Test Policy.....	137
15.1	Mission	137
15.2	Test levels.....	137
15.3	KPIs	137
15.4	Unit-Testing:	137

1 Introduction

1.1 Document Overview

1.1.1 Purpose

HelloFresh SE is a German publicly traded meal-kit company based in Berlin, Germany. It is the largest meal-kit provider in the United States, and also has operations in Australia, Canada, Denmark, New Zealand, Sweden, and Western Europe (including the UK, Luxembourg, Germany, Belgium, France, the Netherlands)

HelloFresh supplies everything you need to prepare quality, delicious, home-cooked meals that require no planning, no shopping and no hassle. Every ingredient needed for our thousands of exclusive recipes is carefully planned, locally sourced and delivered to your door when it's most convenient for you.

Due to strong growth and the associated demands on their logistics operation, HelloFresh is planning the expansion of their operation in Barleben and is setting up an automatic system for create and deliver meals for German market.

The Warehouse Control System (WCS), which will control the processes in these areas, will be *Dematic iQ Optimize*, which is part of Dematic's Software platform *Dematic iQ™*.

This software functional specification contains information regarding the Dematic iQ Optimize software only. It does not contain control or mechanical specifications.

This software functional specification defines the software components of the Dematic solution from which subsequent design, interface, implementation, and testing documents are derived.

1.1.2 Target Groups

This software functional specification addresses stakeholders of Dematic iQ Optimize as well as the operations groups involved with implementation.

Use this document to learn about the features and functions of the Dematic iQ Optimize solution or as a reference for design and implementation of the solution.

1.1.3 Scope

This software functional specification covers the software functions that run the business processes for the Dematic solution within the customer facility.

1.2 Responsibilities

The following table lists the names of key people involved in the creation of this functional specification, as well as their roles within Dematic.

Name	Company	Role	Contact
Andreas Küllmer	HelloFresh	Project Manager	aku@hellofresh.com
Enio Alburez	HelloFresh	Project Manager Software	ena@hellofresh.com
Raymond Smits	Dematic	Project Manager	raymond.smits@dematic.com
Essam Alalami	Dematic	Software Project Lead	essam.alalami@dematic.com
Global Software COE	Dematic	Global Software Center of Excellence	SoftwareCoE@dematic.com

1.3 Workshops

This software functional specification requires sign-off and approval from the customer and Dematic. To obtain the appropriate approvals, Dematic hosts a software functional specification workshops. The following section describes what happens during that workshop.

1.3.1 Procedure

- Based on the available information, Dematic schedules workshops to define the software functionalities, including specialists from the customer for each functional area.
 - The customer identifies the required specialists in advance for each subject.
 - During the workshop discussions, significant decisions are recorded in meeting minutes that are communicated to the appropriate stakeholders.
- Following the workshop, Dematic provides the software functional specification to the customer for review and approval.
- The sign-off and approval stage is schedule-sensitive and is required before the project team can proceed with the design and configuration phase of the project.

1.4 Glossary

This section provides a common list of terms and their equivalent terms in the customer environment. This software functional specification uses the Dematic terminology exclusively.

Dematic terminology	Customer reference	Definition
Advice	Product receipt information	Document received from the WMS for inventory to be received/decanted into a crate prior to storage.
Authorized Operator	Operator	An operator set up within Dematic iQ Optimize with necessary permissions to allow them to undertake the tasks being described.
Batch ID	Lot Number	A lot number is an identification assigned to a particular quantity of material from a manufacturer.
Best Before Date	Expiration Date	Date provided in Advice, saved on the Inventory Unit, this can be used to sort Inventory Units when considering them for allocation.
Clarification	Special handling	Clarification is the process of identifying and addressing issues with crates. I.e. over-height.
Client/Owner	HelloFresh	Owner of the inventory <ul style="list-style-type: none"> • HelloFresh
Compartment	Compartment	Inventory crates may be subdivided into compartments. Each compartment may hold a single SKU. Inventory crates may be configured for 1, 2, 4 or 8 compartments.
Counting Operation	Cycle Counting	Counting operations are specific to a counting order. They provide the functions that are required for stocktaking at a workstation that has been configured for stocktaking. Features include detailed instructions and information for the counting operation as well as details regarding ordered source load units and confirmation of the counting operation.
Dematic iQ Optimize	WES/WCS	Dematic iQ Optimize is the comprehensive real-time software that automates and optimizes distribution center operations.

Dematic terminology	Customer reference	Definition
Dematic Multishuttle	Multishuttle	Multi-tier, multi-aisle automated load storage and retrieval system. Racking with integrated shuttles, conveyors and lift equipment.
ERP	ERP	Enterprise Resource Planning.
GTP	Goods-To-Person picking	Goods-To-Person picking workstation.
Host	WMS or ERP system	Host system feeding the information to Dematic iQ Optimize.
Inventory Unit	Item or each	Within Dematic iQ Optimize, an inventory unit is understood as the inventory contained on/in a load unit (LU).
Load Unit (LU)	Container	Within Dematic iQ Optimize, a load unit (LU) is the entirety of a specific loading device, such as a pallet or crate.
Lock	Lock	Inventory that has been placed in a hold status and is not available for allocation.
LMS	System	Logistic Management System A sub-system of Dematic iQ Optimize responsible for the core business logic.
LPA	Label Print and Apply	Automated label print and apply station.
LPN	License Plate Number	A unique bar-coded number that is affixed to each load unit: case, carton, or crate.
Order	Order	Grouping of SKU's and quantities (order lines) for a customer deliverable.
Pick	Pick	Single action of picking inventory from a Source to a Pick Load unit. One pick order line can be completed by multiple picks.
Pick Load unit	Picking unit	A load unit which is the destination of a pick.
Pick List	Pick group	A pick list contains picks that are assigned to one picker for fulfillment. It represents the workload of all picks to be picked into exactly one pick load unit.
Pick Walk	Pick Walk	A pick walk contains one or more pick missions that must be

Dematic terminology	Customer reference	Definition
		processed within one picking journey.
PbV Device	Pick by Voice Device	The voice unit used by the picker to interact with the voice server/Dematic iQ Optimize.
PTG	Person to Goods	Operator is directed to storage locations to execute picking operations.
PTL	Pick to Light	Refers to a Pick-to-light device used to direct picking operations. The device allows an operator utilizing lights/display/buttons to confirm the directed picking operations.
Screen	User Interface	Refers to a user interface where images and data are displayed. Also referred to as a dialog.
SKU	Item/Product	Stock Keeping Unit.
SKU Quantity Unit	Unit of Measure	Defines a group quantity of Stock Keeping Units, for example a pack or each.
SOP	Standard Operating Procedures	Customer defined set of procedures to direct an operator actions for various warehousing operations.
Stocktaking	Cycle-counting	Periodic counting of inventory for accuracy.
Stocktaking Zone	Cycle-counting Zone	A stocktaking zone is a selection of locations that are configured for planning and executing the stocktaking requests. A location can be assigned to a single stocktaking zone.
UCC	UCC	The Uniform Code Council number for a product.
UOM	UOM	Product Unit of Measure.
UPC	UPC	The Universal Product Code of a SKU.
VAS	VAS	Value Added Services.
WMS	WMS	Warehouse Management System (WMS) also referred to as the host.
Worker Group	User Group	Each worker is associated with one worker group, which assumes the entire properties of a worker and defines the allowed workload for the

Dematic terminology	Customer reference	Definition
		worker, their capabilities (type of work) and their assigned zones
Workstation	Workstation	A location where a physical movement transition or other activity occurs to a load or its contents. Example: Picking Station – a location to which crates are delivered for the picking operation.

1.5 Acceptance Certificate

The functional specification identified by release date: 2023-10-25 for HelloFresh meets the requirements under the terms of the valid contract and replaces all former specifications and side letters in the form of protocols, email, or verbal definitions.

HelloFresh and Dematic have verified this document for accuracy and completeness and agree. This functional specification is – in terms of contractual commitments – the exclusive basis for realization of Dematic iQ Optimize.

Later changes, enhancements, or deletions require agreement between HelloFresh and Dematic.

HelloFresh, Project Manager – Andreas Küllmer Date

DocuSigned by:

Enio Alburez Gutierrez

10/25/2023

FD72A46CC0144C1...
HelloFresh, Project Manager Software – Enio Alburez Date

Dematic, Project Manager – Raymond Smits Date

DocuSigned by:

Essam Alalami

10/25/2023

9EF7446A16064FB...
Dematic, Software Project Lead – Essam Alalami Date

2 System Characteristics

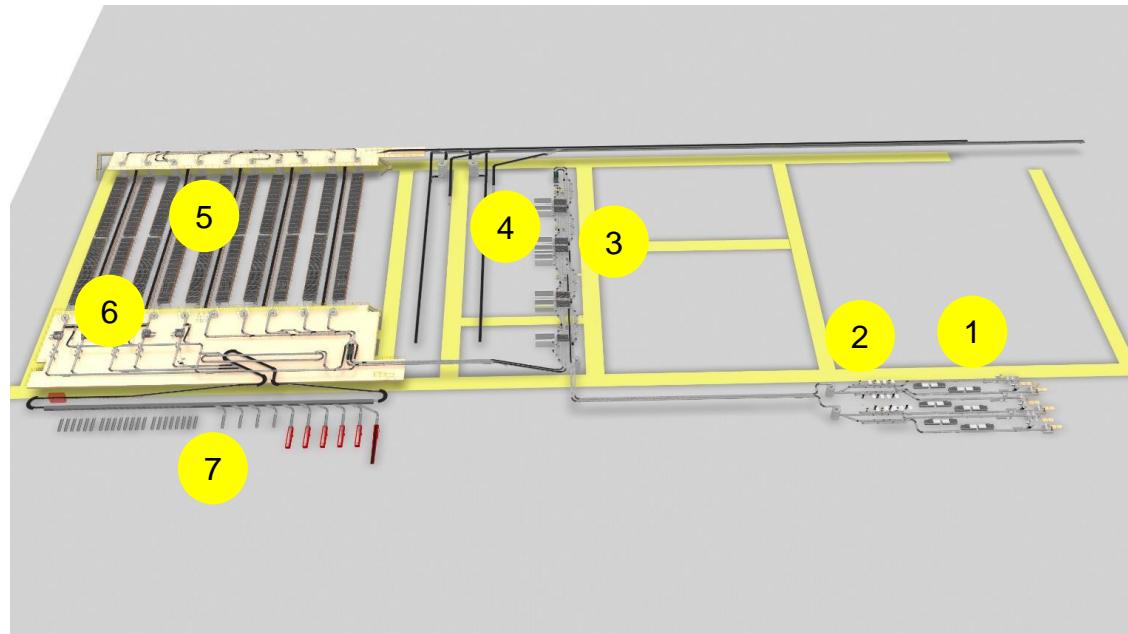
2.1 Purpose

This chapter describes the physical layout of equipment and the overall characteristics of the system.

Note: The drawings included in this software functional specification provide a visual representation of the overall system and may not represent the final approved drawings/layout.

2.2 Physical Layout

The layout shown below is a subsection of the overall site layout showing only those parts of the system which will be controlled by Dematic iQ Optimize.

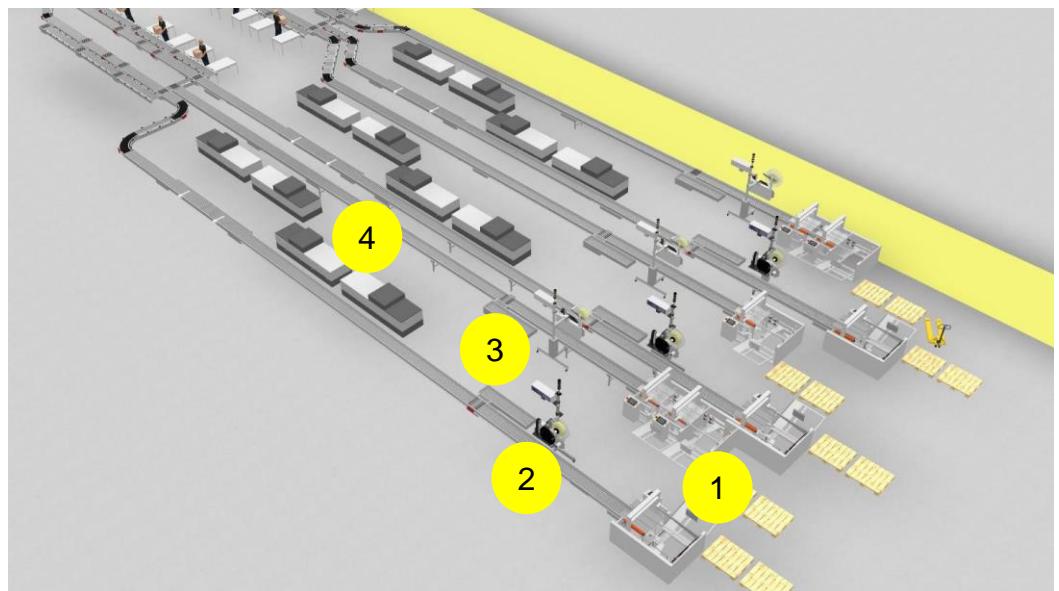


#	Description
1	Carton erecting, labeling and printing of recipes
2	Cool Pouch insertion area (including dispensers)
3	Ice insertion area
4	Add-On area
5	Picking area
6	Lidding, dispatch and recirculation
7	Sortation area

2.3 Physical Components

This section provides a brief overview of the physical components of the Dematic iQ Optimize solution.

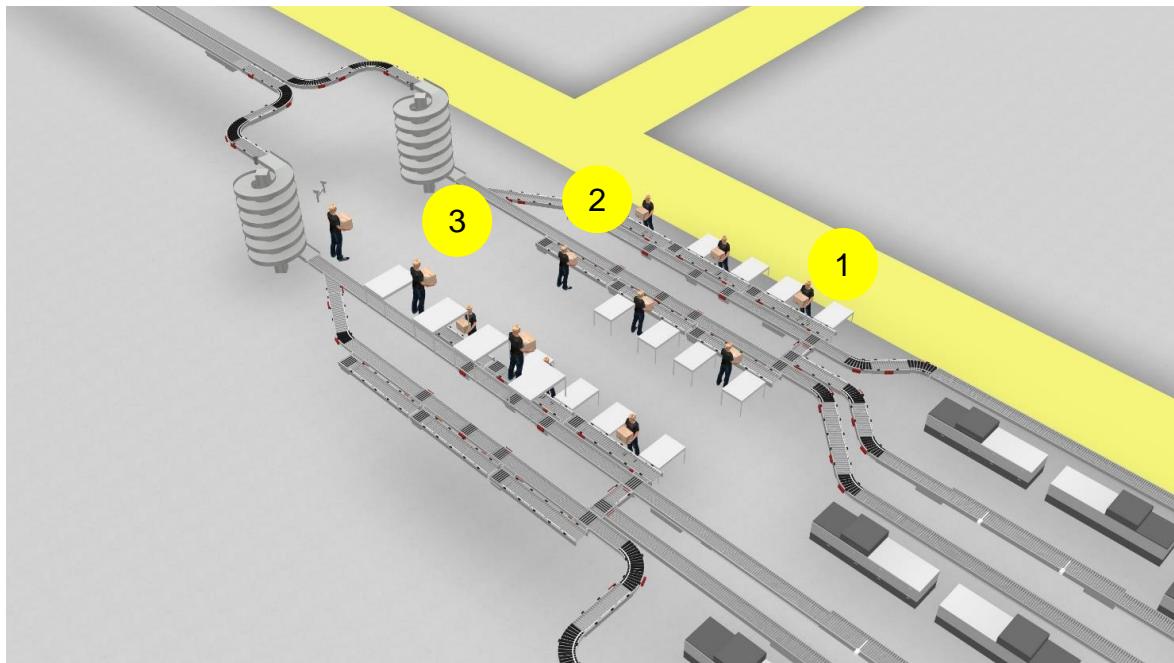
2.3.1 Carton Erecting, labeling and printing recipes



#	Description
1	6 x automatic carton erecting machines: <ul style="list-style-type: none"> - 2 machines are multi type machines. These machines are able, to erect two types of carton and alternate between box sizes automatically without human intervention - 4 machines are single type machines. These are able to erect only one type of carton per production run.

#	Description
2	6 x barcode label applicators
3	6 x NOK workstations
4	Print on Demand: 2 RICOH printers per lines

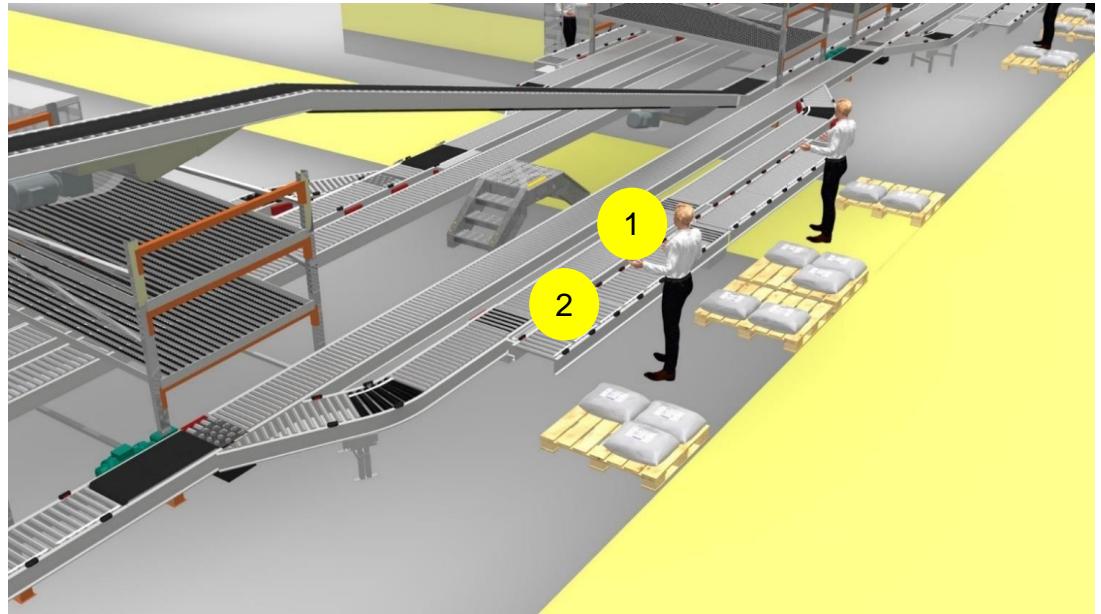
2.3.2 Cool Pouch insertion



#	Description
1	8x Cool pouch insertion workstations. 2 stations per line (each line with cool pouch detector)
2	4 x NOK workstation. 1 station per line
3	6 x RICOH dispensers: 3 dispensers per mainline

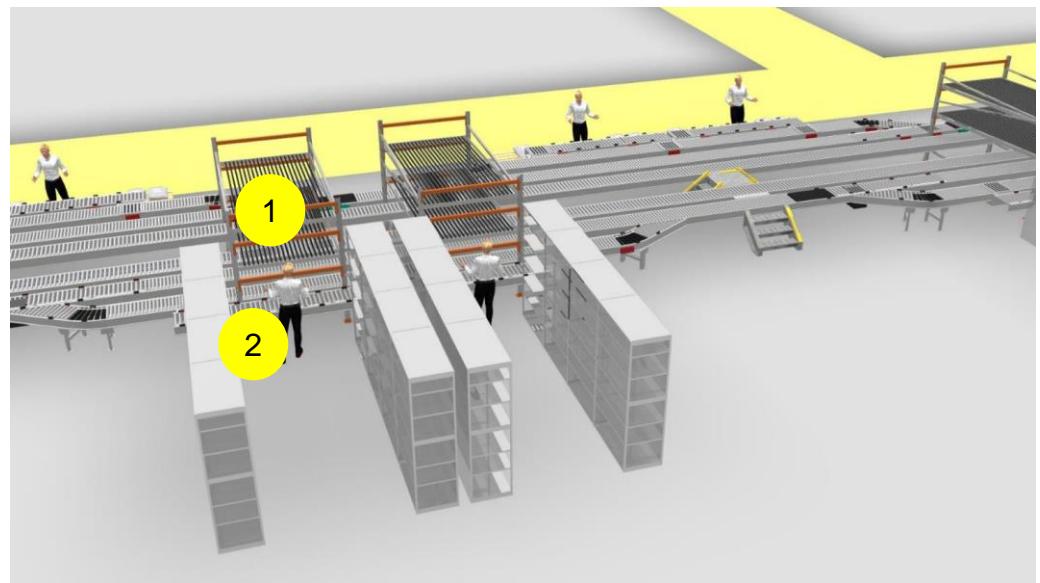
2.3.3 Ice and Add-on Area

2.3.3.1 Ice insertion



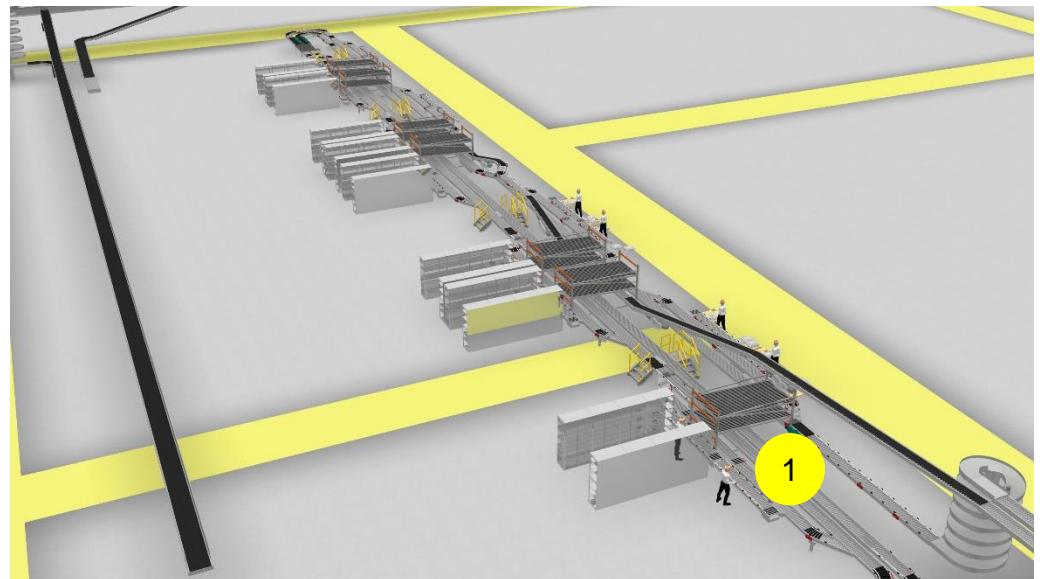
#	Description
1	10 x Ice insertion workstations
2	Workstation buffer
3	1 x NOK Station for ice stations. 1 x weight-scale per main-line. 1 x Intralox-switch(not in the picture)

2.3.3.2 Add-On Insertion



#	Description
1	8 x Add-On workstations
2	Workstation buffer

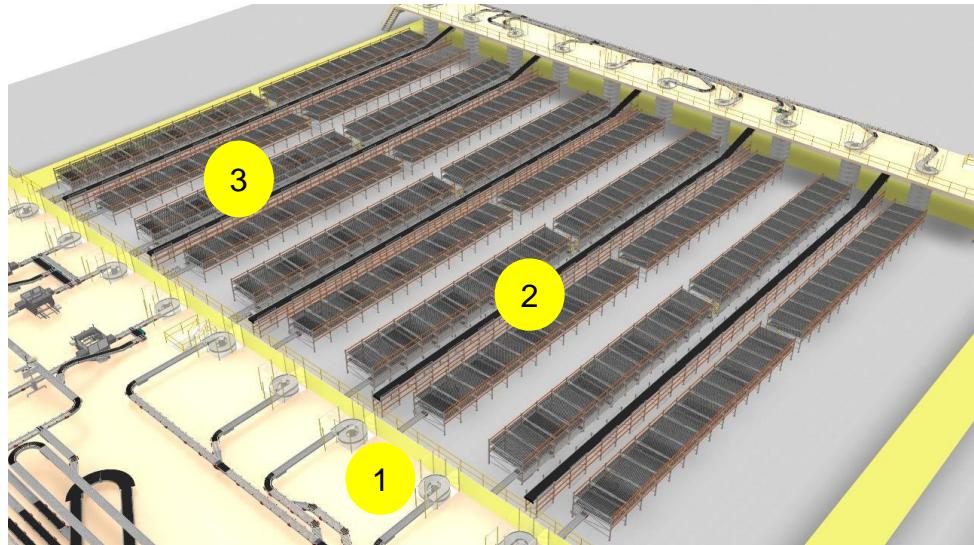
2.3.3.3 NOK station after Add-On



#	Description
1	1 x weight-scale at end of add-on line + NOK workstation

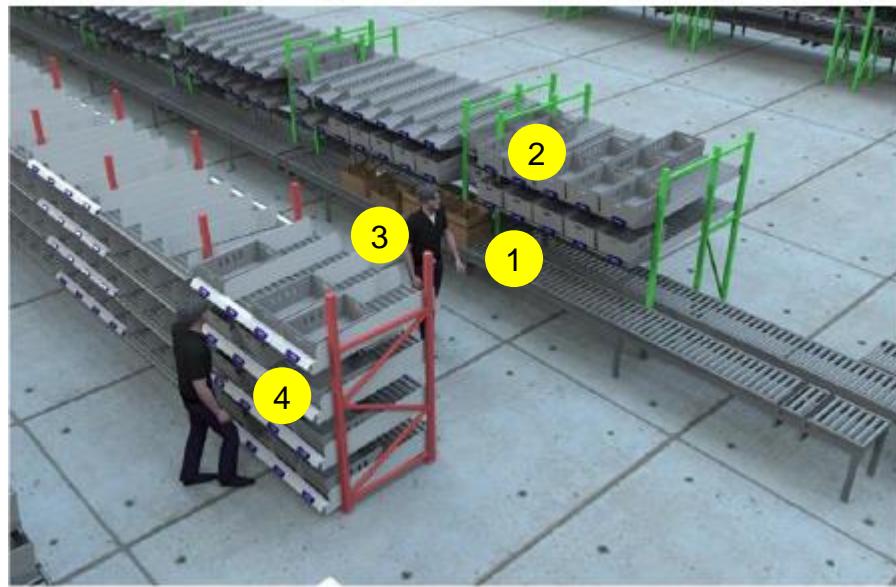
2.3.4 Picking Area

2.3.4.1 Picking lanes



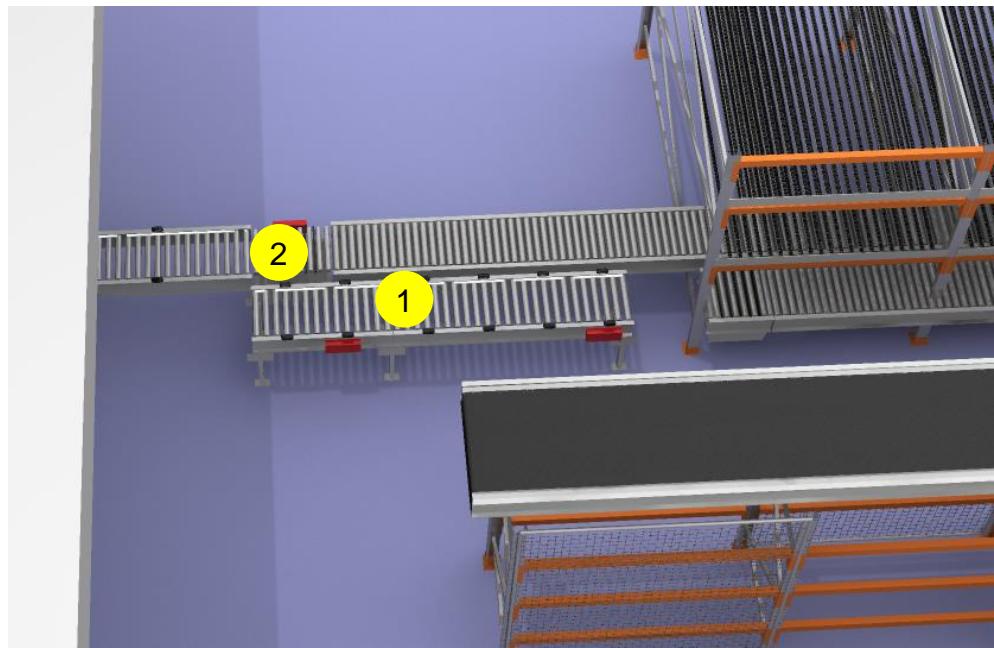
#	Description
1	1x Intralox-switch
2	5 x Protein lines
3	5 x Non-Protein/ Meal Kit lines

2.3.4.2 Picking Station



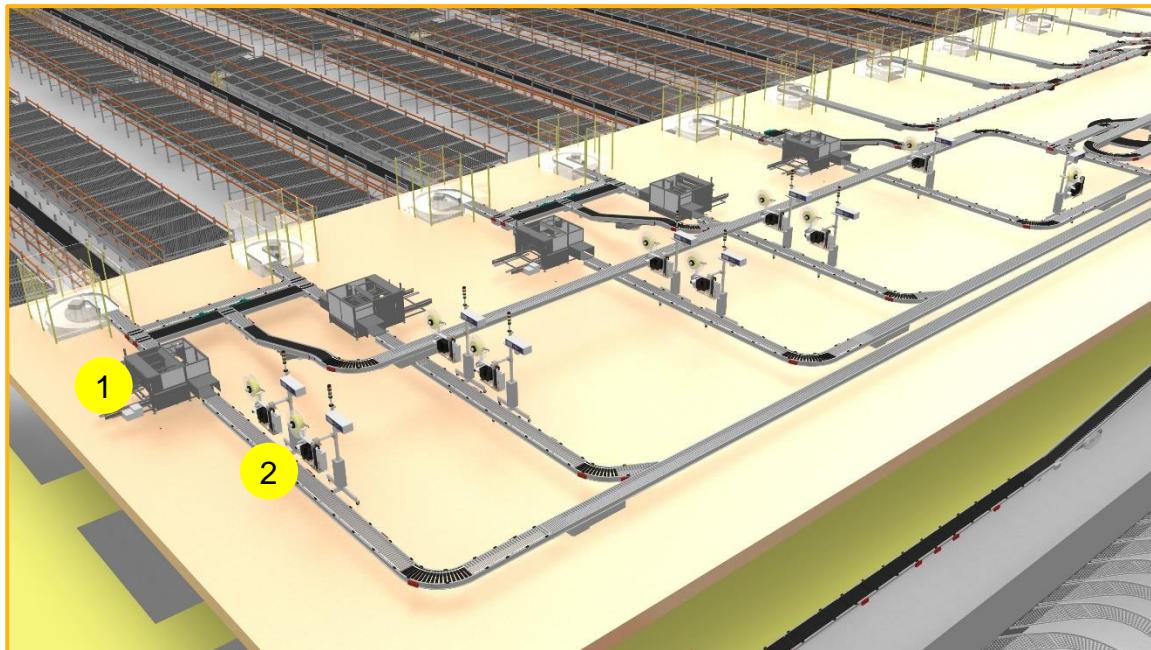
#	Description
1	Workstation buffer with 6 locations including the pick position
2	Front rack with 16 pick faces with own Pick-by-Light device
3	Rear rack with 12 pick faces with own Pick-by-Light device

2.3.4.3 NOK station of picking lanes

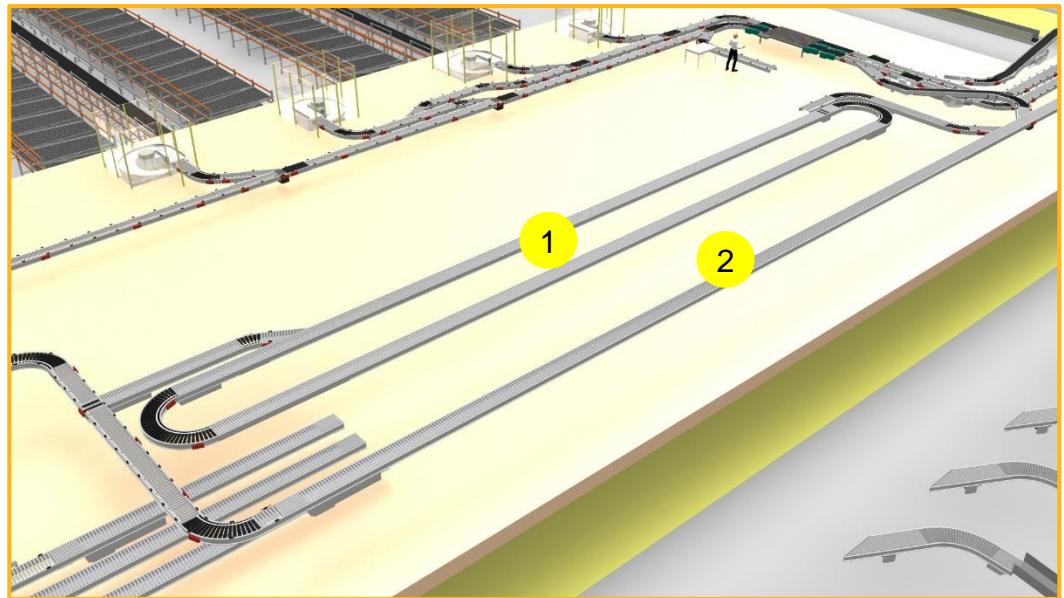


#	Description
1	5 x NOK Workstation with scale and height control to check To check if no goods are sticking out of the carton

2.3.5 Lidding, dispatch and recirculation

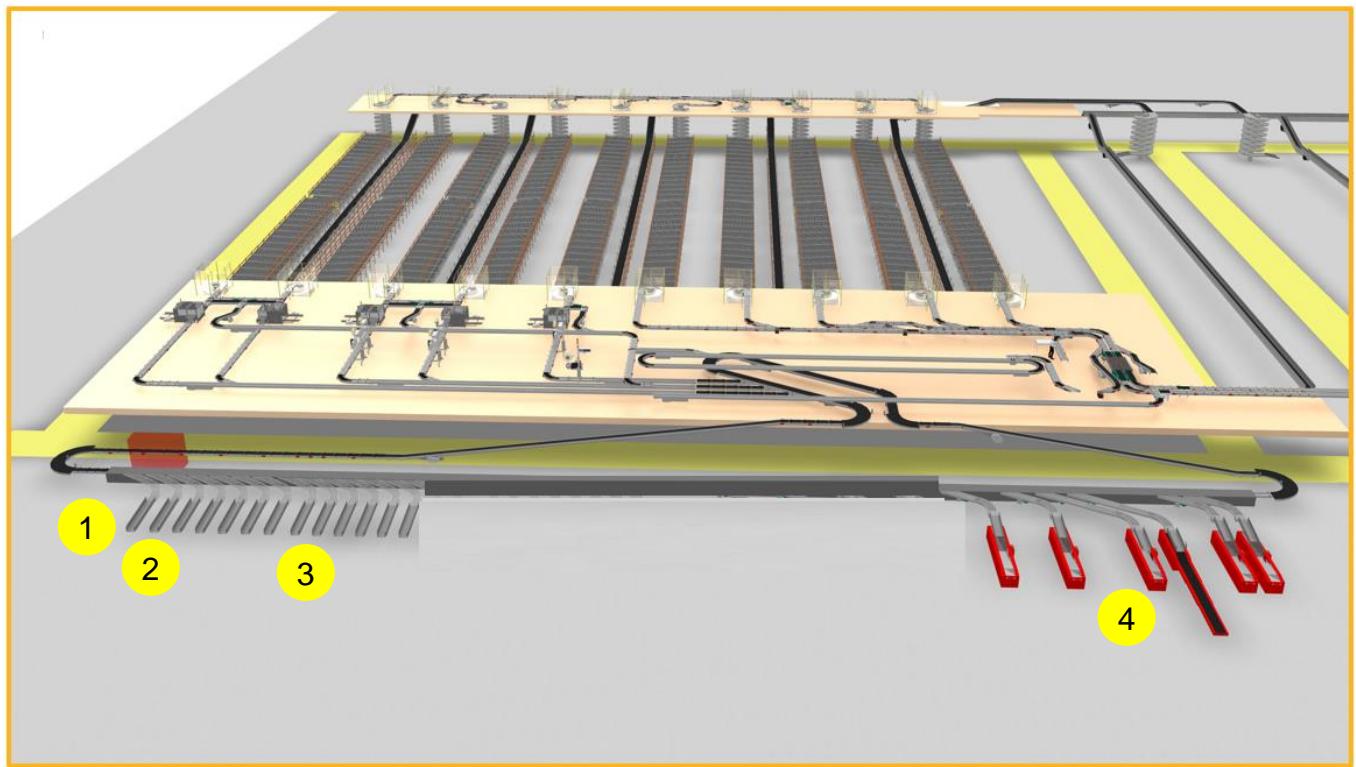


#	Description
1	5 x Lidding machine
2	10 x Shipping label printer



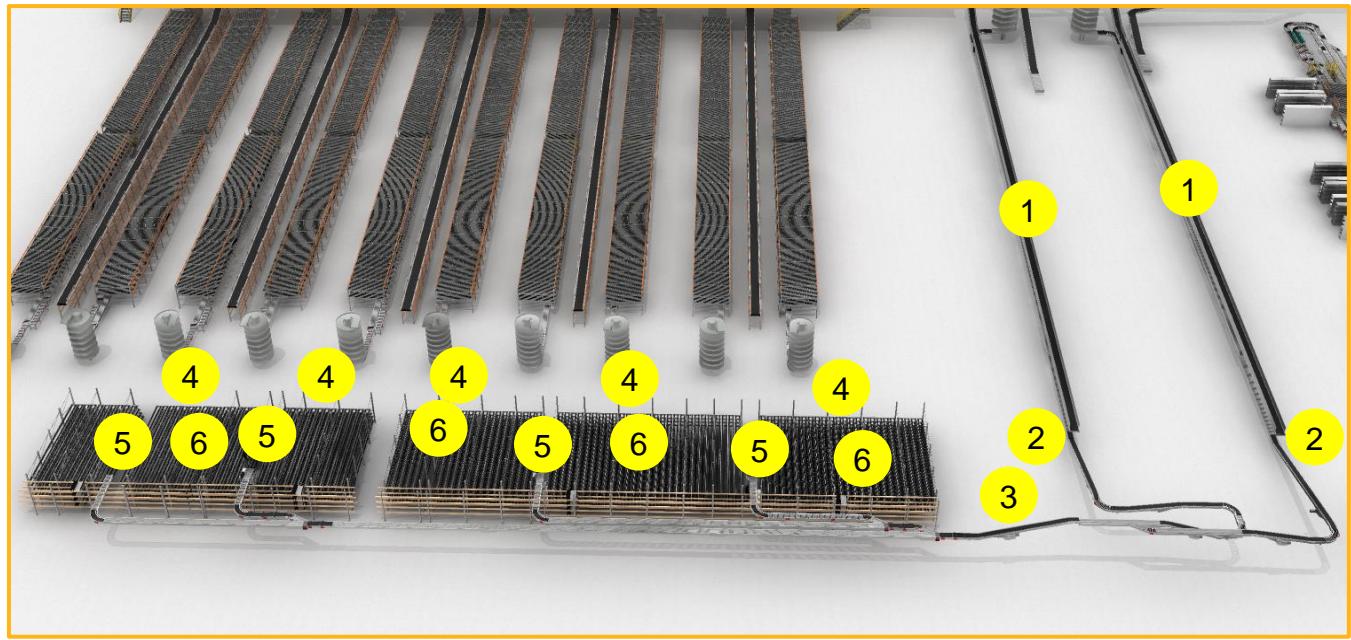
#	Description
1	Out of stock buffer loop
2	Recirculation line

2.3.6 Sortation area



#	Description
1	1 x QC line
2	1 x Overflow line
3	11 x lanes for palletizing
4	6 x lanes connected to a telescope conveyor

2.3.7 Mealkit Storage - Multishuttle



#	Description
1	Crate induction conveyor for Multishuttle area contains 32 decanting workstations
2	NOK workstations with scales and height control
3	Incoming crate conveyor
4	Pick face for operator
5	Multishuttle lift / drop points
6	Flow rack channels

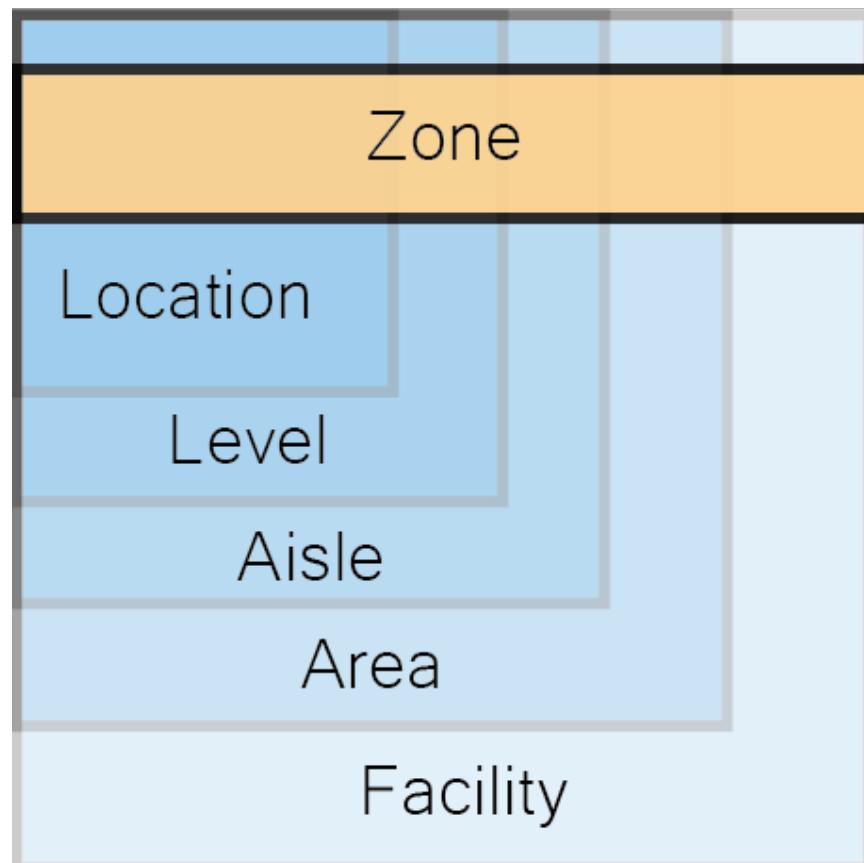
3 Warehouse Organization

3.1 Purpose

This chapter describes how the physical layout of the warehouse maps to the logical organization in Dematic iQ Optimize.

3.2 Structural Elements of Warehouse Organization

The following elements describe the warehouse organization in Dematic iQ Optimize.



3.2.1 Location

The location is the lowest organizational unit within a warehouse that can be uniquely addressed. Locations are identified through a unique identifier and a unique name. A location can be divided into multiple positions which can be allocated by different load unit types.

3.2.1.1 Position

The location may be segmented with positions. For example, in a Dematic Multishuttle location, it may be defined as a single location with multiple positions. This allows for the scenario when there are multiple load units being stored in the location. Typically, a double deep location, where the near and far are individual positions within the same location.

3.2.2 Aisle/Level

Within rack structures, locations are uniquely assigned to aisles and levels. Aisles and levels are locked if a stacker crane or a Dematic Multishuttle has a defect. For areas without racking, for example, a receiving area or shipping area, using aisles and levels is not mandatory.

The default type of subgroup is a level.

3.2.3 Area

A facility is divided into area entities based on function and the physical topology. For example, you would typically have a receiving area, a shipping area, one or more picking areas, one or more storage areas, and so on.

3.2.4 Facility

The largest unit is the facility, which represents the warehouse or distribution center itself. Dematic iQ Optimize may be multi-site, which means it can manage multiple facilities from the same software instance.

3.2.5 Zone

A zone is an entity that is used to group similar elements together, such as facilities, areas, groups, and so on, based on a common function or topology. A zone is not a subset of any of the other area-specific entities, it can cross over to any of the units. For example, several aisles may be split in half with each half belonging to different zone. Zones can also overlap (for example, a location could be part of two or more zones).

3.2.6 Storage Control

Storage control consists of the structures and parameters which are available to control storage within a warehouse.

3.2.7 Location Type

Location types classify storage locations with respect to their physical properties and are assigned to locations. They contain information like dimensions, capacity and allowed load unit types. For each load unit type, the amount of space consumed can be specified from the location through a layout.

3.2.8 Storing Conditions

If a SKU has certain storage requirements (for example, the SKU must be stored in a certain temperature range). The storing condition is used by both locations and SKUs and the LMS will enforce this by only storing the SKU in locations that have matching storing conditions. SKUs and locations can both have multiple storing conditions.

3.2.9 Structural Elements of HelloFresh Warehouse (except MealKit Buffer)

3.2.9.1 Area

A facility is divided into area entities based on function and the physical topology.

HelloFresh areas will be:

- CartonErrector
- RecipesPrinting
- CoolPouchInsertion
- CouponDispensor
- IceArea
- AddOnArea
- HybridLines
- LiddingShipping
- SorterLanes

3.2.9.2 Location

The location is the lowest organizational unit within a warehouse that can be uniquely addressed. Locations are identified through a unique identifier and a unique name. One location is assigned to one area. One location represents one pickface, coupon dispenser or printer. No slots are available because DiQ has no information about how many physical crates are in a flow channel.

3.2.9.3 Zone

A zone is an entity that is used to group locations of a workstation. A zone contains multiple locations.

3.2.9.4 Workstation

A workstation is an entity that represents a physical pick station. A workstation is assigned to one zone.

3.2.9.5 Load Unit

To store stock at a workstation a dummy load unit will be generated by DiQ for each source picking location when replenishment is completed. A load unit is assigned to one location.

3.2.9.6 Inventory Unit

An inventory unit is the smallest unit of inventory that's managed in Dematic iQ Optimize. Inventory units specify the SKU, as well as the load unit currently storing the inventory unit. An inventory unit is assigned to one load unit.

3.2.9.7 SKU

SKUs are stock keeping units, which represent items or articles in a warehouse. The SKU entity maintains all of the fixed, master data and properties of a SKU. A SKU is assigned to one inventory unit.

3.2.9.8 QC Stations:

Dematic iQ Optimize provides different, for HelloFresh warehouse mainly project-specific, load unit information and clarification functions for use at QC stations. After entering the load unit ID, Dematic iQ Optimize suggests several actions that can be taken based on the load unit's status and current situation. The determination to which QC station must the box be diverted, depends on the error case and current area of load unit.

In case of No Read the box will be transported always to next QC station. No Read error cannot be displayed in DiQ clarification screen. For all QC stations, if station is full the box waits and eventually blocks the complete line.

3.3 Administration of Warehouse Structure

The system is delivered with a fully configured warehouse structure, including the facility, areas, zones and locations.

Manual creation of additional locations for automated areas through screen functions is not allowed. Therefore, all screens for warehouse structure administration will not allow creation of new locations or updating of structural properties.

4 Loading and Transportation Equipment

4.1 Purpose

This chapter describes the characteristics of units used for packaging, loading, storage, and transportation.

4.2 Handling of Load Units within Dematic iQ Optimize

This section describes the general principles of load unit handling within Dematic iQ Optimize.

4.2.1 Load Unit

A load unit (LU) is a specific loading device, such as a pallet or tray, and the inventory on or in that device. Load units are classified by their load unit type (LU-type). Inventory in a warehouse is always positioned on a load unit. In the case that inventory does not physically reside on a load unit, Dematic iQ Optimize generates a virtual load unit to which the inventory can be assigned.

4.2.1.1 Load Unit Identification

Each load unit is identified by a unique barcode (LPN). The load unit identifier is normally available as barcode label on the physical load unit.

The load unit identification must be unique across all load unit types.

The details of load unit labelling will be clarified in PLC specification.

4.3 Load Unit Types

4.3.1 Overview

The load unit type specifies the common physical properties of load units, for example, the dimensions, weight information, indications for variable height, information about partitioning, and information for stacking.

The following load unit types are required for the HelloFresh warehouse and will be managed by Dematic iQ Optimize:

- Hybrid line load unit types:
 - Carton size “XS”
 - Carton size “S”
 - Carton size “M”
 - Carton size “L”
- MK buffer (Multishuttle)
 - Crate

4.3.2 Load Unit Type Properties

The following table includes basic data for selected characteristics of different load unit types of hybrid line :

Box Dimension	Minimum	Maximum
Height	150 mm	420 mm
Width	390 mm	390 mm
Length	390 mm	390 mm
Weight	0,2 kg	20 kg
Weight Tolerance	5%	

The crate in MK buffer has the following characteristics:

Dimension: 600 mm x 400 mm x 320 mm (L x W x H)

Weight: Min. 2 kg; Max. 25 kg

5 Clients and Products

5.1 Purpose

This chapter describes how clients and their specific products are managed within Dematic iQ Optimize. The Client is the “owner” of products in the implementation.

5.2 Clients and their Products in Dematic iQ Optimize

This section describes how clients and their product master data are handled within Dematic iQ Optimize.

5.2.1 Client

In Dematic iQ Optimize, a client is the owner of products that are stored and handled within a warehouse. There may be multiple clients or owners of inventory.

The following business entities are client specific within Dematic iQ Optimize:

- Product (SKU) master data
- Advices
- Orders
- Inventory

A host system can be assigned to each client. The client receives data from the host system and sends confirmations and process information back to the host.

5.2.2 SKU (Product) Master Data

SKU master data is normally maintained by a client's host system as the master and passed to Dematic iQ Optimize.

Products in Dematic iQ Optimize are distinguished according to stock keeping requirements. A specific variant of a product, for which stock needs to be kept individually, is called a stock keeping unit (SKU) in Dematic iQ Optimize. The identifier for such a product variant is the SKU identifier.

Stock keeping units differentiate products according to static data, such as part number, color, or size. Product properties varying in process, such as packaging units, batch, or best before date are not used to distinguish SKUs but are kept with inventory units.

Special requirement:

- HelloFresh needs the possibility to mark a SKU as unavailable for order fulfillment. Superuser can set a flag in WCS to one SKU to avoid the release of orders which need such SKU. This flag can be also used for certain cool pouch size which is only available in one cool pouch workstation, e.g. to avoid the overload by such workstation. This flag can be set also by host. See [skulInsertUpdate message in Host Interface specification](#)
- Velocity of SKUs can be changed manually in WCS and get overwritten if Host sends skulInsertUpdate message for the same SKU

5.3 Handling of Clients

5.3.1 Main Client

The following properties are configured for the client.

Clients

Attribute	Value
ID	HF
Name	HelloFresh
Type	External
Default SKU Blueprint	DEFAULT
Default Host identifier	WMS

Dematic iQ Optimize allows multiple clients to share the same storage resources within a warehouse.

5.4 SKU Master Data

5.4.1 SKU Attributes

Dematic iQ Optimize, provides a default set of SKU attributes and SKU-related information which is typical for many applications. These can be extended based upon an individual project's requirements

Details about the whole attribute of SKU are described in the host interface specification.

Dematic iQ standard may have additional attributes which are not used within the WMS. These will remain visible within the system.

6 Inventory Management

6.1 Purpose

This chapter describes how inventory is handled within Dematic iQ Optimize.

6.2 Elements of Inventory Management

This section describes the basic elements and terms for inventory management (SKU quantities) in Dematic iQ Optimize.

6.2.1 Client

The Client is the owner of goods which are stored and handled within a warehouse. Stock Keeping Unit - SKU

The Stock Keeping Unit identifies the goods of a Client in the warehouse. Each SKU is uniquely assigned to a Client and are identified by a unique SKU identifier.

6.2.2 Inventory Unit

An inventory unit is a quantity of an item or SKU with the same attributes (for example, location, packaging level, client). Typically there is a single inventory unit on a load unit, but not always (for example, a stacked load unit may have two or more load units stacked on top of each other with different inventory units inside).

All quantities of SKUs that are handled by Dematic iQ Optimize are stored as inventory units. The SKU quantities on load units are inventory units assigned to a load unit. The inventory unit comes with a comprehensive set of attributes that specifies the availability or lock status of quantities as well as specific characteristics of SKU quantities, such as the best before date or batch identifier.

General discrimination criteria are:

- Client
- SKU
- Load unit and location
- Best before date (if available)
- Hold status
- Batch (if available)

6.2.3 Inventory Availability

As **special requirement** for HelloFresh warehouse it will be assumed that the assigned SKU to one pick location (channel) in picking area is available with unlimited quantity, as far as this channel is not flagged as out of stock. Dematic iQ Optimize has no knowledge about the actual amount of SKUs in workstations. The amount of SKUs will be managed by WMS.

In MK buffer DiQ manages the quantity inside the crate based on the advice message

6.2.4 Inventory Distribution in Hybrid Lines - Rack Plan

The rack plan of picking workstation determines which SKU is located in which workstation rack face. The rack plan is in the whole responsibility of HelloFresh host system. The host system informs Dematic optimize iQ about the current status or changes of rack plan of workstation by replenishment process described in 9.16.3

6.2.5 Inventory Movement Types / Inventory Movement Reasons

Inventory changes are classified by inventory movement types to allow later differentiation. For each inventory movement type, a different inventory movement reason can be applied. Inventory changes are recorded in an inventory journal so that authorized operators can review the changes later.

6.2.6 Inventory Query

Dematic iQ Optimize allows for an inventory query through a screen filtering by specified inventory criterias.

6.2.7 Inventory Journal

The inventory journal contains a record of all inventory activities.

6.3 Inventory Attributes

For the project implementation, only standard inventory attributes of Dematic iQ Optimize are used. No additional attributes need to be added.

6.4 Inventory Discrimination

This section describes the SKU blueprint configurations that are required for project implementation.

6.4.1 SKU Blueprint Configuration

The SKU Blueprint is a rule set which describes for each SKU how inventory shall be discriminated in the warehouse by specifying mandatory or optional inventory unit attributes, such as batch or serial number.

The initial configuration includes a default blueprint that can be used for standard inventory merging purposes.

SKU Blueprints for HelloFresh

Attribute	Mandatory	Merge Configuration
ID: DEFAULT, Description: Default Blueprint		
FIFO Date	No	Use Average Value for Merge
Batch	No	Must be Equal for Merge

Additional discrimination criteria can be defined on SKU level through the SKU Blueprint. The DEFAULT blueprint configuration can be extended by Dematic in software design phase based on project requirements.

6.5 Notification of Host on Substitution

During the order processing the superuser can decide to change an orderline and send the order without or with a substitute SKU. Dematic iQ Optimize will inform the host system about this changes by the host message `orderLineChange`.

Details about the host message can be found in the Host Interfaces Specification

7 User and Resource Management

Purpose

This chapter describes the management of Users and Resources.

7.1 User Management

This chapter describes the basic elements and terms for user management in Dematic iQ Optimize.

User

Dematic iQ Optimize grants system access only to identified users after an authentication process.

Users are maintained in Dematic iQ Optimize with a unique user name , password, RFID UUID and optional contact information such as address, e-mail and phone numbers. For superuser and QC a user need to be registered in DiQ. This group requires special rights and the login in DiQ is only possible by user interface

For picking stations no registration in DiQ is needed, the login by RFID is sufficient to enable the stations.

Authentication

In order to access functionality in the User Interface, the user must login using a password. User authentication can be done within Dematic iQ Optimize.

The following password requirements can be configured:

- Password policy pattern which is a regular expression a password must match
- Max. number of failed login attempts
- Number of days after a password expires
- Number of days which a password cannot be reused (password history)

A password change can be enforced after the User has been created or his password has been reset.

User Sessions

User sessions can be monitored in Dematic iQ Optimize.

It is also possible to configure

- session timeout
- automatic screen lock
- automatic log-out

after a certain time of inactivity.

Terminals

Terminals are used for identification of the device from which a user session was started. The terminal ID can be specified as parameter in the URL used to connect to a Dematic iQ server.

If no terminal ID is explicitly specified, an ID provided by the browser will be used which is usually the computer name specified in the operating system.

Authorization / Permission

A Permission is the right to access a specific functionality, e.g. to execute a command, to modify an attribute or to access a dialog.

When the system is delivered, permissions are initialized for all dialogs and selected commands (special buttons in dialogs).

If required, authorized users can create additional permissions for individual dialog elements such as fields and buttons.

Authorization / User Groups

Permissions are not directly granted to users but to user groups. HF is able to create user groups on its own.

Users can be members in one or multiple groups.
Groups can also be members in groups.

Users inherit their permissions through their group membership.

Initially the following groups with appropriate rights will be set up:

- Administration
- User
- Supervisor
- QC operator
- Super user

7.2 Log In and Out

As special requirement the log in and out process of Dematic iQ Optimize will provide the RFID technology. Every operator will have a RFID card to log in to Pick By Light stations.

Dematic iQ will provide a dialogue where the supervisor can create access for a specific user which is only needed for QC stations and superusers. Login and Logout in QC station will be done by using the DiQ user interface.

All RFID Cards are able to activate the picking stations without being previously added to DiQ database.

This login process is needed on every following workstation:

- Cool pouch stations
- Ice stations
- Add-on station
- Workstations picking lane

Log in / Log out with RFID card in Pick By Light stations:

The users are only allowed to work when they are logged in with their RFID card. An inactivity timer is required the duration of the timer can be set by the super user. This timer decides when the user will be logged off without interacting with the Pick by Light system. Pick by Light of workstation will indicate this, before the user will be logged out automatically.

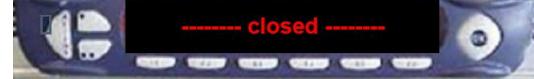
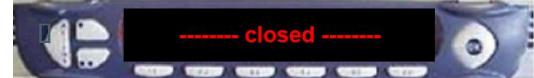
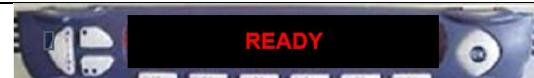
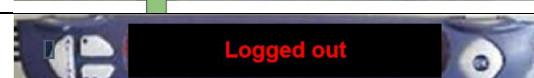
If a station is changed to status "closed" the user will be logged out automatically

The login is only possible if the station is in any of the "Active" status. If station is in any of the closed status log in is not possible.

Only one user is allowed to work on one specific workstation. Only the supervisor is allowed to be logged into different workstations.

If the operator is already logged in to another workstation and he will do a new login at a different workstation, the "old" workstation will automatically be logged out.

Following are the expected use cases of RFID card connected to Pick By Light:

State	Action	Pick By Light
1. Workstation is closed no user logged in	PTL display is turned off	
2. User log in	Operator presents RFID card	
3. Station gets activated	WCS displays confirmation of login with ID number	
4. User logs out	Operator presents RFID card or press F1 long or by timer	
5.	WCS confirms that user has been logged out	

Timer Logout

State	Action	Pick By Light
1. No activity from operator for X minutes	WCS warns user about inactivity and requests to present card within Y seconds	
2.1 Station is active and user logged in	Operator displays card ID and restarts timer	
2.2 No activity and no present card within Y seconds	WCS displays the workstation status see 9.10.7	

X time before warning and Y time before logout can be configured as parameter in WCS by super user.

8 Workstation

Purpose

Picking and Cool Pouch closing workstations are administrated in Dematic iQ. For HelloFresh warehouse the picking process will be executed in several areas as cool pouch, Ice, Add-Ons and hybrid lines. For picking and cool pouch closing workstation Pick By Light devices will be installed.

Types:

There are 2 logical types of workstations. The physical layout of the station is the same. The stations can be interchanged on a weekly basis:

- Picking station: Used to pick items into the box
- Cool pouch closing: Used to close the cool pouch

Setting:

The super user can assign the type of stations in the WCS UI. By default all stations are picking stations

Terminal:

Every workstation is uniquely assigned a terminal. Whenever a session is started from a terminal associated with a workstation, the specific features of this workstation are available within the session.

For example specific dialogs, dedicated to a workstation, only show in the menu and only can be started when a session was started for the terminal associated with this workstation.

Status

Standard workstation statuses of Dematic iQ optimize allow activation or deactivation as well as close of workstation. For HelloFresh processes additional statuses are required to manage some specific process such as out of stock, replenishment or rack planning.

Following table describes the needed statuses and the expected behavior of Dematic iQ optimize for each status

Status	Use Case	Consider workstation for new orders	Boxes in buffer
Active manned	Normal picking operation. Picking	Yes	Move to picking position

Status	Use Case	Consider workstation for new orders	Boxes in buffer
	station is active and an operator is logged in		
Active no replenishment	End of the week depletion of stock	Yes	Move to picking position
Active no rear replenishment	End of the week depletion of stock	Yes	Move to picking position
Active not manned	Picking station is active but no operator is logged in, e.g. operator leaves station unattended for break	No	Move to picking position. The box moving to the picking position does not trigger the Pbl and can't therefore be picked
Closed	Picking station is not active, e.g. cause of damage in station or cleanup needed	No	Move to other workstation
Closed with clear down	Week changeover before maintenance. Picking station is not used at the moment and its stock should be repalletized in staging to be reallocated to other parts of the line.	No	Move to other workstation
Close with cleardown to rack	Week changeover before maintenance.	No	Move to other workstation
Closed with active replenishment	Week change over after maintenance. Picking station is not used at the moment and its stock can be used to replenish other stations in the same group	No	Move to other workstation

In all described cases above, the operator has to finish the picking of current box in picking position.

For each status change Dematic iQ optimize informs HelloFresh Host System by sending a telegram so that the suitable process can be triggered by host, e.g. triggering of replenishment process from Mealkit Storage (see 9.16.3).

There are two options to implement the required extensions on workstation level:

1. Extension of DiQ standard workstation status list with status in the table above
2. Using DiQ standard statuses (Active, Closed) and implementation of each status on table above as flag for standard statuses which can be set and removed by Super User.

The Implementation of one of both options will be decided by Dematic in Software Design Phase. If there is any impact on the UI HF will be informed.

Status of Line: for each line a group of picking station are assigned. Super User needs a function to change the status of all assigned workstations of one line at once.

Integration in Transport System

Workstations, which are part of an automated system, have locations associated which serve as transport destinations or transport start points.

8.1 Pick By Light

Purpose

Different models of Pick By Light will be used in HelloFresh warehouse. Based on picking area the suitable model will be installed.

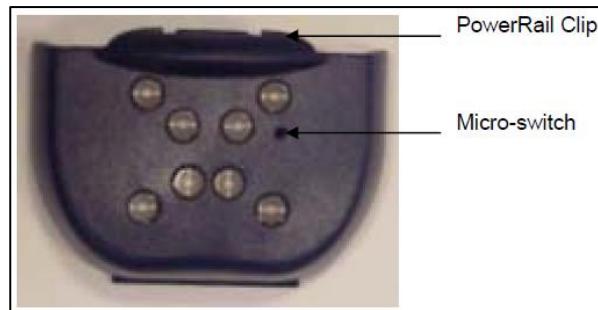
This chapter provides an overview of these models and their standard functionalities.

Chapter 9.10 describes the required customization and additional HelloFresh functions which have to be implemented for to fulfill the different picking use cases of HelloFresh warehouse.

8.1.1 Bay Color

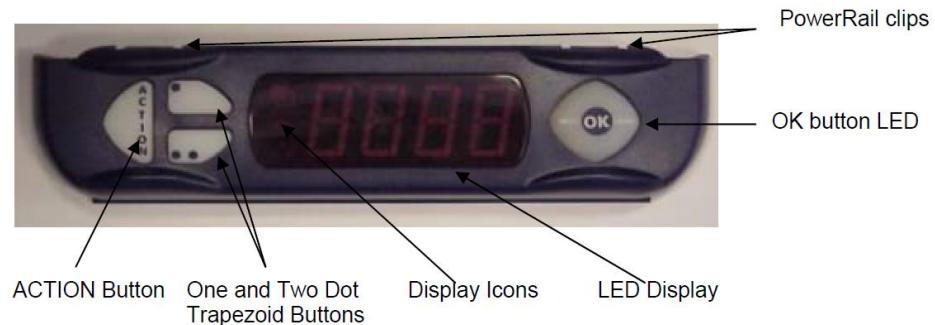
The BayColor is a pick control device used for indicating bay picking locations. The BayColor contains a bank of eight high luminosity LEDs able to display three different colors, red, green and amber. These lights are configured to flash in bays where picking is required.

In HelloFresh Project Bay Color will be used as orientation device for operator in Hybrid Lines area



8.1.2 Maxi Pick

MaxiPicks provide information on picking quantities, cartons, prepacks, and units. Display icons indicate specific functions such as introducing a new container, adjusting a quantity, or displaying multiple pick sequences for large quantities. MaxiPicks are primary devices and can control one or more SinglePicks.



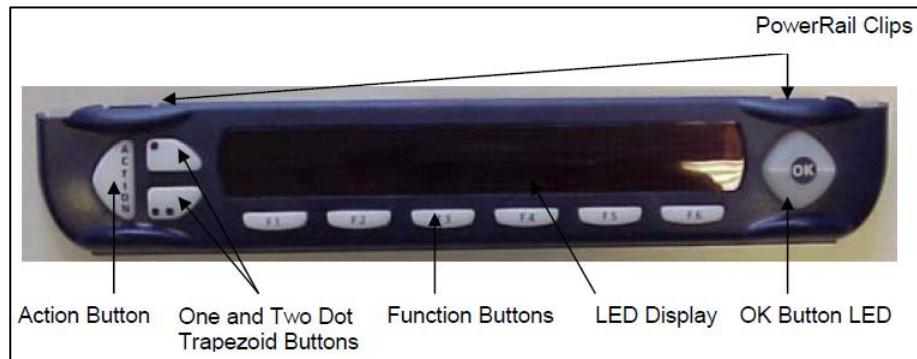
Button	Function description
Action	No standard functionality
Single Dot / Up	Increase pick quantity
Double Dot / Down	Decrease pick quantity
OK	Confirm pick

Special Requirement:

- Action button will be used to mark the slot as out of stock

8.1.3 Bay Display

The BayDisplay is the primary picking device and is used for indicating, displaying, and entering data at picking locations.



Button	Function description
Action	Menu
Single Dot / Up	Scroll menu up
Double Dot / Down	Scroll menu down
F1	Sign out: Sign out the current operator
F2	Next: Clears skipped order packing flag during pack out
F3	Suspend: Suspend the current cluster, container or container
F4	End operation: Finish operation like - Add container to cluster - Force pack out state
F5	Diagnostics: Shows Pick to light diagnostics
F6	Cancel: Cancels the current operation like - Build Cart - Build or adjust cluster - Add or suspend container
OK	Confirm

The functions of the not required buttons will be deactivated.

Special Requirement:

- Action button will be used to flag the box with an QC issue

- F3 button will be used to call supervisor. By pressing F3 button an alarm will be displayed in Alarm Monitor for supervisor

9 Business Processes

Purpose

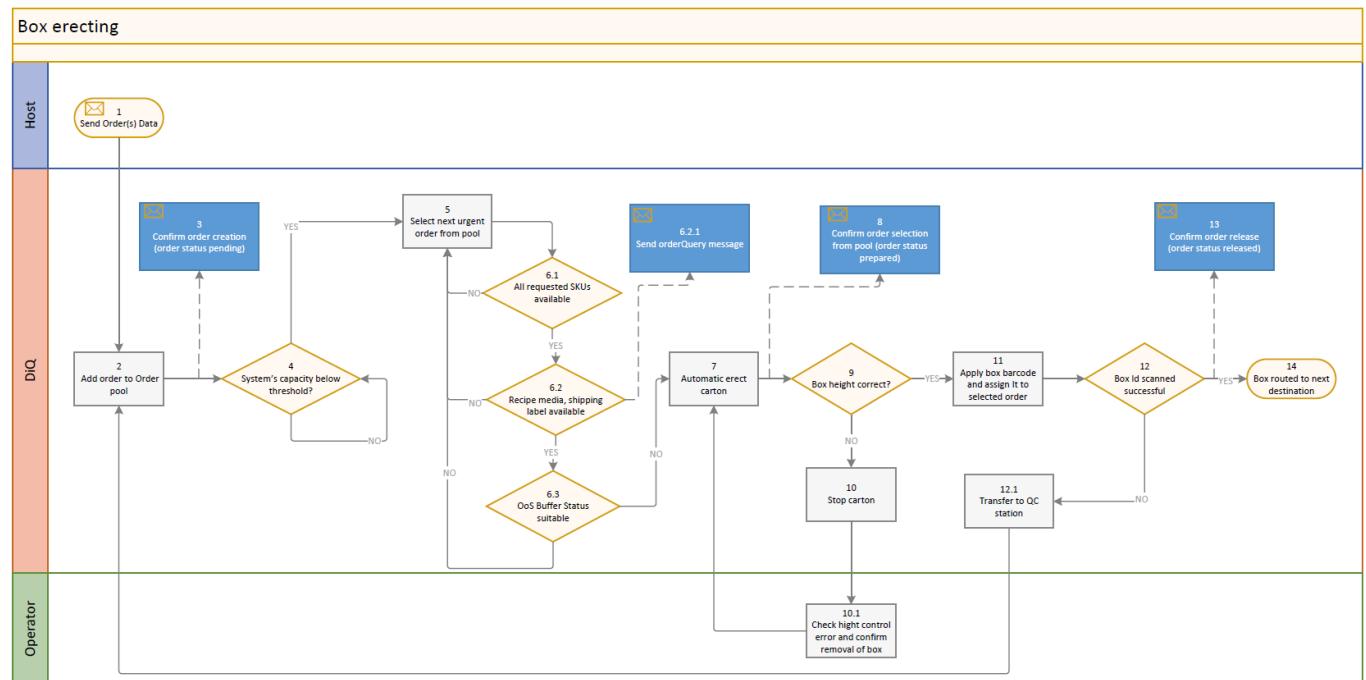
This chapter describes the various business processes that are to be supported by Dematic iQ Optimize.

Note: the description of business processes based on the simulation report v1.9. The fulfilment of required functionalities will consider the conditions and strategies which are used in simulation. Further changes in simulation will be checked from by DiQ team and can lead to changes in the software concept.

Overview

Dematic iQ Optimize (DiQ) – Warehouse Control System (WCS) will interface with the HelloFresh System - Warehouse Management System (WMS). The WMS is the responsibility of the customer and is referenced here to add completeness.

9.1 Carton Erecting



The configuration of the carton size will be done by the erector itself and not in DiQ. Dematic's PLC has an interface to the erectors. The PLC informs DiQ about the carton setting. DiQ will provide an overview dialog to display the current setting of erectors, no modification will be possible in this overview.

Step	Description
1	The WMS sends order data to WCS. Order data consist of an order header and one or multiple order lines.
2	On receipt of order data, DiQ will validate the order data and create order. Created orders will be added within the DiQ order pool.
3	DiQ confirms the creation of order to the WMS. Order get status "pending"
4	DiQ checks the capacity of whole system permanently to decide the release of next order.
5	If the system capacity threshold is not exceeded DiQ select the next order from order pool according to order release concept described in 9.15.3 The capacity thresholds is adjustable by the super user.
6	If the order is selected for releasing the following preconditions must be met to trigger the carton erecting for the order.: 6.1 All requested SKUs are available and theirs gross weight is defined in DiQ (> 0.0) 6.2 If recipe media is required by the order, DIQ check the availability of the printout by sending a orderQuery message to the RICOH. Availability of shipping label will be also checked. 6.3 No SKU is out of stock (OoS) and max. number of OoS boxes from requested SKU in OoS buffer is not exceeded from active orders If the order cannot fulfil any of these preconditions the order will stay in status pending.
7	Order is ready to be released and DiQ requests the carton size by an telegram to PLC. PLC will select the carton erector machine based on the configured size and the workload to get all lines balanced as far as possible. PLC communicate to the carton erector machine to create the requested carton.
8	DiQ confirms the successfully selection of order to the WMS. Order get status "prepared"
9	It will be decide by the height control if the right size of carton is crated
10	If the machine produced wrong size, the carton will be stopped in height check position.
10.1	Operator checks the status of box and confirms the removal of carton from the conveyor by PLC button. A new carton will be created for this order. continue to step 7
11	If the box passes the height control the box will be transported to barcode printer and get automatically a unique load unit ID
12	After successfully scanning of the barcode the potential order will be connected to the carton

Step	Description
12.1	The carton will be transported to QC station and the order will be restarted. continue to step 2
13	DiQ confirms the order release to the WMS. Order get status “released”
14	If required, the carton will be transported to print on demand area to get the recipes PDF

9.1.1 QC Workstation:

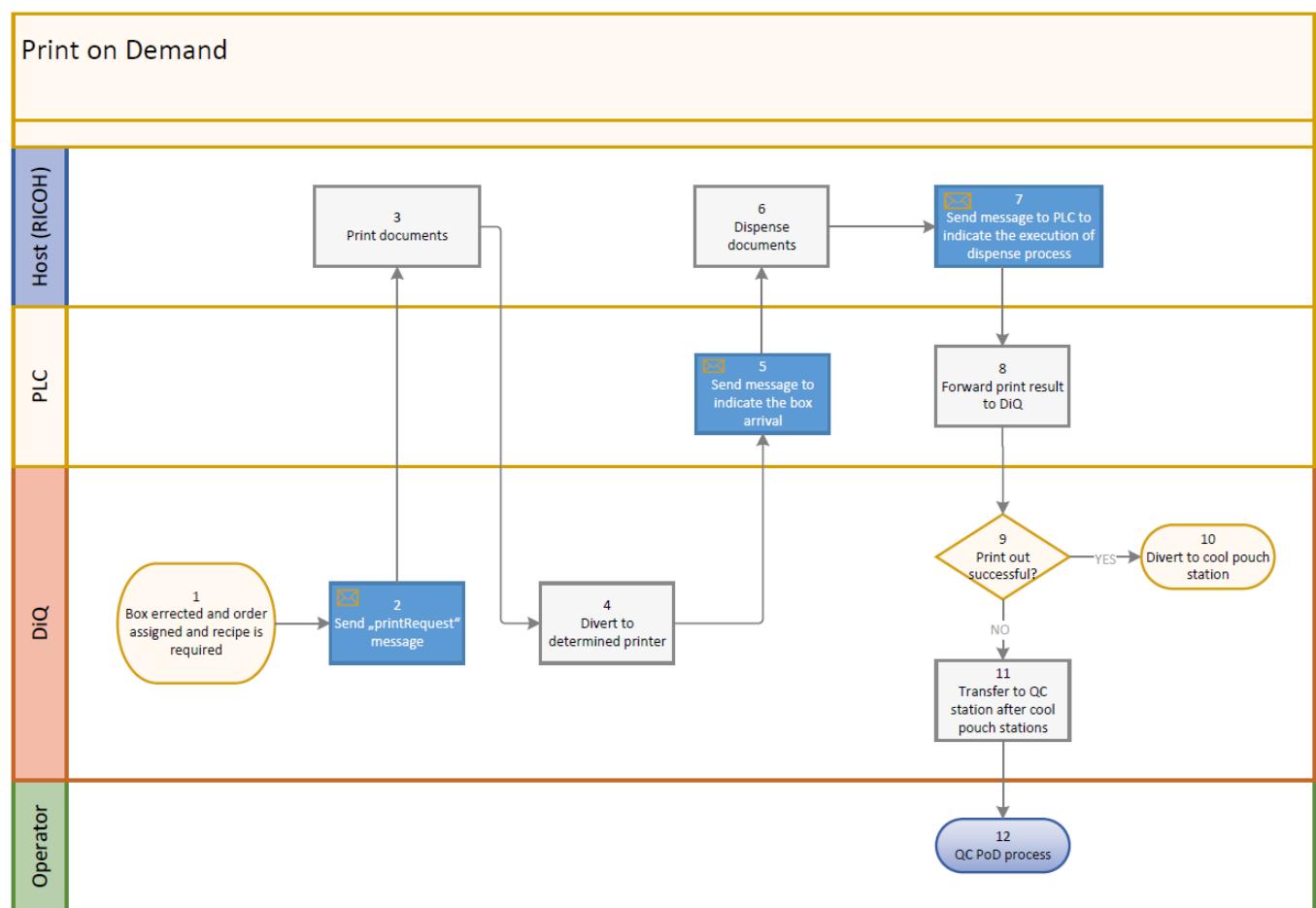
For all error cases in carton erector area there is only one workflow designed for operator on the QC workstations located after barcode applicators. Operator removes the cartons from QC workstation and handle these according to the process “Manual infeed of cartons” (see change request RFC-187186-38).

For these QC workstations there are no screens planned to be installed. Operator clarifies the errors in this area without support of DiQ processes.

WCS has to place order number back into order pool (if order number was assigned) and delete LPN barcode from the system

9.2 Printing of Recipes

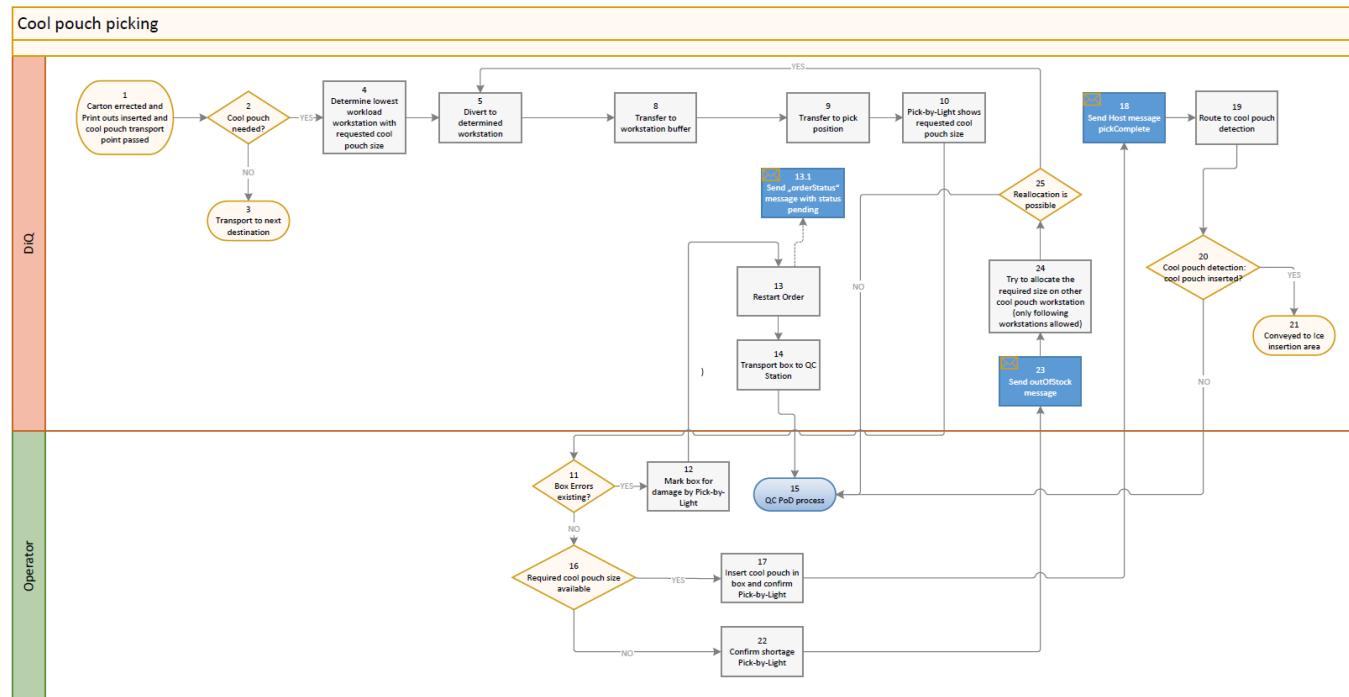
This process is only necessary if the recipe is requested by the order. Otherwise the box will pass the print on demand area without any communication to the printers.



Step	Description
1	Check of recipes is only necessary if the box was successfully erected and the order requires recipe cards
2	If the carton successfully connected to the order, DiQ requests printing of PDF on the line of carton
3	RICOH triggers the printing of document for the order
4	DiQ transports the box to printers location. Both printers in line share the same automation, therefore the box stops at the same location independent of the printer used.
5	When the box arrives the printer location PLC informs the host to drop off the PDF into the box
6	RICOH decides which printers is responsible for this order. Determined printer dispenses the document into the box
7	RICOH informs PLC about the result of drop off to decide the next destination
8	PLC forwards the result of printing to DiQ

Step	Description
9,10	If the PDF is created and dropped off into the box successfully, DiQ transports the box to cool pouch area
9,11	In case of errors in print on demand area DiQ restarts the order and transports the box to next QC station. As new requirement for this case, PLC must indicate the printer that create the error. DiQ must display in the printer ID in NOK station
12	Operator clarifies the box according to clarification process described in 9.5

9.3 Cool Pouch Insertion



Step	Description
1	After successfully inserting of receipts the box will be directed to cool pouch area
2	DiQ checks the order data concerning cool pouches
3	If no cool pouches are required, DiQ transports the box to next destination area.
4	For orders which require cool pouches DiQ determines one workstation based on the availability of required cool pouch size and current workload. DiQ will balance the assignment of boxes to cool pouch workstations. If a box reaches a workstation that can't be entered (buffer full or station closed) DiQ recalculates the next destination. If the station not reachable is the last station the box goes to the QC. The line stops if all cool pouch workstations are full.

Step	Description
5	Box will be transported to the determined workstation
8	The box enters the buffer of workstation
9	When the box arrives the pick position of workstation, the picking of cool pouch can be started
10	Pick by Light displays the requested cool pouch size which is determined by host as order line criteria
11	The operator checks the quality of the box.
12,13	If the operator marks the box as damage by Pick by Light, DiQ returns the order in order pool and restarts it once again
13.1	DiQ informs the host about the restart of order by sending the message orderStatus with status pending
14,15	The damage box will be transported to QC workstation to clarify it according to QC process. See 9.5
16, 17	If the requested cool pouch size is available the operator puts the cool pouch into the boxes and confirms by Pick by Light
18	DiQ confirms the picking of cool pouch to the WMS
19	Box will be routed to cool pouch detection point
20	If cool pouch detection failed the box will be transported to QC workstation to clarify it according to QC process. See 9.5
21	If the box passes the cool pouch detection point, the box will be transported to Ice Area Cool pouch detector sensor can be enabled or disabled in WCS. This can be done only by the superuser in a WCS UI. Enabled: The Sensor check for the content and divert boxes to NOK station in case the pouch is missing or it was added when not required Disabled: The boxes will not be checked and no action will be taken
22	If the requested size is not available the operator confirms the out of stock for this size by Pick By Light in this workstation
23	DiQ informs the WMS about the out of stock of missing size on this workstation so that the host can trigger the replenishment
24	DiQ tries to find the required size on other cool pouch workstation on the same line
25	If the required size is available on the same line continue to step 5. Otherwise the box will be transported to QC workstation to clarify it according to QC process. See 9.5

9.4 Coupon Dispenser

9.4.1 Interfaces

1. All coupon dispenser communication with Coupon Dispensers happens at PLC level.
2. There is no direct communication between WCS and RPD for the dispense of the assets.
3. The stock availability (OoS or in stock) and dispenser availability is determined by PLC Dematic (see PLC specification)
4. Confirmations and errors are also determined via PLC Dematic

9.4.2 Coupons data and location:

1. The coupons will be sent from host as order line by order message
2. A Dispenser can only hold one SKU
3. The location of the coupons is set with an replenishmentComplete message.
4. There are 2 groups of 3 dispensers. It is planned to have a total of 3 different SKUs. Each group could be different (different sequence of SKUs and missing SKU in case of dispenser failure within a group). That means each dispenser will be defined in WCS as a location to handle the dispensing process by picking and replenishment same as with other area.

9.4.3 Process

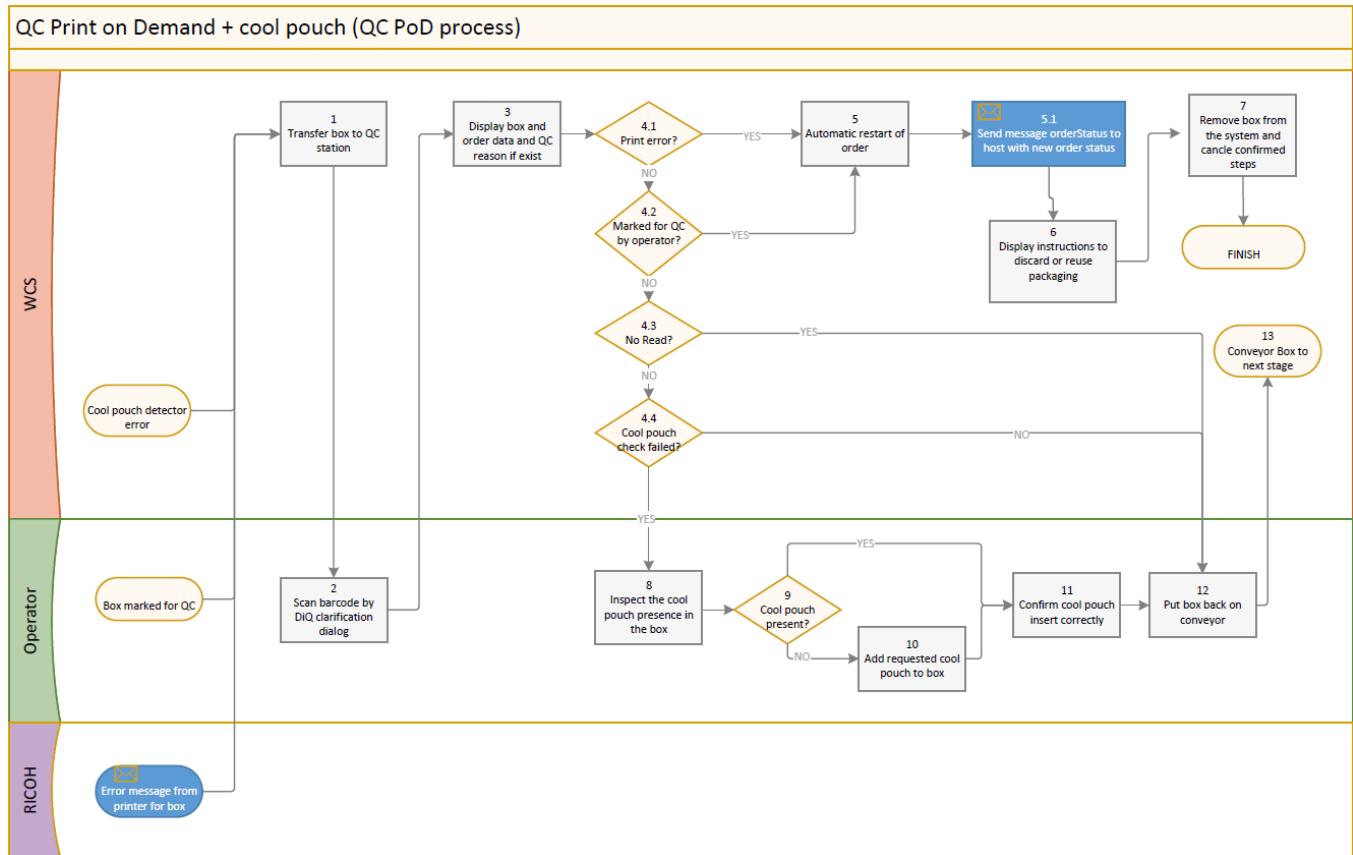
1. WCS checks SKU availability of coupons in the dispensers reachable
2. WCS erects only boxes where the requested coupons is available in the system
3. WCS erects boxes with requested coupons in the system.
4. WCS sends information to Dematic PLC about required coupons and their locations.
5. PLC triggers coupon dispensers according to data from WCS
6. Dispensers send confirmation/error to PLC and PLC forwards it to WCS.
7. WCS record errors and confirms all coupon order lines independent of the status of the dispenser. That means if the dispensing of coupons was not successfully, DiQ will confirm this order line as picked.

9.5 QC Workstation after Cool Pouch Area

Boxes can be routed cause of following reasons to QC workstation located after cool pouch area:

- **Error determined by RICOH printers:** this error can occur by printing of receipts in print of demand area. DiQ receives an error message with faulty printer from PLC and transports the box to QC workstation. The specified printer will be displayed as part of error message on QC station screen
- **Error determined by cool pouch detector:** PLC sends to DiQ a status message about the presence of cool pouch in the box. DiQ checks by order data if cool pouch is requested for the order. If cool pouch is needed to fulfill the order and the cool pouch detector don't confirm the presence of cool pouch in the box, DiQ will transport the box to QC workstation.
- **Box misses cool pouch station:** the same workflow as the error determined by cool pouch detector.
- **Box marked by operator for QC:** operator can mark the box as damage in cool pouch insertion workstation by Pick By Light. DiQ will transport the box to QC workstation.
- **No Read**

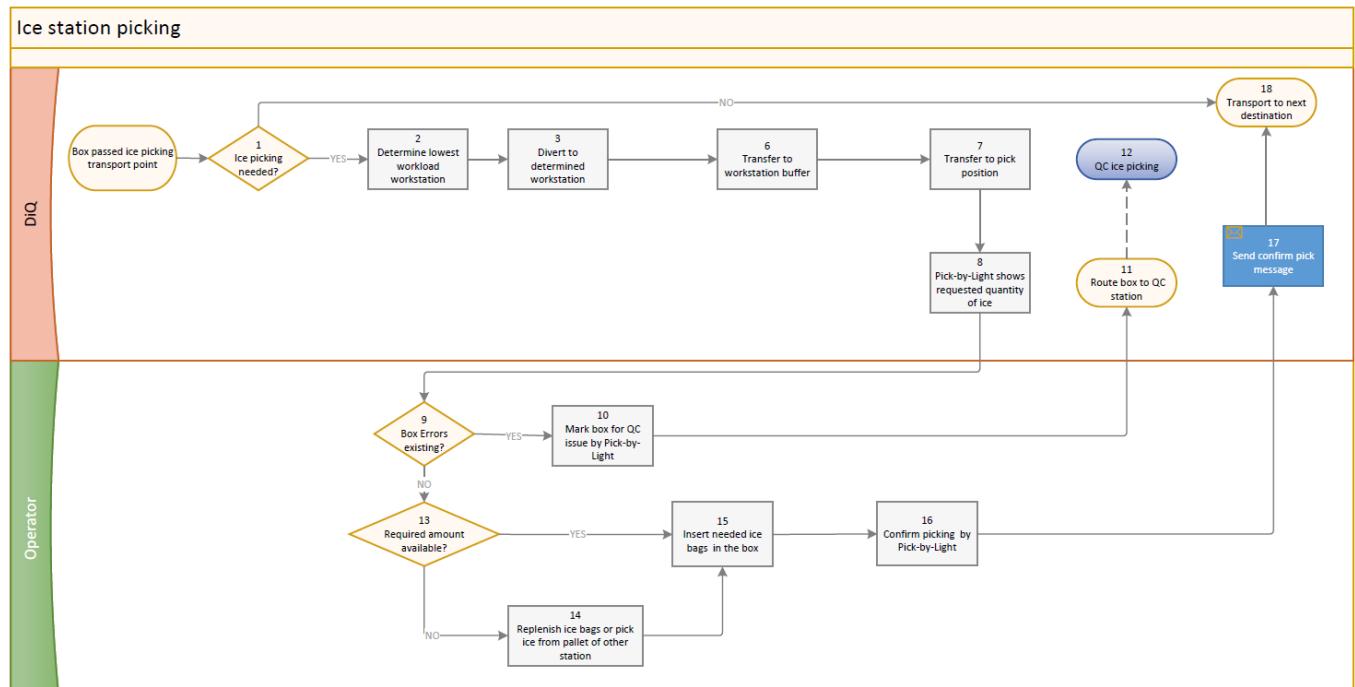
These reasons can be clarified individually. The clarification way of each error is included in the following diagram and described in more detail below.



Step	Description
1	After an error is detected, DiQ transports the box to QC workstation
2	The operator scans the box in DiQ clarification screen
3	DiQ clarification dialog shows the error reason and enable the clarification functions based on the error case
4.1	If print error is confirmed by RICOH, DiQ clarification screen displays the reason of rejection and hint how to handle the box e.g. "Please confirm the removal of the box from the line to reuse it for other order". Such boxes can be handled according to the process "Manual infeed of cartons" (see change request RFC-187186-38). proceed to step 5
4.2	If the box marked as damage, DiQ clarification screen displays the reason of rejection and hint how to handle the box e.g. "Box is damage. Please confirm the removal of the box from the line. Box cannot be reused". proceed to step 5
4.3	In case of No Read DiQ shows the data of box and order. NO error will be display. The operator will proceed to step 12
5	For error cases 4.1 and 4.2 DiQ will restart the order at the moment of the event (this is before and independent of the scan in the QC station). For that the relation between order and box will be removed and DiQ adds the order again to order pool. Order status returns back to pending

Step	Description
6	DiQ informs the host about the change of order status
7	DiQ removes the box data and cancel the already confirmed steps to start the order once again (This happens automatically together with step 5)
4.4	If DiQ evaluates the cool pouch check as failed DiQ clarification screen displays the reason of rejection and the hint how to handle the box e.g. "cool pouch size M is missing! Please inspect the cool pouch presence in the box"
8	The operator checks the presence of cool pouch
9	If the cool pouch exists in the box proceed to step 11
10	If the cool pouch is missing the operator add the requested size in the box
11	The operator confirm the presence of cool pouch in DiQ Clarification Dialog. If the cool pouch picking is confirmed to the host before by cool pouch pick station, then no pick confirm message to host is required. Otherwise DiQ sends confirmation message to the host
12	The operator puts the box on the conveyor
13	DiQ transports the box to ice picking area

9.6 Ice Stations



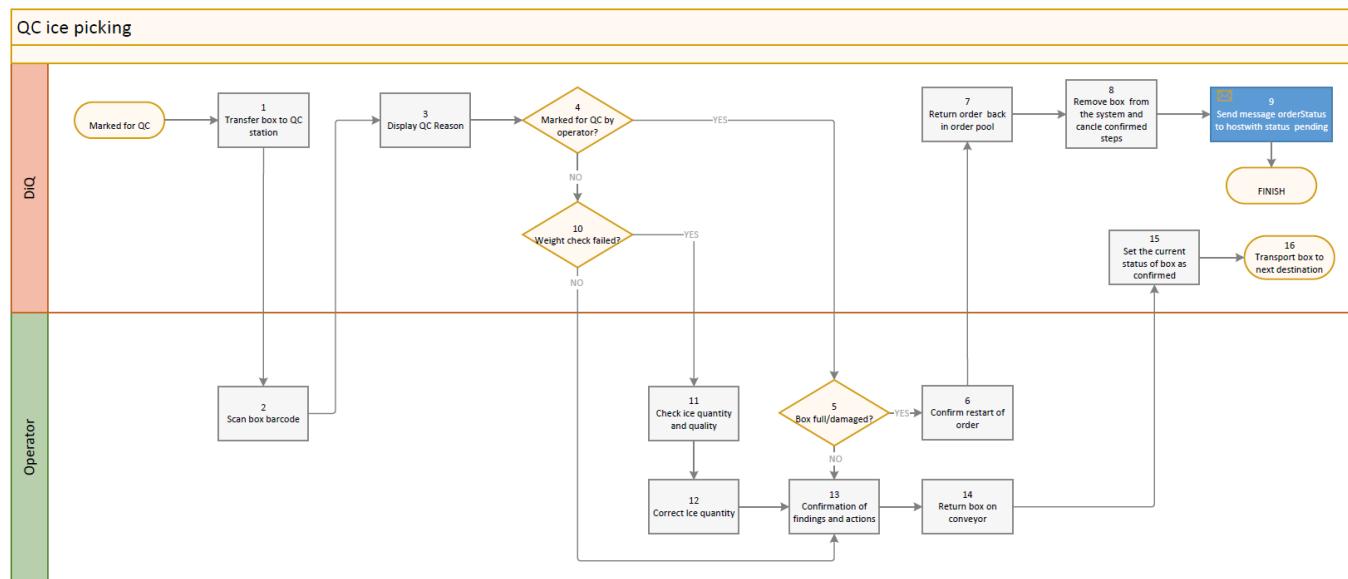
Step	Description
1	After the box passes the ice picking transport point DiQ checks order data if the ice bags requested for the box. If no ice is required, DiQ transports the box directly to next destination area

Step	Description
2	For orders which require ice bags DiQ determines one workstation based on the current workload. DiQ will balance the assignment of boxes to ice picking workstations. DiQ will not consider ice stations without free capacity of buffer. The line stops if ice stations are full.
3	Box will be transported to the determined workstation
6	The box enters the buffer of workstation
7	When the box arrives the pick position, the picking of ice can be started
8	Pick by Light displays the quantity of requested ice bags
9	The operator checks the quality of the box and the cool pouch present.
10	In error case the operator marks the box for QC by Pick by Light
11,12	The box will be transported to QC workstation to clarify it according to QC process. See 9.6.1
13, 14	If the needed ice bags is not available the operator has to get the missing quantity by replenishment of ice bags or from other workstation.
15	The operator puts the requested ice bags in the box
16	The operator confirms the picking of ice by Pick By Light
17	DiQ confirms the picking of ice to the WMS
18	Box will be routed to next area

9.6.1 QC Ice Picking

Boxes can be routed to QC workstation located after ice picking area cause of weight mismatching or the box is marked for QC by operator in ice station.

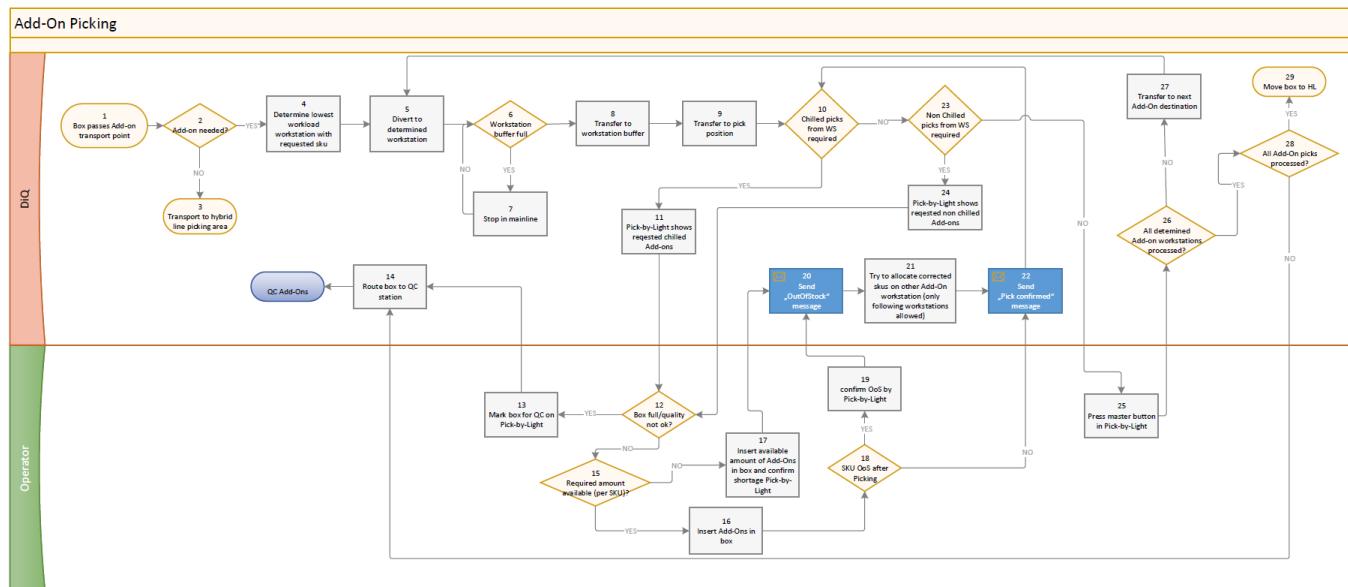
The clarification way of each case is included in the following diagram and described in more detail below.



Step	Description
1	If the box marked for QC by operator or by weight control, DiQ transports the box to QC workstation
2	The operator scans the box in DiQ clarification screen
3	DiQ Clarification Dialog shows the error reason and enables the clarification functions based on the error case
4	If the box marked for QC by operator in ice picking workstation, DiQ clarification screen displays the reason of rejection and how to handle the box e.g. "please check the quality of box and confirm the restart of order if necessary"
5,6	If the box is damage or full the operator confirms the restart of order. If not proceed to 13
7,8	DiQ executes the restarting process of order. For that the relation between order and box will be removed and DiQ adds the order again to order pool. Order status returns back to pending. DiQ cancels the already confirmed steps to start the order once again
9	DiQ informs the host about the change of order status (this happens when the error is recorded and previous to scanning the barcode in QC)
10	If the weight of box is mismatched, DiQ clarification screen displays the reason of rejection and how to handle the box e.g. "the box weight doesn't meet the expected weight. Please check the ice quantity and quality". If no error can be found proceed to 13
11	The operator checks the content of box
12	The operator correct ice quantity if necessary
13	The operator confirms the clarification of box. No message is needed.
14	The operator puts the box on the conveyor after Ice station no. 10 before the scales.

Step	Description
15	The weight of the box is measured again and matched to the contents of the box confirmed by the operator. The current (new) weight must be stored in the system as Tara.
16	DiQ transports the box to destination area.

9.7 Add-On Stations

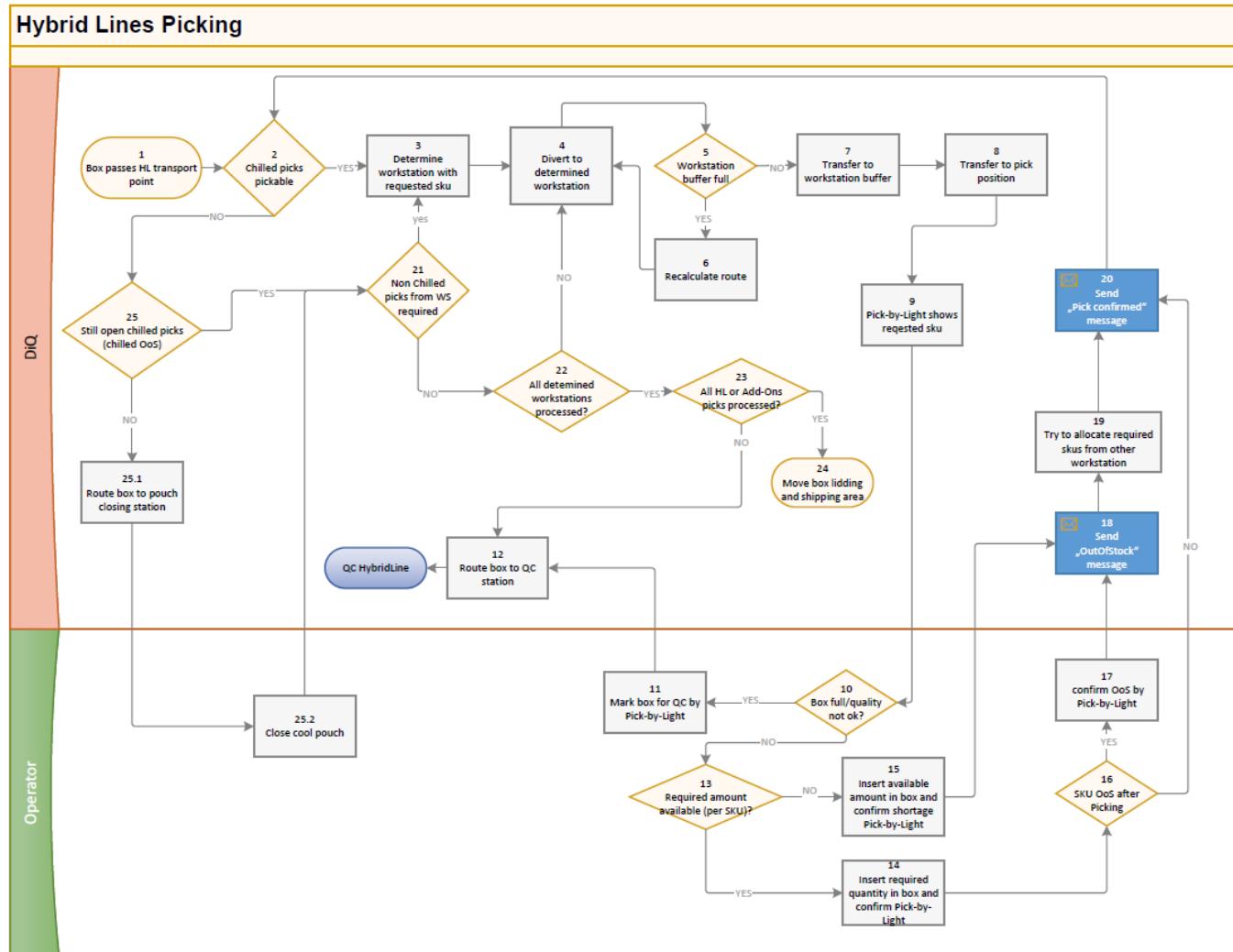


Step	Description
1,2	After the box leaves the ice picking area and directed to Add-on area, DiQ checks order data if the Add-Ons are requested.
3	If no Add-Ons are required for the order, DiQ transports the box directly to hybrid line area
4	For order requested Add-Ons DiQ determines the Add-On workstations based on Minimum Cost Routing Algorithm (MCA). See 9.15.5. DiQ will balance the assignment of boxes to Add-On workstations.
5	Box will be transported to the determined workstation
6	DiQ checks the current status of workstation buffer
7	If the buffer is full the box will stop in mainline in front of the station. That will block the line till the buffer get free capacity
8	The box enters the buffer of workstation
9	When the box arrives the pick position, the picking of Add-Ons can be started

Step	Description
10	As special requirement , chilled Items must be picked first. For that DiQ checks if picking of chilled items is planned from current workstation. If yes proceed to step 11, if not proceed to step 23.
11	The operator will be oriented by Pick by Light to start first with picking of chilled Add-Ons. Pick by Light will be extended to have a visual indication of chilled picks. One of following possibilities will be implemented: <ul style="list-style-type: none"> - Display the chilled picks first and then the non-chilled picks with different colors. Confirmation in master Pbl button required to change from chilled picks to non chilled picks (box is not leaving the station) - Or chilled and non-chilled picks will be displayed at the same time but in two different color <p>Dematic will decide for one of these both options in software design phase and agreed HelloFresh team about the possible option</p>
12	The operator checks the quality of the box or if the box is full or will be full after the current picks
13	If the box is not suitable to fulfill the order, the operator marks the box for QC by Pick by Light
14	The box will be transported to QC workstation to clarify it according to Add-On QC process. See 9.11.1
15,16	If the reserved Add-On is available the operator puts the Add-Ons in the box and confirms by Pick by Light. Proceed to 18
17	If the requested quantity is not available the operator puts the available amount in the box and confirms short picking by Pick by Light. By short picking DiQ marks the channel automatically as out of stock. Proceed to 20
18	The operator checks if the channel will be out of stock after the confirmation of current pick. If yes proceed to step 19, if not proceed to step 22.
19	If the channel is out of stock the operator confirms by Pick by Light
20	DiQ informs the WMS about out of stock of channel so that the host can trigger the replenishment for it
21	DiQ tries to find the missing quantity from other Add-On workstation on the same line
22	DiQ confirms the picked quantity of Add-On to the host and proceed with step 10 to start the next pick from current Add-On workstation
23	If no pick of chilled items is open from workstation, DiQ checks if picking of non-chilled items is planned from the same workstation. If yes proceed to step 24, otherwise proceed to step 25.
24	If the order requires non-chilled Add-Ons, Pick by Light shows the picks and the operator can pick the non-chilled items starting from step 12
25	After processing of all picks planned from current workstation the operator confirms by central Pick By Light (Bay Display) that all picks are confirmed and the box can move to next destination
26	DiQ determines the next Add-On workstation planned for the order
27	If further Add-Ons are planned to be picked from other Add-On workstation, DiQ transports the box to the next workstation

Step	Description
28	If no further Add-On workstation is determined, DiQ double checks if all Add-On picks are successfully confirmed. If DiQ could not reallocate Add-On items for the shorted picks, the box will be transported to Add-On QC workstation to clarify it according to Add-On QC process. See 9.11.1
29	If all Add-On picks are successfully processed the box will be routed to hybrid line area

9.8 Picking Lanes



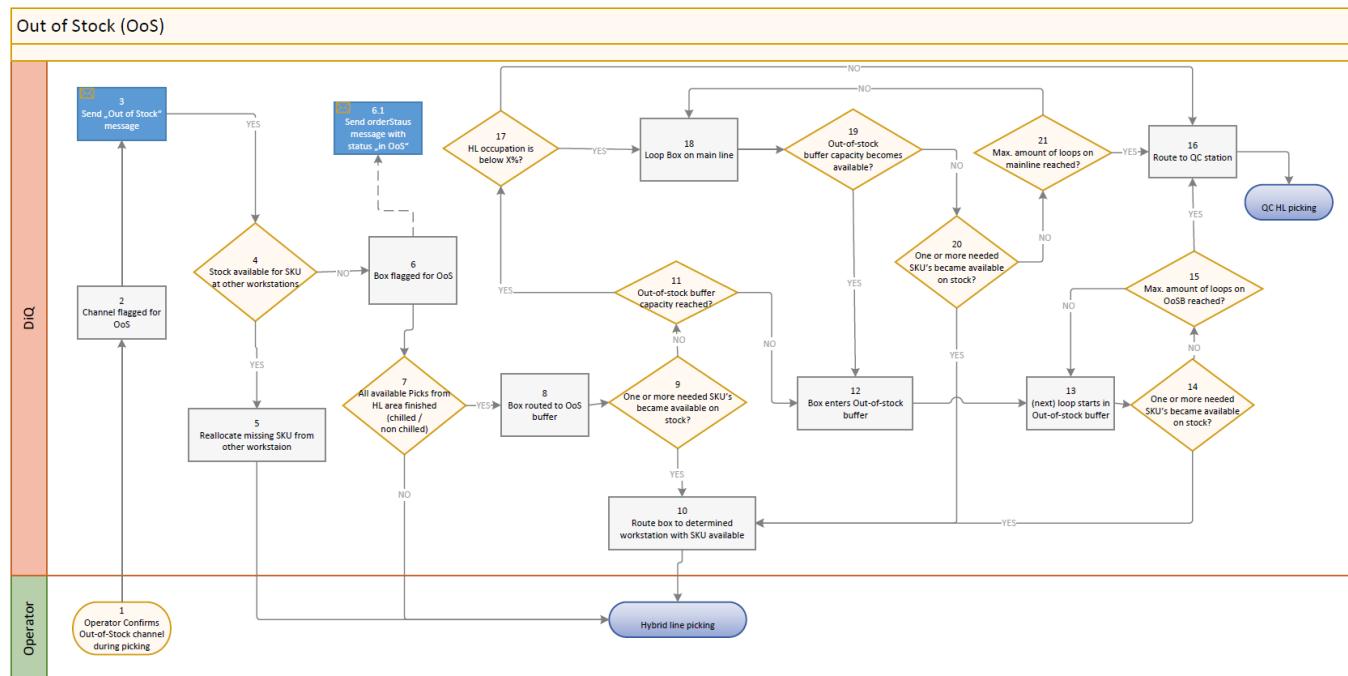
Step	Description
1,2	After the box leaves the add-on area and directed to hybrid line area, DiQ checks order data concerning the requested SKUs. The Picking of chilled SKUs will be started first. For order contains chilled SKUs proceed to step 3, otherwise proceed to step 21
3	DiQ determines the picking workstations for requested SKUs based on Minimum Cost Routing Algorithm (MCA). See 9.15.5
4	Box will be transported to the determined workstation
5	DiQ checks the current status of workstation buffer
6	If buffer is full the box continues moving and the route will be recalculated.
7	Otherwise the box enters the buffer of workstation
8	When the box arrives the pick position, the picking of reserved SKUs can be started
9	Pick by Light shows the requested SKUs and the quantity to be picked from current workstation
10	The operator checks the quality of the box or if the box is full or will be full after the current picks
11	If the box is not suitable to fulfill the order, the operator marks the box for QC by Pick by Light
12	The box will be transported to QC workstation to clarify it according to hybrid line QC process. See 9.11.2
13,14	If the reserved SKU is available the operator puts the SKUs in the box and confirms by Pick by Light. Proceed to step 16
15	If the requested quantity is not available the operator puts the available amount in the box and confirms short picking by Pick by Light. By short picking DiQ marks the channel automatically as out of stock. Proceed to 18
16	The operator checks If the channel will be out of stock after the confirmation of current pick. If yes proceed to step 17, otherwise proceed to step 20.
17	If the channel is out of stock the operator confirms that by Pick by Light
18	DiQ informs the WMS about out of stock of channel so that the host can trigger the replenishment for it
19	DiQ tries to find the missing quantity from other workstation on the Hybrid line. Box will be transferred to determined workstation where the SKU is available
20	DiQ confirms the picked quantity to the host. The same steps will be processed for the next picks
25 25.1, 25.2	After picking of available chilled items DiQ checks if all requested chilled SKUs are picked successfully and no missing chilled SKU for the order. If that is the case, the box will be routed to cool pouch closing station. Operator closes the cool pouch. If some chilled SKU cannot be picked because of Out of stock, the cool pouch closing must not be executed and the box goes to the NOK. This includes chilled SKUs from the add-on section.

Step	Description
21	If no pick for chilled items is open, the picking of non-chilled SKUs can be started. DiQ checks if picking of non-chilled items is required. If yes proceed to step 3, otherwise proceed to step 22.
22	If further picks are planned to be picked from other workstation, DiQ transports the box to the next workstation. For example out of stock SKUs which got available in the mean time.
23	DiQ double checks if all hybrid line picks and Add-On picks are successfully confirmed. If the order still has short picks which cannot be fulfilled from other workstations, the box will be transported to the next destination according to the conditions which described in 9.8.1
24	If all expected picks from hybrid line and Add-Ons are successfully processed the box will be routed to the lidding and shipping area

9.8.1 Out Of Stock in hybrid line area

This section provides an overview about the life cycle of out of stock boxes from flagging the channel as out of stock to routing the box to QC workstation.

The handling of out of stock boxes in QC workstation will be described in 9.11.3



Step	Description
1	If one channel gets empty, the operator confirms the out of stock for related SKU by Pick By Light

Step	Description
2	DiQ marks the channel as out of stock and ignore it for other orders which require the assigned SKU
3	Host receives from DiQ an "Out of Stock" message to trigger the replenishment of missing SKU for the channel
4	DiQ checks if the missing SKU is available at other workstation
5	If the SKU is available in the warehouse, DiQ plans the picking of SKU from other workstation and proceeds with next picks according to hybrid line picking process.
6, 6.1	In case that this SKU is out of stock system wide, DiQ marks the box as out of stock and sends orderStatus message with status "in OoS"
7	If other picks from hybrid line area still open and have to be executed, DiQ route the box to next picking workstation
8	If all pickable SKUs are picked and the order has only out of stock order lines, DiQ routes the box to out of stock buffer
9,10	On the way to out of stock buffer DiQ checks if one or more out of stock SKUs is became available. If such SKUs requested by the order, DiQ routes the box to determined workstation. The operator continues with picking according to hybrid line picking process.
11	Before the box enter the out of stock buffer, DiQ checks the capacity of out of stock buffer. If the maximum capacity is not reached proceed to step 12, otherwise proceed to step 17. The max capacity of the out of stock buffer is a configurable parameter that can be set by the superuser in the UI.
12, 13	Box enters the out of stock buffer and start looping. DiQ control the looping of each box in out of stock buffer. The box is allowed to loop in out of stock buffer till one SKU became available or the configured staging time in the loop is reached.
14	During the looping of box in out of stock buffer if one or more out of stock SKUs is became available, DiQ routes the box to workstation with required SKU and the operator continues with picking according to hybrid line picking process.
15	If no out of stock SKU became available the box continue with looping in out of stock buffer till the max staging time in the loop is reached. If the max staging time in the loop is reached DiQ routes the box to one of hybrid line QC workstations. New Requirement: Alarm which will inform the control tower which boxes have been staged more than Y minutes in out of stock buffer.
16	The box will be clarified according to QC HL Picking process (see 9.11.3) Following priorities will be considered by determination of hybrid line QC workstation: 1. QC workstation has already boxes with same out of stock SKU 2. Balancing of hybrid line QC workstations

Step	Description
17	In case of no free capacity of out of stock buffer DiQ checks the capacity of whole hybrid line system to determine the next destination of the out of stock box, this implies looping the box in the system if needed. If the hybrid line occupation exceeds the configured level, DiQ routes the box to one QC workstation.
18	If the hybrid line occupation below the configured level the box circulates on the main line. DiQ controls the looping of each out of stock box on main line. The box is allowed to loop on main line till one SKU became available or the configured looping count is reached. Looping count parameter is adjustable by the super user and can be set from 0-1000. 0 means it is not allowed to loop and has to exit to buffer to the QC station immediately. 1000 means virtually it is allowed to loop for unlimited time
19	During the circulation of box in main loop if out of stock buffer became free capacity the box will be routed to out of stock buffer
20	If one or more out of stock SKUs became available which are needed by one box on main loop, DiQ routes the box to determined workstation and the operator continues with picking according to hybrid line picking process.
21	If no out of stock SKU became available the box continue with looping on main line till the max loops count is reached or a space in the OoS buffer is available in which case the box is routed to OoS buffer. If the max amount of loops is reached DiQ routes the box to QC workstation.

Out of stock capacity and SKU availability will be checked constantly during the travel of the box.

Special Requirement:

Following are some additional actions which can applied by superuser during the described process above:

- The superuser can select a specific set of orders (e.g. all with cut off time 12:00 and OoS SKU 123) and mark the SKU 123 as not needed anymore for all orders. This action will release all the affected boxes in the buffer, stations and looping marked as out of stock. The boxes will then be fulfilled according to the standard process. This applies for orders in the out of stock buffer and also for boxes before releasing.
- Superuser can select all orders with OoS flag and with a specific SKU and select a destination QC station. The boxes then are released and routed to the selected QC station.

9.9 Scales and weight control Ice, Add-on and Hybrid Line

Scales in Hybrid Line and Add-On have the task to detect weight deviation that might indicate a missing or additional picks at each picking step of the box.

Scales will be grouped by area as follow:

1. Ice: 2 scales
2. Add-Ons: 1 scale
3. Chilled SKUs (Proteins): 2 scales
4. Non-Chilled (Meal kits): 5 scales

9.9.1 Scales weight check process

Scales will have two operation modes

1. ENABLED: The weighing considers every SKUs which was placed within the box since the last weight control. If the box weight is within tolerances the box passes, otherwise it fails and will be transported to the next QC workstation.
2. DISABLED: Weight is recorded but no action is taken. In case the weight check does not match the weight will be stored in WCS but the box will not be diverted to NOK.

Each time a box passes over a scale, the picks which are done after the last weight check, should be evaluated by the current scale.

This also applies for boxes after being checked in QC stations. The operator can correct the box content by adding or removing SKUs and place the box on the line before the scale. The weight of the box is measured again and matched to the contents of the box confirmed by the operator. The current (new) weight must be stored in the system as Tara

The tolerance is applied only to the picks done between last weight check and current check. Tolerances are set by group of scales. This means that the Non-Chilled scales all have the same tolerance. Tolerances are defined in percentage and are the same for all boxes. For example all boxes in ice have 10%.

Upper and lower tolerances are independently adjustable by the Super User with the system running. (e.g. the Add-On scale -2% / +10%)

Every weight check is recorded and is consistent for all boxes. E.g. Boxes with and without Add-Ons are checked in the Add-On area

9.9.2 Gross weight for check

The scales weight check process needs the total weight of SKU. This weight will be sent by the host, does not interface with any external system. The superuser has the ability to modify the total weight of each individual SKU in WCS while the system is running. The total weight is overwritten every time the SKU data is sent.

If Gross weight of one SKU is not defined in DiQ (empty or equal 0.0), this SKU cannot be used for order fulfillment. Orders which require such SKUs cannot be released. Otherwise all boxes which contain such SKU will be routed to QC station cause of weight mismatching.

9.10 HelloFresh Pick By Light Solution

This chapter describes the picking use cases from point of view of HelloFresh and the expected steps to fulfill the picking process by pick by light.

9.10.1 Central picking with orientation

State	Action	Pick By Light
1. Box arrives	WCS displays remaining faces	
2. Pick displayed on MaxiPick	Operator confirms pick on rack location	
3. After confirm	WCS displays remaining pick faces	
4. All open picks from workstation are confirmed	WCS turns off display and enable button for confirmation	
5. Box is ready to be pushed	Operator confirms box finished WCS moves box to next station	

9.10.2 Mark box for QC

State	Action	Pick By Light
1. Box in picking position	WCS displays quantity pending SKUs to be picked	
3. Box has problem	Operator marks box as needing QC inspection	
3. QC message	WCS displays message and enables button for confirmation	

State	Action	Pick By Light
4. waiting operator confirm	Operator confirms box finished WCS moves box to QC station	

9.10.3 Unmark box for QC

State	Action	Pick By Light
1. Box is marked for QC	WCS displays message and enables button for confirmation	
2. Box status is ok	Operator unmarks box	
3. Unmark QC confirmed	WCS displays pending SKUs picks and disable box finished button (or if all done enable button)	

9.10.4 Complete pick then mark as out of stock

State	Action	Pick By Light
1. Requested quantity reserved from rack slot	WCS displays quantity of current pick, turns on light	
2	Operator confirms pick	
3. Rack slot is out of stock	Operator marks pick face as out of stock	
4. out of stock confirmed	WCS displays blinking out of stock	

The operator can mark a pick face as out of stock (state 3 and 4) also when the pick face is not required by the box in the pick position and without a box in the station. If the picking of one order is already active on the workstation and the number of picks is displayed in the maxi pick the action button will be disabled and an OoS can be marked only by confirming a short pick (0 or less quantity than required). After this the action button will be enabled again and clearing OoS will be possible. See 9.10.5 and 9.10.6.

Boxes in the workstation buffer requiring only one SKU that has been marked as OoS in the same workstation, will exit the station without stopping at the picking position.

9.10.5 Short picking

State	Action	Pick By Light
1. Requested quantity reserved from rack slot	WCS displays quantity of current pick, turns on light	
2 Quantity available is less than required	Operator decreases amount picked and confirm	
3. Short picking confirmed	WCS displays blinking out of stock	

9.10.6 Unmark out of stock

State	Action	Pick By Light
1. Rack slot is marked as OoS	PTL blinking out of stock	
2. Replenishment of SKU executed and SKU is back in stock	Operator marks SKU as back in stock	
3. Back on stock confirmed	WCS removes message	

9.10.7 Display Workstation status

Pick by Light will display the following different status of workstation

Station status	Description	Pick By Light
Closed	Workstation is closed	
Active not manned	Workstation is active and no user logged in	
Active manned	Workstation is active and a user logged in	

9.11 Quality Check Process on NOK Workstations

this will be a CR to be delivered after GoLive

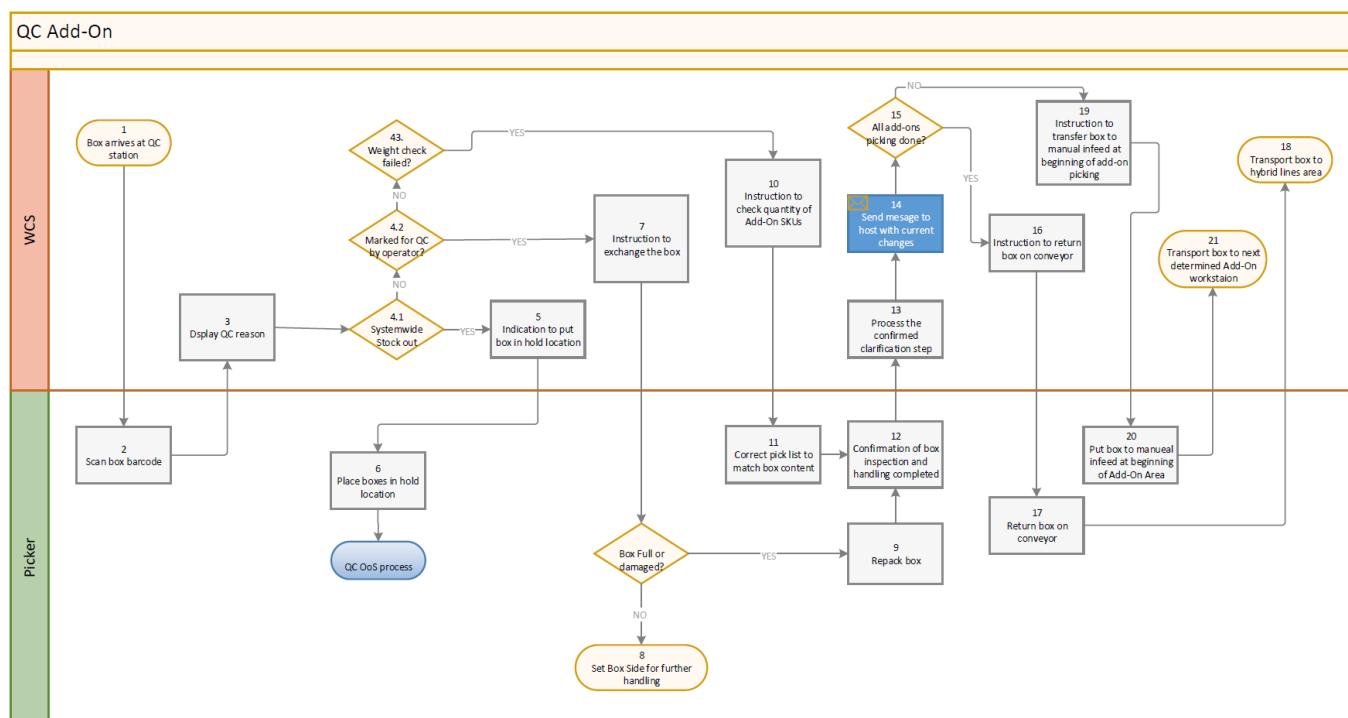
9.11.1 QC Add-On

Boxes can be routed to QC workstation of Add-On area cause of weight mismatching, the box is marked for QC by operator during Add-On picking or out of stock of required Add-On.

For QC clarification a project specific StepByStep dialog will be implemented which covers the different clarification functions for each QC reason (see 9.11.4).

The handling of out of stock boxes on QC station will be described in 9.11.3

The clarification way of other error cases is included in the following diagram and described in more detail below.



Step	Description
1	Box arrived Add-On QC station and operator can start the clarification process by QC Operation Dialog, see 9.11.4
2	The operator scans the box barcode in QC Operation Dialog.

Step	Description
3	QC Operation Dialog shows the error reason and enables the clarification functions based on the QC case. If DiQ don't show any error reason the operator has to check the barcode and DiQ Alarm Monitor concerning No Read on the line.
4.1, 5	If one of requested Add-On marked as out of stock DiQ shows hint to put the box in hold location
6	The operator take the box out of QC workstation and place it OoS hold location. The hold locations will be not managed by DiQ and will be handled as virtual location. The operator will handle OoS boxes according to QC OoS process. See 9.11.3 The operator has the option to confirm the starting of picking from hybrid lines although some of Add-Ons are out of stock. For that the operator has to flag box. Only in this case DiQ allows the transport of box to hybrid line area with missing Add-Ons. The Add-On out of stock will be handled afterward on hybrid line QC stations
4.2, 7	If the box marked for QC by operator in Add-On picking workstation, QC Operation Dialog displays the reason of rejection and instruction to handle the box e.g. "Exchange the box"
8	If the operator cannot determine any problem on the box, the operator puts the box side and informs the supervisor for further handling. Otherwise proceed to step 9.
9	The operator executes a repack process by follow the dialog steps: - bring new box with bigger size - print new barcode - put ingredients in new box - scan barcode of new box to connect it to the order - discard old box Proceed to step 12
4.3, 10	If the box marked for QC by scale check because weight of box is mismatched, QC Operation Dialog displays the reason of rejection (overweight or underweight) and instruction to handle the box e.g. "please check the quantity of Add-On SKUs"
11	The operator checks the pick list of Add-Ons and compares these with the box content. The operator indicates the cause of mismatching and take the suitable action according to the clarification steps described in 9.11.4
12	After the clarification of the box is finished, the operator confirms the completion of inspection
13	DiQ processes the confirmed steps in QC Operation Dialog
14	DiQ confirms the changes to the host by orderStatus message with new loadUnitId
15	DiQ checks if all Add-Ons are picked successfully and no picks or missing quantity still open for the order. If all Add-Ons are completely picked then proceed to step 16. Otherwise proceed to step 19.
16	DiQ displays instruction to return the box on conveyor

Step	Description
17	The operator corrects the box content by adding or removing SKU and places the box on the line before the scales. The weight of the box is measured again and matched to the contents of the box confirmed by the operator. The current (new) weight must be stored in the system as Tara
18	DiQ routes the box to hybrid lines area
19	If Add-Ons picks still open, DiQ displays instruction to return the box to the manual infeed at beginning of add on area to continue with next picking of the other requested Add-Ons
20	The operator puts the box on conveyor at beginning of add on area
21	DiQ determines the next Add-On workstation and transport the box.

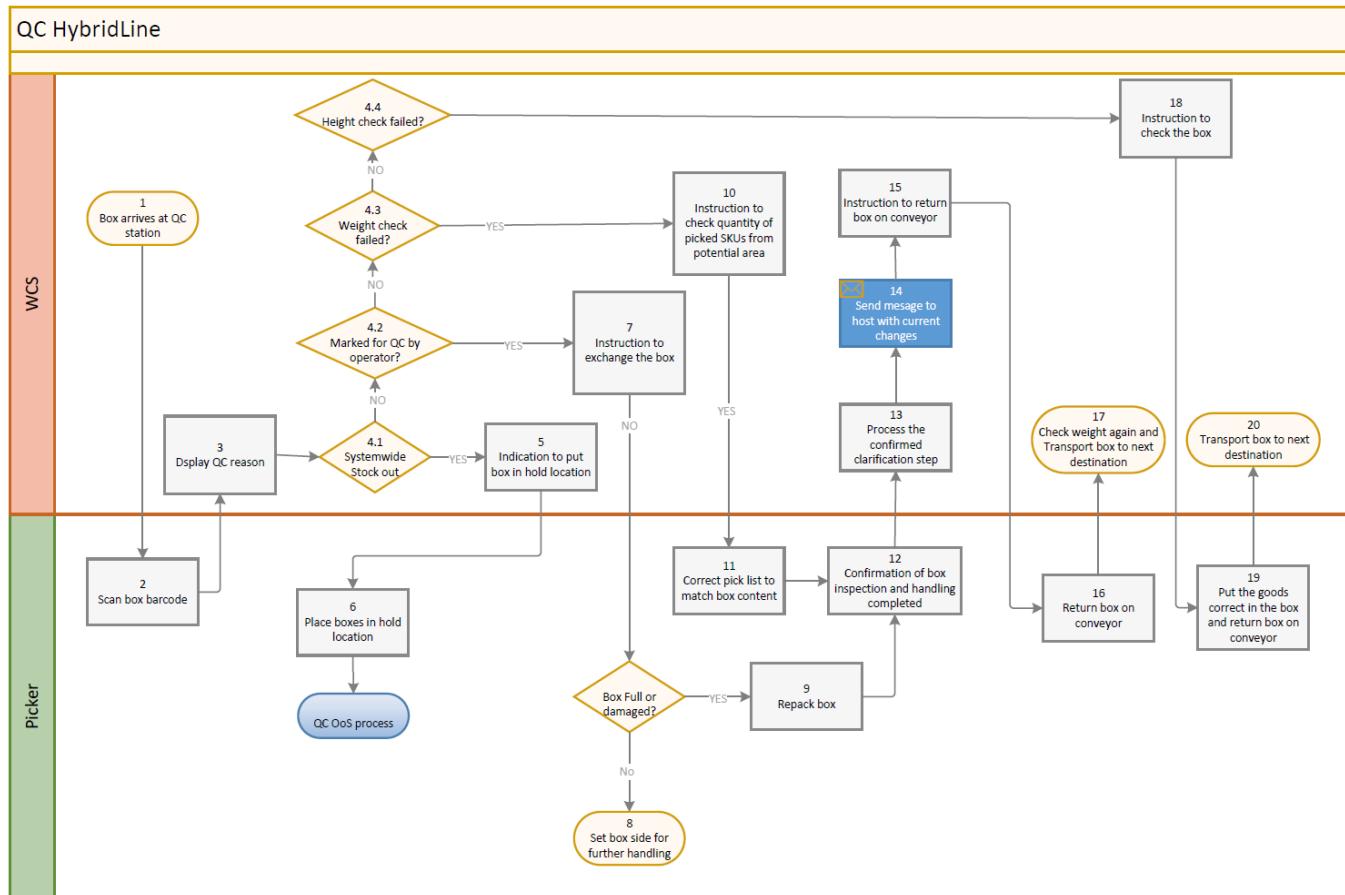
9.11.2 QC Hybridline

Boxes can be routed to QC workstations of Hybridlines cause of weight mismatching, the box is marked for QC by operator during picking or cause of out of stock of required SKUs or ordered flagged by host to go to QC after all picks are done.

For QC clarification a project specific StepByStep dialog will be implemented which covers the different clarification functions for each QC reason (see 9.11.4)

The handling of out of stock boxes on QC station will be described in 9.11.3

The clarification way of other error cases is included in the following diagram and described in more detail below.

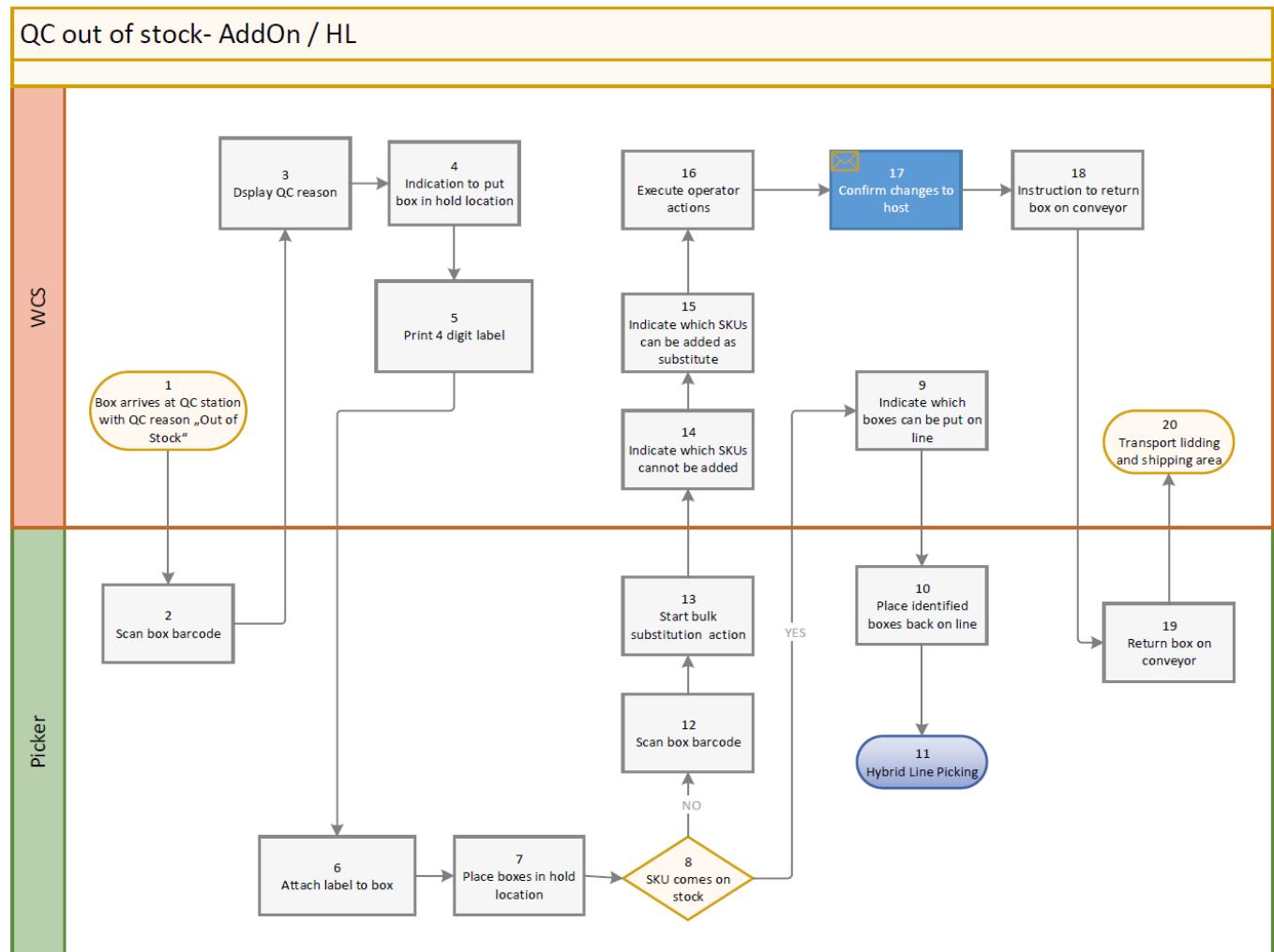


Step	Description
1	Box arrived QC station of hybrid line and operator can start the clarification process by QC Operation Dialog, see 9.11.4
2	The operator scans the box barcode in QC Operation Dialog
3	QC Operation Dialog shows the error reason and enables the clarification functions based on the QC case. If DiQ don't show any error reason the operator has to check the barcode and DiQ Alarm Monitor concerning No Read on the line.
4.1, 5	If one of requested SKUs marked as out of stock DiQ shows hint to put the box in hold location
6	The operator take the box out of QC workstation and place it in OoS hold location. The hold locations will be not managed by DiQ and will be handled as virtual location. The operator will handle OoS boxes according to QC OoS process. See 9.11.3
4.2, 7	If the box marked for QC by operator in hybrid line picking workstation, QC Operation Dialog displays the reason of rejection and instruction to handle the box e.g. "Exchange the box"

Step	Description
8	If the operator cannot determine any problem on the box, the operator puts the box side and informs the supervisor for further handling. Otherwise proceed to step 9.
9	The operator executes a repack process by follow the dialog steps: - put ingredients in new box - scan barcode of new box to connect it to the order - discard old box Proceed to step 12
4.3, 10	If the box marked for QC by scale check because weight of box is mismatched, QC Operation Dialog displays the reason of rejection and instruction to handle the box e.g. "please check the quantity of picked SKUs"
11	The operator checks the picked SKU from potential area and compares these with the box content. The operator indicates the cause of mismatching and take the suitable action according to the clarification steps described in 9.11.4
12	After the clarification of box is finished, the operator confirmed the completion of inspection
13	DiQ processes the confirmed steps in QC Operation Dialog
14	DiQ confirms the changes to host only if box is changed, quantity changes are not relevant to the host by orderStatus message with new loadUnitId
15	DiQ displays instruction to return the box on conveyor
16	The operator puts the box on conveyor
17	The operator corrects the box content by adding or removing SKU and places the box on the line before the scales. The weight of the box is measured again and matched to the contents of the box confirmed by the operator. The current (new) weight must be stored in the system as Tara
4.4, 18	If the box marked for QC by height check because the goods sticking out, QC Operation Dialog displays the reason of rejection and instruction to handle the box e.g. "Height check error → please check if goods sticking out from the box"
19	The operator puts the goods correct into the box and returns the box on conveyor
20	DiQ transports the box to next destination

9.11.3 Handling of Out Of Stock

One of the important tasks which will processed on QC workstations of Add-On and hybrid lines is the handling of out of stock boxes. The following diagram and the description below include the different approaches to clarify the out of stock of one box.



Step	Description
1	Box with out of stock error arrived the QC station of Add-On or hybrid lines and the operator can start the clarification process by QC Operation Dialog. See 9.11.4
2	The operator scans the box barcode in QC Operation Dialog
3	QC Operation Dialog shows the error reason "out of stock" and enables the clarification functions
4	DiQ shows indication to put the box in hold location
5	DiQ prints automatically a 4 digit label which identify the out of stock for certain SKU. Label with the same 4 digit will be printed for each box which has the same out of stock SKU. In case of several distinct stock outs multiple labels with unique 4 digit will be printed, so one for each out of stock SKU.
6	Operator attaches the label to the box

Step	Description
7	Operator take the box out of QC workstation and place it in OoS hold location. The hold locations will be not managed by DiQ and will be handled as virtual location.
8	DiQ constantly checks if out of stock SKU is already replenished and became available in one picking workstation in Hybrid Line
9	By replenishment confirmation DiQ can identify which boxes on hold location can get the missing SKUs and should be put on line. DiQ indicates these boxes by the 4 digit in each workstation by a notification in workstation alarm section and an alarm in the control tower.
10	Operator puts boxes with determined 4 digit label back on line 1. Box gets pushed back to the line 2. Gets scanned 3. If any OoS is resolved box travels to the station destination 4. If not resolved (for example the wrong box was placed on the line) it gets pushed back to the same QC station (without looping)
11	DiQ plans the picking of SKU. The operator process the picking according to hybrid line picking process. See 9.8
12,13	If missing SKUs comes not on stock super user can decide to use substitutes for missing SKUs. Operator scans the box in QC Operation Dialog to start with substitution action. See 9.11.4
14	DiQ indicates the SKUs which cannot come on stock and prevents the finishing of order
15	DiQ indicates also the SKUs which already selected by the user as substitute for out of stock SKU. : the possible substitutes are all the known SKUs to WCS and an option of substituting with nothing (send without) is also available.
16	DiQ executes the substitution actions proceeded and confirmed by operator
17	DiQ confirms the changes to the host
18	If no picks still open and all out of stock SKUs are substituted, DiQ shows instruction to return box on conveyor
19	The operator returns the box on conveyor
20	DiQ routes the box to lidding and shipping area

9.11.4 QC Operation Dialog

To clarify the different QC cases described in above chapters a project specific StepByStep clarification screen will be implemented. The steps will be started based on the different scenarios.

Following steps and screenshots are the proposal of HelloFresh team for clarification process. The layout and UI components will be specified and adjusted according to DiQ framework. HelloFresh will review this screen during development phase.

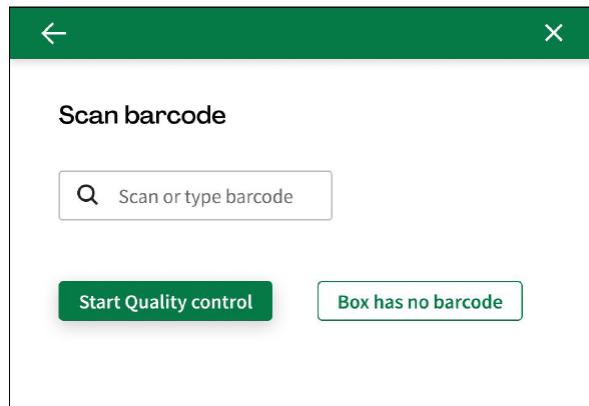
Beside the description below, following documents will be considered by development and taken as basic for the implementation of QC process:

- 20220121 QC operator UI Barleben designs.pdf
- 20220121 QC operator UI Barleben procesflow.pdf

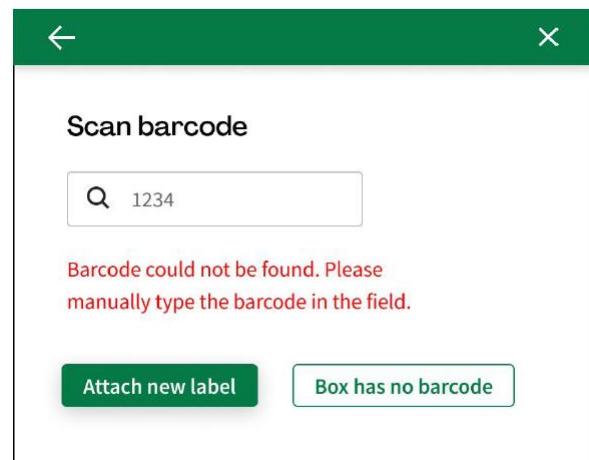
The QC operation screen will be used by operator on QC Workstations of different areas. The screen needs to behave according to the scenarios which are valid for certain area. Following table describes such different scenarios and when to show which options:

	Cool pouch itself	Ice packs	Add-ons	Hybrid lines
Extra inspection or actions possible (after initial check) - available in menu option in right bottom corner	- Packaging	- Packaging - Cool pouch itself - Reprint LPN	- Packaging - Cool pouch itself - Ice packs - Reprint LPN label - Print OoS label - Search for resolved OoS	- Packaging - Outside cool pouch (add-ons / mealkits) - Inside cool pouch picks (add-ons / protein picks) - Print OoS label - Ice packs - Cool pouch itself - Reprint LPN label - Search for resolved OoS
Moment of providing options for extra actions?	- When detected by camera, after checking cool pouch	- When detected by scale, after checking ice packs - When marked by operator, upon arrival	- When detected by scale, after checking add-ons - When marked by operator, upon arrival	- When detected by scale, after checking applicable items - When marked by operator, upon arrival
Restarting possible?	Yes (with damaged box, PoD error or no read)	No (use new box and reprint LPN)	No (use new box and reprint LPN)	No (use new box and reprint LPN)
Reasons for entering QC	-PoD errors -Marked by operator -Camera check -No read	-Marked by operator -Scale -No read	-Marked by operator -Scale -No read	-Marked by operator -Scale -No read -OoS buffer is full

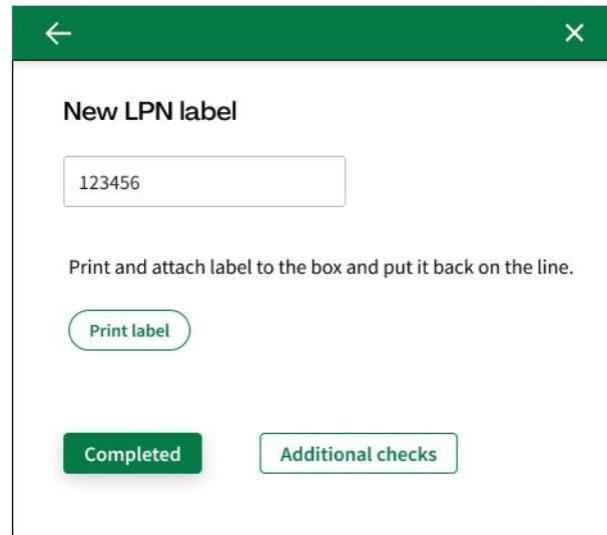
1. Scan box barcode



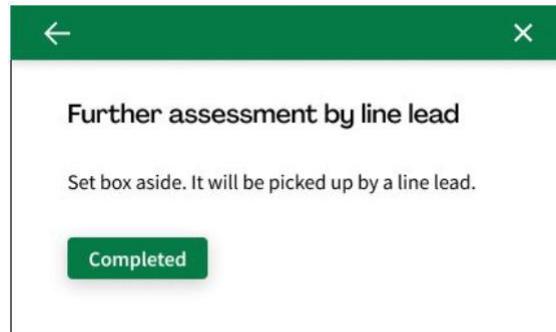
- Quality control starts automatically when box is scanned (so then the start button does not have to be pressed). The “start quality control” button only needs to be used for when the barcode is manually typed.
- If box scan is not successful DiQ displays error



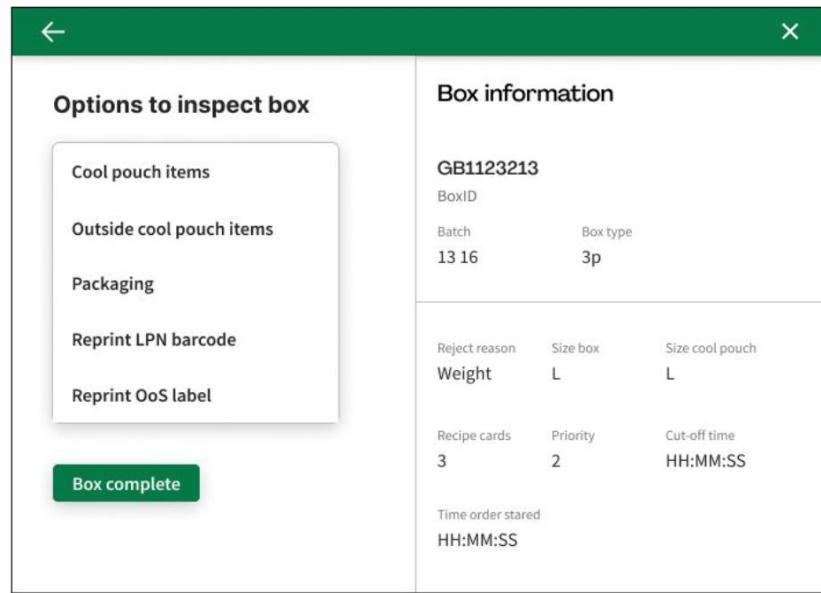
- It is mandatory to attach a new label after manually typing the barcode (because the reason for not reading is most probably a damaged license plate). This is to prevent that QC is started without solving the LPN problem.



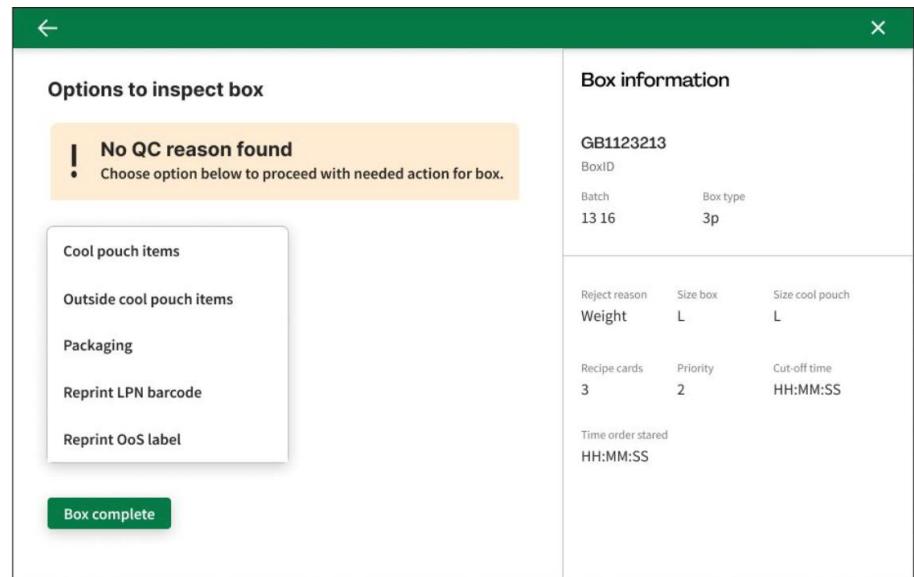
- If the barcode is not visible and it is not possible to manually type barcode, the line lead should check in WCS for which boxes this occurred and should be made aware of this through an alarm or pop-up.



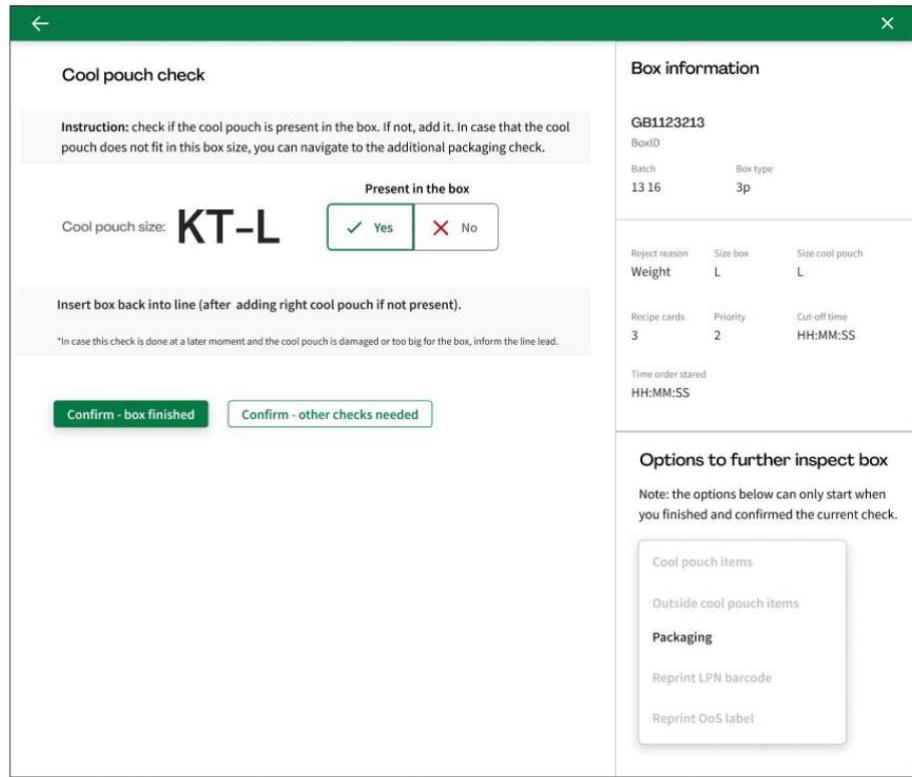
- After successfully typing or reading a barcode WCS displays the check that is needed. The options will be displayed depending on the reason that the box was routed to the QC station. See table above.



- If no reason can be found, for example no read on the line, all options are showed.



2. Cool pouch check



When the operator presses "confirm - other checks needed", it needs to be indicated in the screen that this current action is confirmed (and the 2 confirm buttons disappear). Then the operator can choose an option from the menu in the right bottom (or finish the box with the button). This interaction also accounts for the other applicable screens in this document (please refer to table overview for exceptions).¹

Cool pouch check

Instruction: check if the cool pouch is present in the box. If not, add it. In case that the cool pouch does not fit in this box size, you can navigate to the additional packaging check.

Present in the box

Cool pouch size: KT-L

Insert box back into line (after adding right cool pouch if not present)

You have completed the check above. You can select another option to inspect the box from the menu on the right bottom or confirm below when the box is finished.

Box finished

Box information

GB1123213
BoxID
Batch 1316 Box type 3p

Reject reason Size box Size cool pouch
Weight L L

Recipe cards Priority Cut-off time
3 2 HH:MM:SS

Time order started HH:MM:SS

Options to further inspect box

Note: the options below can only start when you finished and confirmed the current check.

- Cool pouch items
- Outside cool pouch items
- Packaging
- Reprint LPN barcode
- Reprint OoS label

3. Ice pack check

Ice pack check

Instruction: In case that the amount of ice packs is not correct, adjust it to the right quantity and put the box back on the line.

*In case this check is done at a later moment and the ice packs are damaged or missing, inform the line lead.

Ice pack quantity: 2

Right quantity

Confirm - box finished Confirm - other checks needed

Box information

GB1123213
BoxID
Batch 1316 Box type 3p

Reject reason Size box Size cool pouch
Weight L L

Recipe cards Priority Cut-off time
3 2 HH:MM:SS

Time order started HH:MM:SS

Options to further inspect box

Note: the options below can only start when you finished and confirmed the current check.

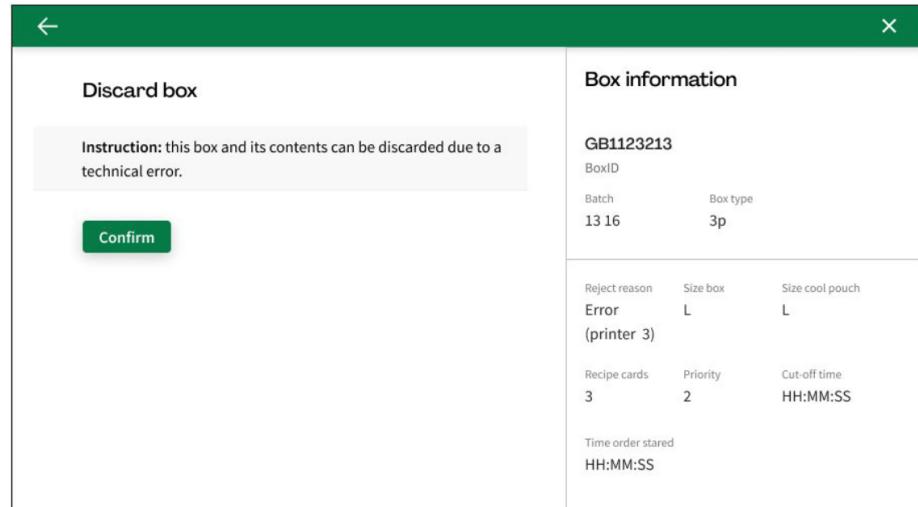
- Cool pouch items
- Outside cool pouch items
- Packaging
- Reprint LPN barcode
- Reprint OoS label

4. Discard box

This scenario is applicable when the box will be automatically restarted, for example in case of a Print on Demand error or when the QC operator at cool pouch picking indicated the box

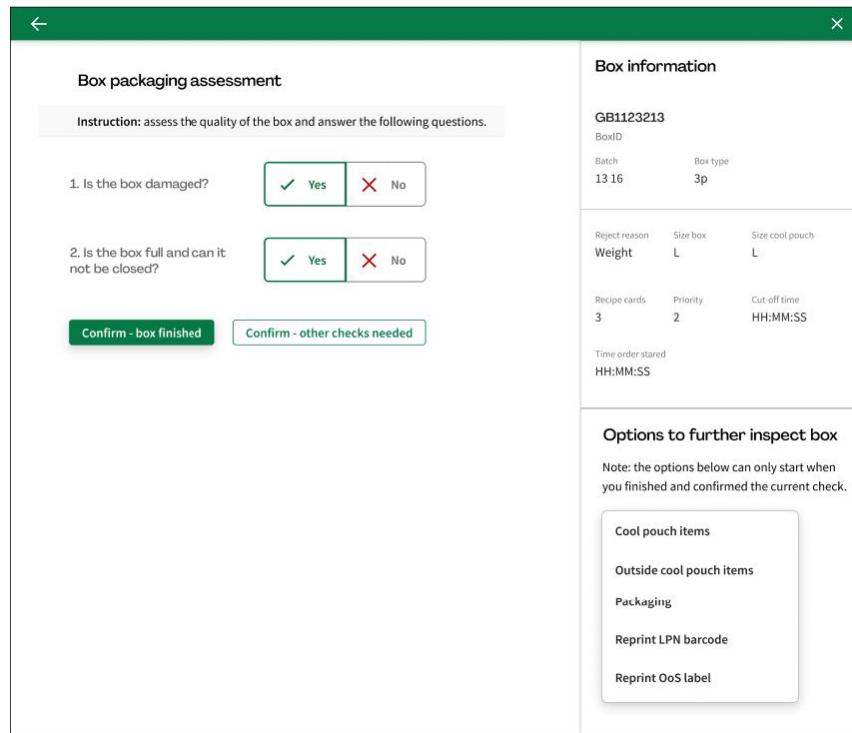
In case of a Print on Demand error, the number of the printer should be displayed

There are no further options available to do other inspections for the box.



5. Assess the box packaging

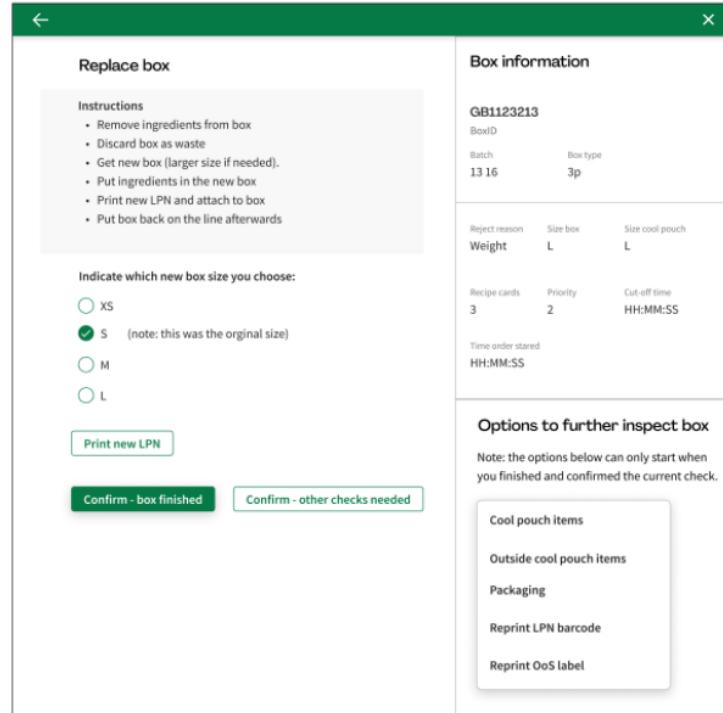
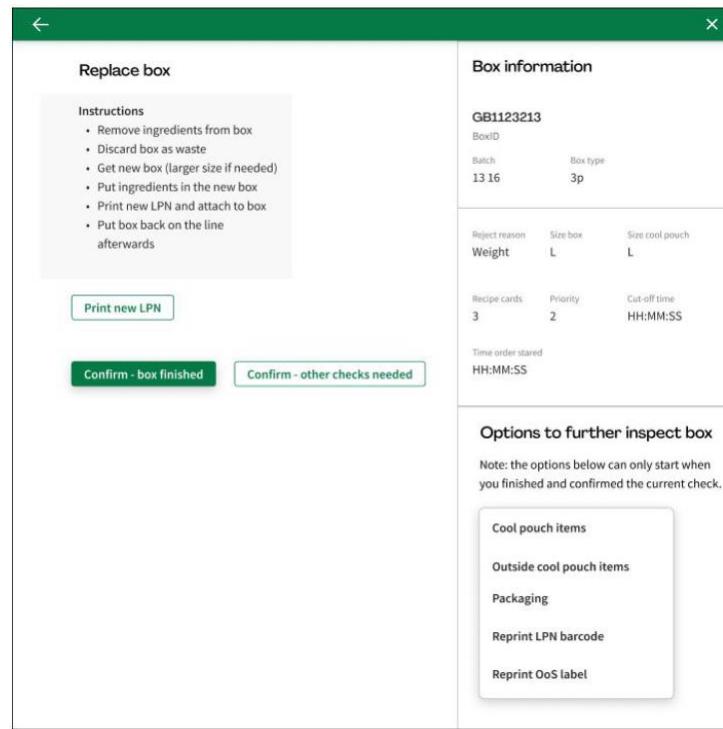
This screen will be shown if the box is damaged or full. The “No” option will be preselected to speed up the process.



6. Handling of damage or full box

If box is renewal is needed, operator has to put the ingredients in new box. Operator create new box manually and print new label in QC workstation.

The new size of the box should be confirmed by the operator. DiQ will update the order data with new size.

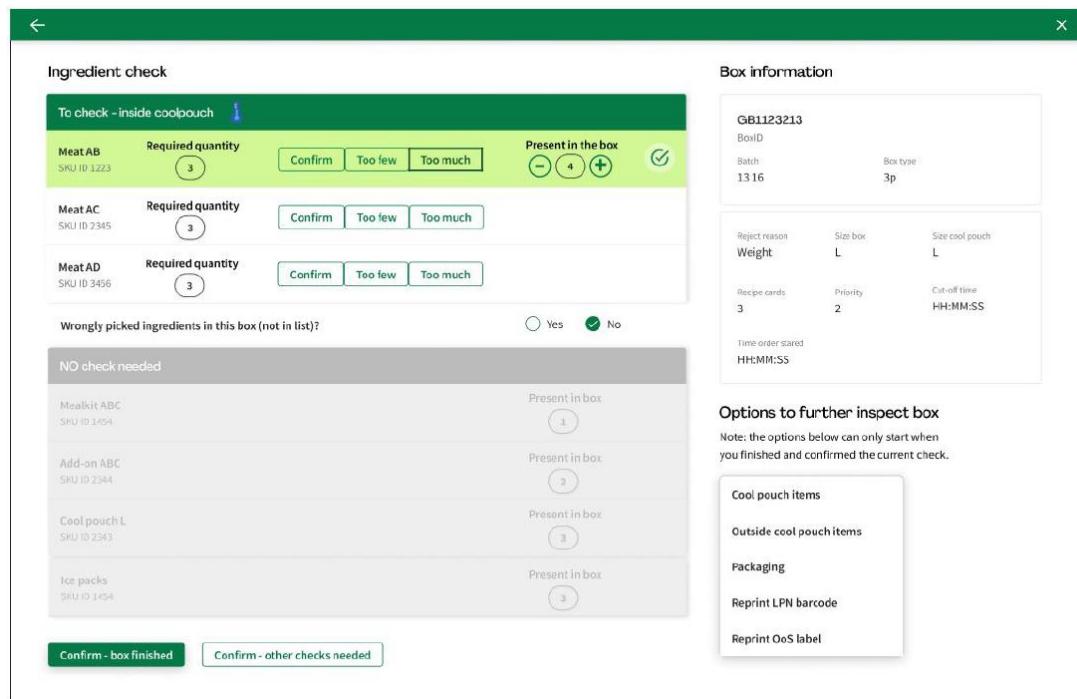


7. Ingredients assessment

If the box doesn't have quality problem operator starts to assess the ingredients in the box

SKUs which are picked and passed successfully from other scale points or have been already checked in previous quality checks, should be not assessed by operator again. DiQ will show the list of such SKUs. These SKUs can be excluded by current quality check.

DiQ shows the list of SKUs which can be the reason that the box is routed to QC. Operator processes the inspection per ingredient and confirms afterwards



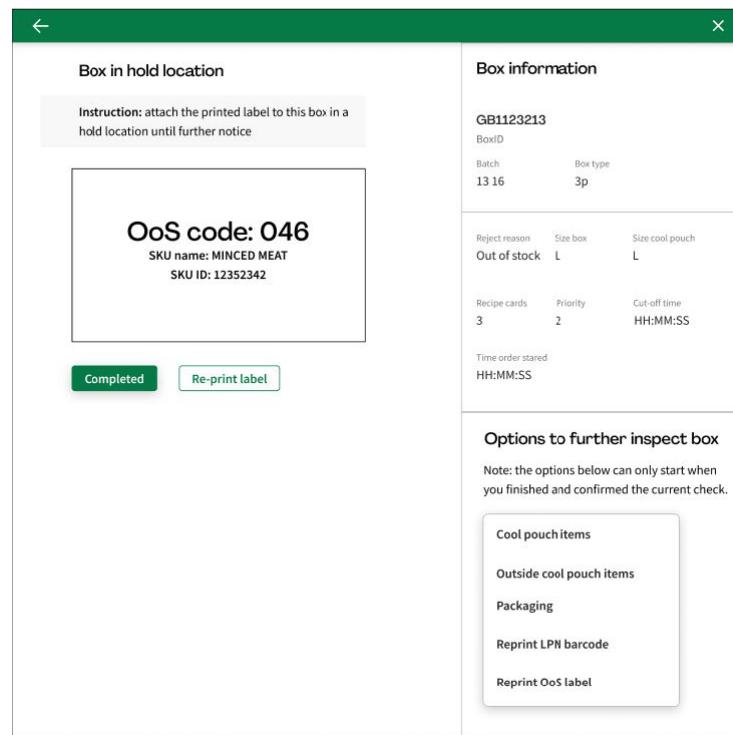
Handle out of stock box

Based on current status of out of stock SKU, DiQ will start the suite step to handle the current box after scanning the box barcode in QC operation dialog

8.1. Display box data

If the SKU as marked as out of stock system wide and the box is routed to QS workstation, DiQ shows indication that the box need to be put on hold location.

DiQ displays the box data and master data of out of stock SKU. By first scan the out of stock code will be printed automatically. Operator has also the possibility to reprint the code again.



Operator can decide in this step to proceed with substitution of missing SKUs see 8.4

The substitution of the SKU must be defined centrally (control tower) by an authorized user (line lead).

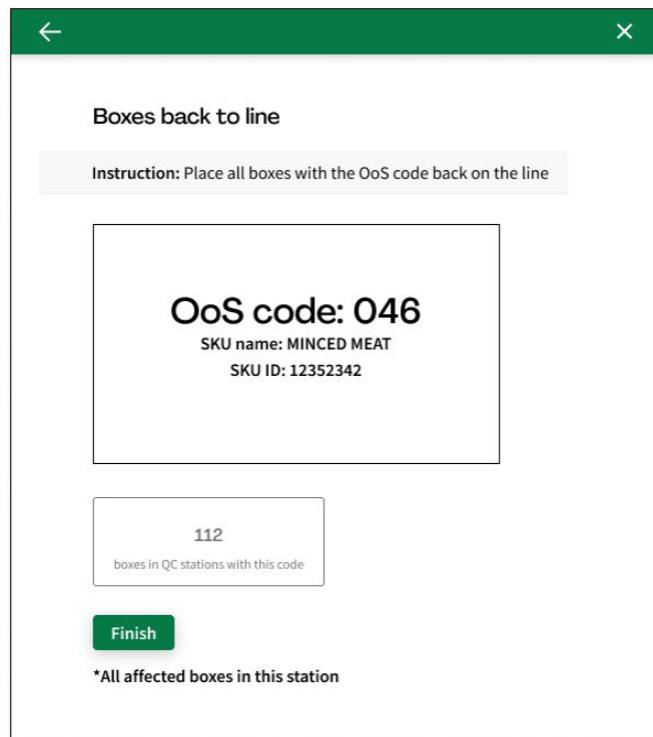
Additional option for Add-On area:

In Add-On QC workstations the operator will have the option to allow the box to move to hybrid lines area for picking of chilled and non-chilled SKUs although the out of stock of Add-Ons SKUs is not resolved. The missing Add-On will be handled then later on hybrid line QC workstations.

By the button “Check Add-On OoS later” the superuser only can flag the box for this option. Boxes with missing Add-Ons without this flag will be rejected to next QC workstations if the box put or pushed manually on the conveyer.

8.2. Request boxes back to the line

If one out of stock SKU became available in hybrid line, special alarm will be highlighted in alarm of QC workstations and Overview Alarm Monitor. By this alarm the operator will be notified that this SKU is back in the line and manual infeed of affected boxes is requested.



DiQ shows the number of boxes with same out of stock reason which located on hold locations of all QC workstations. Operators on each QC workstation confirms that all boxes related to this SKU are put on the conveyer. DiQ checks after receiving the confirmations from all workstations if no box still booked on hold locations and removes the alarm for this SKU. Otherwise the alarm will not be removed and operators should checks if some affected boxes are not placed yet on the conveyor.

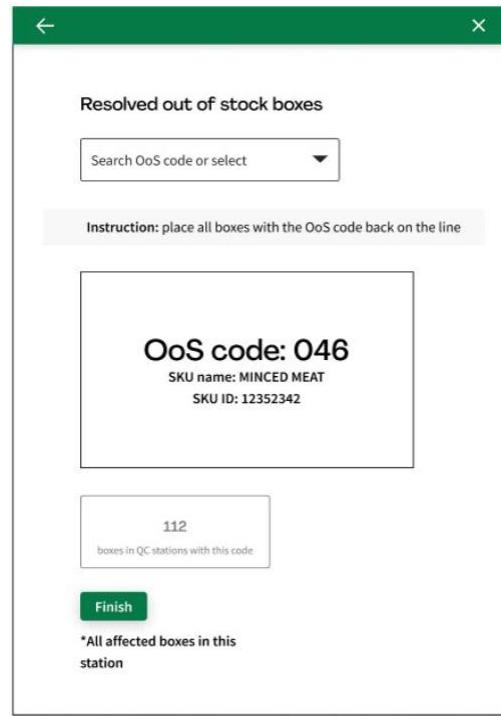
If the operator places the wrong box (with a different unresolved OoS) on the conveyor the box is routed back to the same QC station without looping

8.3. Search for resolved Out of Stock

Operator can start with this step from the start page of QC Operation dialog (see 1)

QC Operation Dialog shows a list of resolved out of stock with affected boxes which not yet placed back on the conveyer. Operator select one

out of stock code. DiQ shows the data of this out of stock. Operator processed with 8.2 to resolve the problem for each affected boxes.



8.4. Substitution bulk action

1. The superuser selects the SKU that is OoS and a substitution SKU that will be added instead together with the quantity. A chooser of other SKUs can be implemented to give the line lead additional options to add other SKU as substitution. The possible substitutes are the SKUs available in WCS and an option in the dropdown "No new SKU needed" (see below).
2. Resolved OoS screens requires operator to insert substitution SKU and the quantity (see below).
3. Operator inserts the substitution SKU and pushes the box to the line
4. The scanner in the line confirms that the box has a resolved OoS,
 1. if yes a message confirming the substitution is sent
 2. if not the box is rerouted to the QC station

The screenshot shows a mobile application interface with a green header bar. The main title is "Substitution and boxes back to line". Below it is an instruction box containing the text: "Instruction: Retrieve the boxes with the following OoS code and insert the SKU listed below before putting it back on the line." A large bold number "046" is displayed prominently. Below it, the text "Boxes with OoS code:" is followed by "213123 'Minced meat'". The quantity is listed as "Quantity : 1". A callout box displays "112 boxes in QC stations with this code". At the bottom is a green "Finish" button and a note: "*All affected boxes in this station".

The screenshot shows a mobile application interface with a green header bar. The main title is "Substitute out of stock SKU". It has three input fields: "SKU / Out of Stock (OoS) code that cannot be added" (with a dropdown menu), "SKU that will be added instead" (with a search bar and magnifying glass icon), and "Quantity of SKU to be added" (with a numeric input field showing "2" and increment/decrement buttons). At the bottom is a green "Save" button.

9.12 Emergency Handling in QC Workstation:

The implementation of the change request described in 9.11 will have impact to the schedule of GoLive. Therefore HelloFresh requires to implement a simple solution for the following functionalities, which can be used in the ramp up phase in QC workstation, till the change request completely implemented and deployed after GoLive.

9.12.1 Quantity change of picked SKU

If the box routed to QC station cause of weight mismatching, the user will execute the following steps in DiQ clarification screen:

1. Operator scans the box
2. DiQ shows the already picked amount
3. Operator can select the pick which has a wrong confirmed quantity
4. Operator changes the quantity to match the actual quantity in the box
5. DiQ triggers a new reservation for the missing quantity
6. Operator puts the box on conveyer

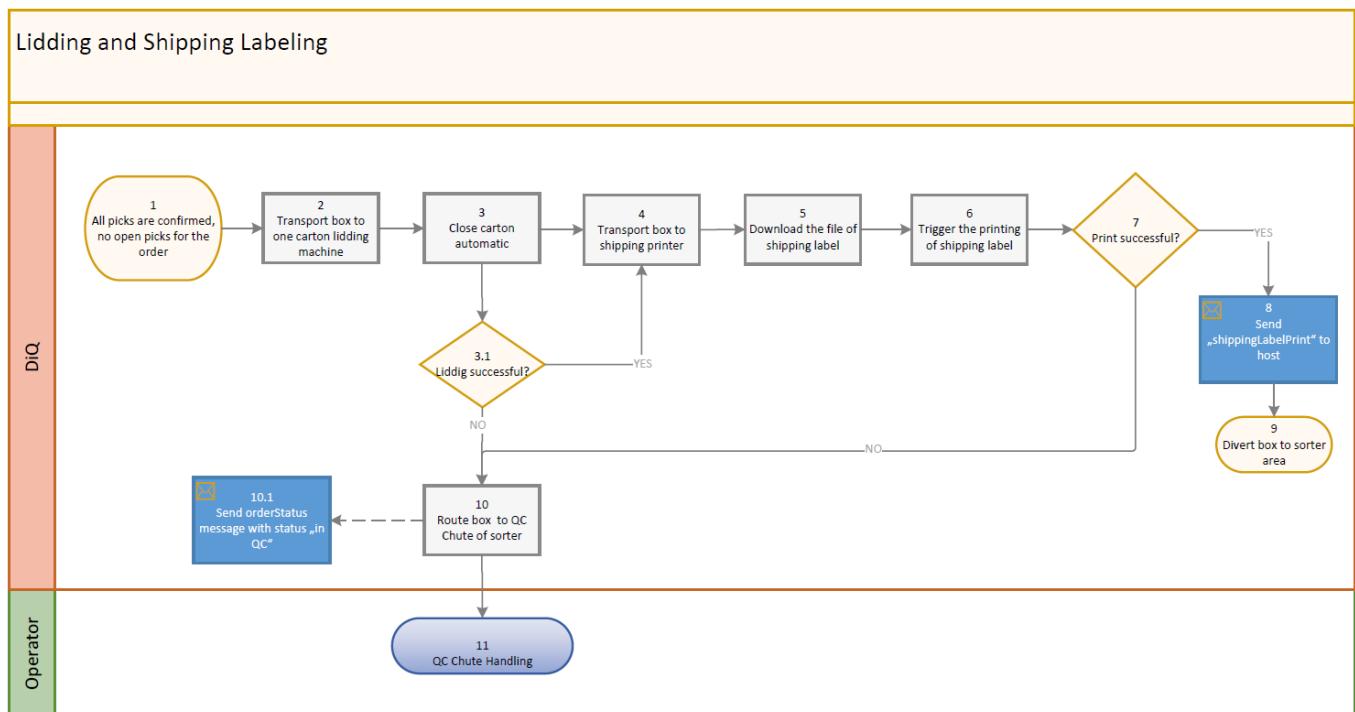
9.12.2 Substitution of SKU

If one SKU cannot be picked cause of out of stock, the operator can execute the substitution for this SKU physically. The operator confirms the original pick as fulfilled in DiQ UI. DiQ confirms the pick of this order line with the original SKU to the host without any information about the substitution.

9.12.3 Damage and full boxes

the damage boxes and full boxes can be handled in all QC workstations similar to the process determined for QC Ice pick. If one box is damage or full the operator confirms the restart of order.

9.13 Lidding and Shipping Labeling



Step	Description
1,2	When all items are picked into the box, the height of the carton will be measured before entering the lidder at nok stations. Special case: In case a lidding machine at Meal-Kit-line 7 to 10 is defect, the cartons can be routed to the neighbor lidding machine. If lidder in string 6 is out of service the boxes will loop and go to any other string with a working lidder.
2	DiQ transports the box to the automatic carton lidding machine.
3	Carton lidding machine closes the box under control of PLC
3.1	If lidding was successful proceed to step 4, otherwise proceed to step 10
4	After closing of box DiQ transports the box to shipping label printer. There are two shipping label printers per line, the load between them must be distributed during normal operation by alternating the destination of the boxes. (The PLC has to confirm this is possible).

Step	Description
5	The host system provides the shipping label file (ZPL format) to the WCS in a the S3 bucket. Labels are permanently moved by the WCS to a local folder on the WCS server. The label can be associated to the order by the order ID in the file name. Updates to the shipping label are possible as long as the box has not passed the Lidding and Labelling area. The WCS fully manages the local folders and takes care to purge old files.
6	When the order carton arrives the shipping printer, DiQ triggers the label printing for this order
7,8	If the shipping label is successfully printed and applied on the box, DiQ confirms the label print to the host. After sending this confirmation the update of shipping label is not possible anymore
9	DiQ routes the box to sorter area
10	In case of lidding error or shipping label print error DiQ routes the box to QC chute of sorter. order status changes to "in QC"
11	Operator clarify the error according to QC chute handling process described in 9.13.1

9.14 Sortation

There are two options to assign one routes to sorter chutes. The default option is the dynamic assignment which is described in the diagram below.

The second option is the manually assignment. Super User will have the possibility to configured chutes for defined routes manually. Routes can be assigned automatically by DiQ to certain chutes or manually by Super User (see 9.14.2.4). Chutes can be opened, closed and reassigned arbitrarily.

The definition of "route" for the sorter is the combination of the attributes "route" and "loadingTime".

A route can be manually assigned to a chute arbitrarily, even if there is another active route in that chute. In this case a multiple assignment of routes to one chutes is allowed. No sequencing or routing logic in case of multiple assignment is required.

A route cannot be automatically assigned to a chute with an active route. This means boxes of the route are not finished and the first box already reached the sorter, regardless if the assignment was done manually or automatic.

The fill level of each chute will be controlled by PLC. WCS ignores the full chute till PLC confirms that the chute has free capacity and can receive new boxes.

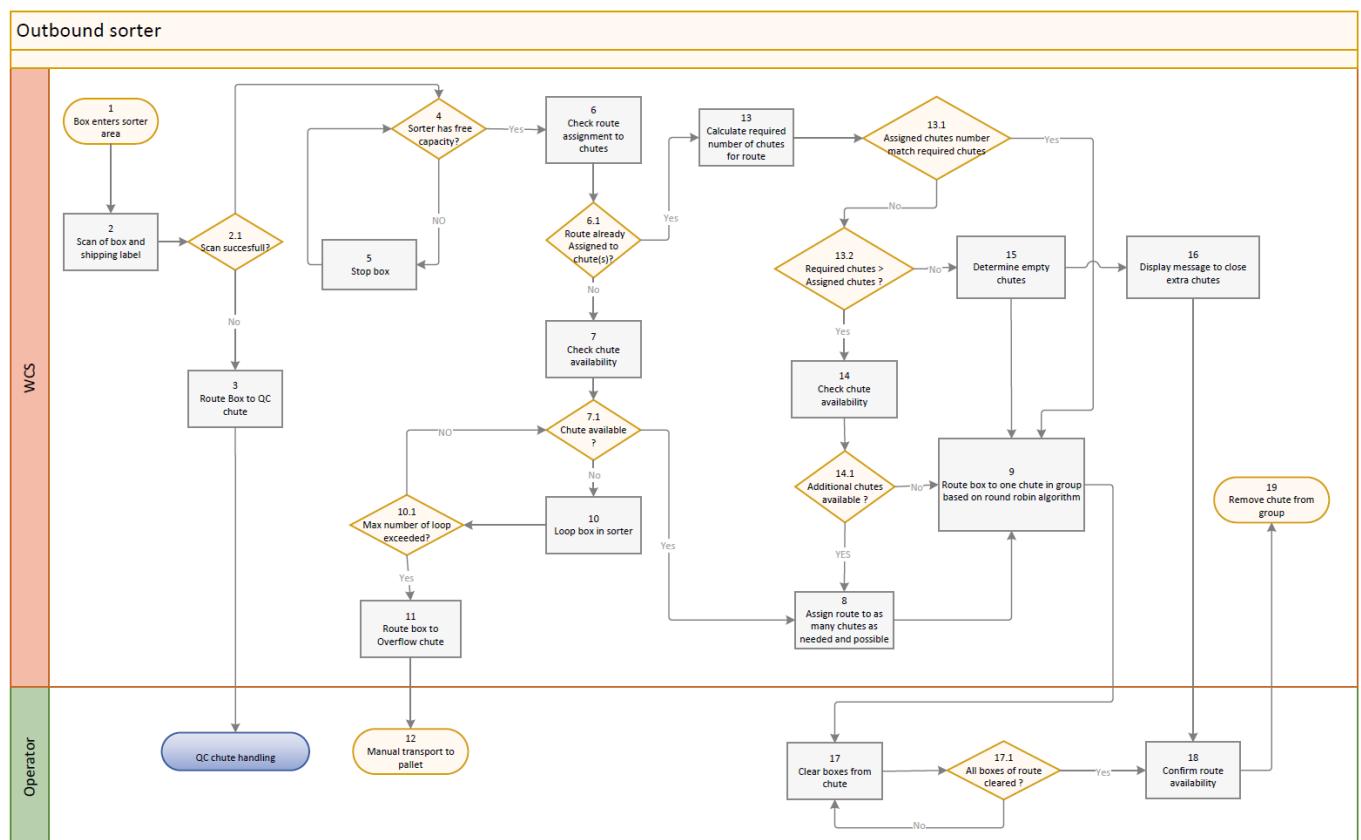
Boxes from different groups arrive at sortation area in mixed sequence order.

It is assumed, that the sorter has got enough capacity and enough destination chutes to fulfill the route restrictions at dispatching.

New requirement: Alarm to monitor when number of routes in the system (boxes erected) exceeds a specific value.

Use case: Control tower realizes that there are too many routes in the system and allocates more people to the chute or manually assigns routes to chutes.

Further it is assumed, that there are always enough operators available at the sorter chutes, to remove the arriving cartons fast enough.



Step	Description
1	Box leaves lidding and shipping printer area and enters the sorter area
2, 2.1	After scanning of box barcode and shipping label DiQ evaluates the status of both labels
3	If one of the two labels get no read or if route, destination or label details are unclear, the box will be routed to QC chute of sorter. Operator will handle the box according to QC chute handling process. See 9.14.1
4, 5	The capacity of sorter will be controlled by PLC. In case of no free capacity the box will wait before entering point of sorter till the sorter get free capacity.

Step	Description
6, 6.1	As soon as the capacity of sorter get available DiQ starts to determine the destination chute of the box. DiQ checks if the route of box is already assigned (manually or by handling of previous boxes from same route) to chutes group. If an assignment for the rout exist already proceed to step 13. Otherwise proceed to step 7.
7,7.1	In case of route without assignment to chutes group DiQ checks the availability of chutes. One chute is available if the chute doesn't have an active route assigned
8	If DiQ determines available chutes the route of box will be assigned to as many chutes as needed. DiQ tries to select the chutes for one route next to each other as far as possible
9	Box will be routed to chutes group. DiQ determines one chute from the group for the current box based on round robin method. Continue with 17
10, 10.1	In case that no chute is available the box will be looped in sorter till the assignment of route is possible
11	If the loops number exceeds the configured max number of looping, DiQ routes the box to Overflow chute of sorter
12	Operator transports the box manually to the pallet
13	If the route of current box is already assigned to chutes group, DiQ calculates the number of chutes needed to sort all boxes of route. For this calculation DiQ considers the number of active boxes of route in the system and boxes of route which still pending in order pool.
13.1	If the amount of chutes in chutes group of route matches the required chutes, then no additional chutes are needed. In this case DiQ routes the box to chutes group of route. Proceed to 9
13.2, 14	If the amount of required chutes exceeds the already assigned chutes for the route, DiQ checks the availability of chutes to add further chutes to the current chutes group.
14.1	If further chutes are available, DiQ extends the chutes group of box with additional chutes as many chutes as needed, next to other current chutes of group as far as possible. Proceed to step 9 If no additional chutes available proceed to step 9
13.2, 15	If the amount of required chutes for the route less than the amount of chutes already assigned to group, DiQ checks the unused/empty chutes from chutes group and determines which chutes can be removed from group. DiQ selects unused chutes which are not side by side to other chutes of group. At the same time DiQ routes the box to one used chute from the group based on round robin method Proceed to 9
16	DiQ displays in the chute screens that the assigned route is finished for that chute and that the operator should confirm when the chute is cleared (all boxes are taken from the chute) Proceed with 18
17, 17.1	Operator clears arrived boxes from the chute till all boxes of assigned route cleared from the chute. It is in operator responsibility to empty the chutes fast enough to not hinder the sorter from delivering new boxes to chute.

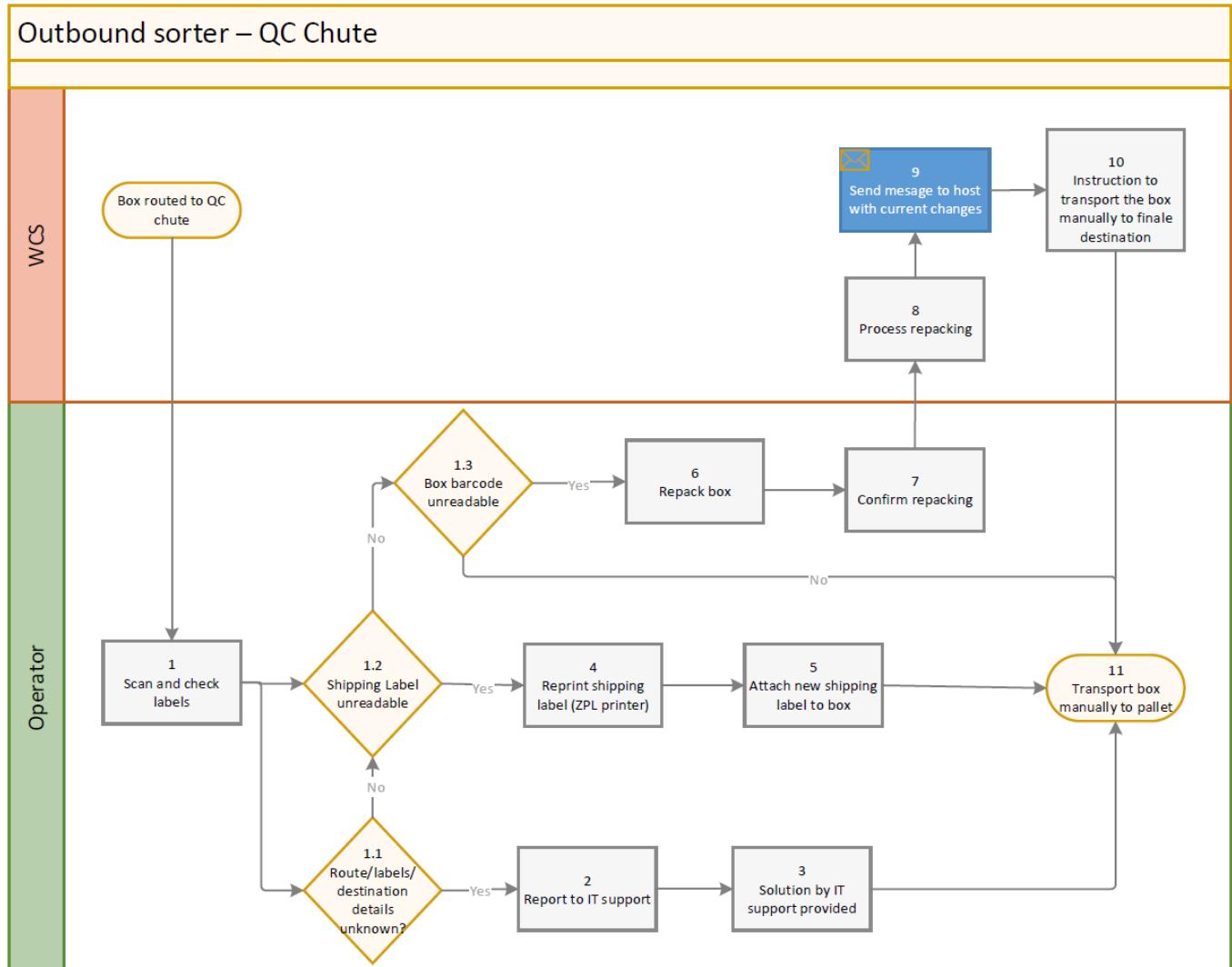
Step	Description
18	Operator confirms by pressing a PLC button that the chute is now empty and can be used for new routes.
19	DiQ removes the chute from group ad considers it as available for next route

The allocation of chutes to routes will be calculated by every box entering the sorter (starting by the 1st box of the route). The boxes of the route to be considered are shown in the table below:

Carton	Box status	Consider in sorter?	Argument
Not erected	Pending	No	
	On Hold	No	
	Prepared on hold	No	
	Prepared	Yes (after 1st box reaches the sorter)	
Erected	Released	Yes	
	Active	Yes	
	In QC	Yes	- High spread of routes over different cut-off times allows for waiting for remaining boxes (5 routes / 3 hours)
	In OoS	Yes	- Most stock-outs are solved within 15 min (therefore, need to consider) - Solved OoS boxes must be diverted to original chute, diverting to another chute (far away) adds complexity. - Preferred only one router per chute because no scan validation during palletization - Using the initial chute for another route in the meantime (during OoS boxes being solved) leads to more difficulties (e.g. positioning of pallets)
	Shipping label applied	Yes	

	Finished	No	
--	----------	----	--

9.14.1 QC Chute Handling



Step	Description
1	Box arrived QC chute of sorter and operator scans and checks the barcode of box and shipping label. DiQ shows the reason of box rejection

Step	Description
1.1, 2	If DiQ cannot determine the finale destination of box cause of unknown finale destination based on order data or the destination of shipping label, operator informs HelloFresh IT team
3	HelloFresh IT team provides support for operator to transport the box to finale destination
1.2, 4	If shipping label is damage is not readable or was not applied operator reprint shipping label by ZPL printer located in QC chute
5	Operator attaches the new label to the box and transports it manually to pallet
1.3, 6	If the of box is damage or not readable the picked SKUs have to be repacked into new box. The operator executes a repack process by follow the dialog steps: <ul style="list-style-type: none"> - put ingredients in new box - scan barcode of new box to connect it to the order - print new shipping label if required - discard old box
7	The operator confirms the clarification
8	DiQ processes the confirmed repacking
9	DiQ confirms the changes to the host
10	DiQ displays instruction to transport the box manually to the finale destination
11	Operator transports the box manually to pallet

9.14.2 Outbound Sorter Screens

For sorter area several project specific overview dialogs/dashboards are required to display the current status of chutes and routes. Furthermore such dialogs will be used to manage the sorter process by setting of needed configurations and predefined parameters.

Beside the overview dialogs/dashboards an “End of Chute” screen will be implemented to show the current status of each chute in main time.

Following screens are the proposal of HelloFresh team for sorter area. The layout and UI components will be specified and adjusted according to DiQ framework. HelloFresh will review the screens in implementation phase.

The requirement is to have the each of the following screens in one independent screen.

9.14.2.1 Chute overview

Chute	Status	Route	Expected	Sorted	Completed %	First box scan	Last box scan	Time difference between first and last scan
1	NOK	A1	200	100	50%	09:03	09:09	00:06:12
2	Assigned	A2, A3	100	25	25%	09:03	09:09	00:06:12
3	Assigned	A4	50	25	50%	09:03	09:09	00:06:12
4	Unassigned							
5	Unassigned							
6	Overflow	A7, A8	150	30	20%			

- Expected: amount of boxes that are expected to be sorted to this chute for a route or combination of routes
- Sorted: amount of boxes that are diverted to a chute
- Completed: sorted as percentage of expected
- First box scan: first box that had a divert scan for a particular chute or route
- Last box scan: last box that had a divert scan for a particular chute or route

9.14.2.2 Route overview

Route	Status	Expected	Sorted	Completed %	Chutes assigned	First box scan	Last box scan	Time difference between first and last scan	Cut-off time
A01	Assigned	200	100	50%	2,3	09:03	09:09	00:06:12	13:00
A02	Assigned	100	25	25%	1	09:03	09:09	00:06:12	13:00
A03	Assigned	50	25	50%	4,5	09:03	09:09	00:06:12	15:00
A04	Assigned	100	50	50%	6,7	09:03	09:09	00:06:12	15:00
A05	Assigned	50	20	40%	8	09:03	09:09	00:06:12	20:00
A06	Pending	150	30	20%					20:00

Route statuses:

- Pending: route that is currently active but no route assigned
- Assigned: route that has chute(s) assigned
- Cancelled: route that has been cancelled
- Sorted: all boxes for the route are diverted to the chute
- Completed: chute is cleared with the button after the route is marked as finished

9.14.2.2.1 Route details

Route: A01

Box Number	Status	Assigned chute(s)
123	Pending	2
456	Scanned	2
789	Sorted	2,3

Box statuses:

- Pending: box that has not been scanned by first scanner at sorter entry yet
- Scanned: a box scanned by the first scanner at sorter entry but not sorted yet
- Sorted: box diverted successfully to chute
- Not sorted: box diverted to the overflow or QC chute
- No order: a box that has been scanned but there is no associated route

9.14.2.3 Sorter and route summary

Sorter summary			Route summary	
Sorter status	Number	%	Sorter status	Number
Total boxes on sorter	10		Pending	1
Boxes looping	4	40%	Assigned	10
Boxes without chutes assigned on sorter	2	20%	Completed	5
Used chutes	16	80%	Cancelled	3
Available chutes	2		Paused	0
Boxes at overflow	3		Total	19
Boxes at NOK	1			
Throughput sorter (last hour boxes)	400 boxes			
Average sorting rate per chute (boxes/h)	45 boxes			

- Total boxes on sorter: all the boxes that had the scan at the scanner at the entry of the sorter. Excluded are boxes that are sorted to chutes, overflow or QC.
- Box looping: boxes that could not be sorted in their first loop and that are currently recirculating
- Used chutes: number of chutes that have a route assigned

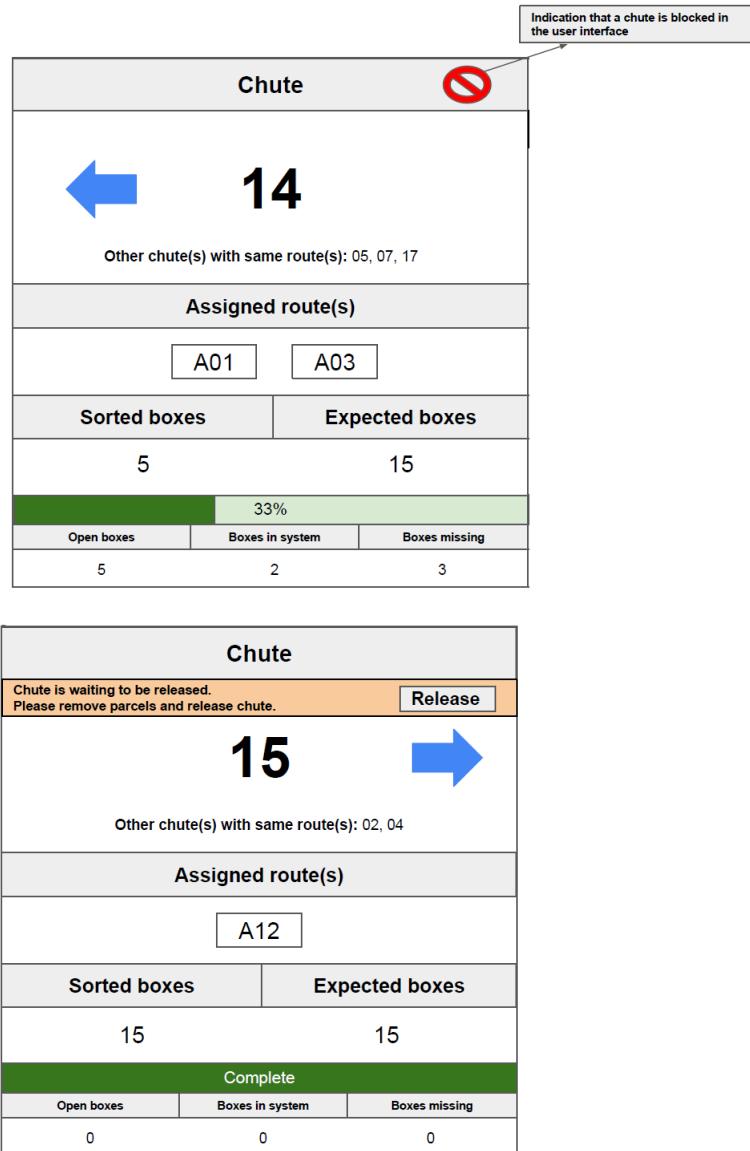
- Available chutes: number of chutes that have no routes assigned and that are cleared
- Throughput sorter: number of boxes that are sorted (diverted to chutes)
- Average sorting rate per chute: number of boxes sorter per hour, divided by the number of chutes. Value is reset each hour.

9.14.2.4 Chute details and route list

Chute	Chute Status	Blocked	Route type	Current routes	Route status	Add route	Release route	Acknowledge route status	Push button release
1	NOK	No		NOK ▼					
2	Assigned	No	Static	A1 ▼	Assigned	+ +	🔒	Acknowledge	
3	Unassigned	Yes	Static	A2 ▼		+ +			
4	Assigned	No	Dynamic	A3 ▼	Sorted	+ +	🔒		Push button
5	Unassigned	No	Static	A4 ▼		+ +			
6	Overflow	No	Overflow	Overflow					

9.14.2.5 End of chute screen

There is one end of chute screen for every two chutes. The operator does not have any interaction with the chute screen, this is only for displaying information. The operator interacts with an end of chute button (physical connected to PLC) to indicate the assigned and finished route can be cleared.



The screen is divided vertically in two, each side containing information for a specific chute. In each side the following information is displayed:

- Expected boxes: Sum of all expected boxes for each route assigned to the chute. Expected boxes for each route is the total amount of boxes in WCS (including order pool, orders being fulfilled orders in sorter and sorted boxes of active chutes) divided by number of chutes active for the route. This number is constantly updating when the active chutes are updated
- Sorted boxes: amount of boxes sorted to the chute from the active routes assigned to the chute
- Open boxes: difference between expected and sorted boxes from the active routes assigned to the chute

- Boxes in system (sorter): count of boxes assigned to this chute that have been identified at the scanner at entry at the sorter but not have been sorted yet.
- Boxes missing = Expected Boxes - Sorted Boxes - Boxes in sorter

9.14.2.6 Settings and parameters

To manage the sorter area and execute the sorter process different settings have to be implemented as configurable. For that a DiQ specific configuration topic for sorter will be created which contains the following setting possibilities:

- Assign overflow chute
- Assign QC chute
- Define initial chute allocation when the system is empty: e.g. 3,5,7,16,18
- Define sorter capacity: the maximum number boxes allowed on the sorter before the infeed is stopped.
- Threshold or capacity of sorter %: Percentage of max boxes on the sorter when the sorter is considered to be near a deadlock
- Recirculation counter: maxim amount of times/loops that a box loops on the sorter before it is routed to the overflow chute.
- Max number of boxes routed to overflow chute before triggering an error in alarm monitor. When this amount is exceeded, it can be assumed that a blocking issue within the system is apparent. In this case the sorter will be stopped.
- Multiplier value for more chutes: this is the value for the amount of boxes from which an extra chute is assigned. The idea of this parameter (X) can be described as follows:
 1. Orders for route A are sent to WCS. Route A has in total 1000 boxes
 2. The first box of route A reaches the sorter.
 3. The sorter calculates the number of chutes needed using the parameter X. Chutes needed = $1000 / X$
 4. Every time a new box enters the sorter the same calculation as in 3 is done. Based on this result the number of chutes is determined
- Define the max number of chutes per route
- Max number of routes in the system: Defines the number of route in the system (boxes erected) before an alarm is triggered

9.15 Order Processing

Order processing is comprised of Order Management and Order Fulfillment functions.

9.15.1 Order Management

Order management supports many business processes for administration, maintenance, planning and fulfilling of orders.

All orders will have an associated order type. Orders are passed to Dematic optimize iQ by the WMS. One common order type is a shipping order. A shipping order consists of a request for a single box. The WMS may update or cancel an order previously passed and created in Dematic iQ.

The WMS may request product by SKU. For HelloFresh the order process based on selecting of SKU. Dematic optimize iQ makes the determination for which rack slot to reserve requested SKU to satisfy the order requirement.

9.15.2 Order Fulfillment

Order fulfillment supports the execution processes for the completion of fulfilling orders. Orders are released based on order priority and staging date. For HelloFresh warehouse Dematic optimize iQ uses a special algorithm called Minimum cost routing algorithm (MCA) for the reservation process of the appropriate inventory load units. See 9.15.5

9.15.3 Order Release

HelloFresh orders will be grouped by routes. Orders of one route will be normally sent once by Host to DiQ and have the same priority. Routes are very large and can contain several from hundred to several thousand of orders.

The order urgency based on route priority and staging date.

For select new route from order pool and start releasing of its orders the capacity of whole system should be below a configurable threshold. The whole system capacity is a parameter configurable on the UI by the super user. Dematic only guarantees the performance of the system if this parameter is set to the exact value as used in the simulation.

For release one order from selected route following preconditions have to be checked:

- All requested SKUs are not blocked on SKU level and theirs gross weight is defined in DiQ (> 0.0)
- Recipe media and shipping label of order are available
- No requested SKU is out of stock or not available as inventory in the WCS

- Max. allowed number of out of stock boxes from requested SKU in OoS buffer is not exceeded from active orders
- Workstations of requested SKU are available within the reachable line. For example: cool pouch is out of stock in a string, DiQ should not consider this string

If one of these preconditions cannot be met by one order, the order will stay in order pool with status pending. WCS checks the preconditions to release the order periodically. Otherwise the order is selected for release and carton erection will be triggered with requested carton type. All picks of one order are planned to be fulfilled by one carton.

For balancing of carton erector lines the type of carton requested by order will be considered. For order release the different types of cartons need to be used in a balanced way according to the carton erector line capabilities. Therefore, the next order to be released will be selected from a workload pool of several orders waiting to be released.

The order release mechanism is pull based. The total number of cartons inside the system is tracked and compared against the capacity of whole system. The capacity of system is decreased as soon as a carton erection is triggered by order release and is increased, after it enters the dispatching area. That means as far as one carton is routed to lidding and shipping label machine, WCS will not consider this carton by calculation of system capacity. The present situation at dispatching area is not considered (filling level of the sorter, number of assigned chutes). Therefor there is no delay or interrupt in carton release due to constraint violations at dispatch area. Boxes currently in OoS buffer and in QC stations must not be taken into account for the system capacity threshold.

The order release mechanism checks periodically, if the threshold of system capacity is not exceeded. In that case all orders of the next priority route which met the preconditions are released into the system, independent of the size of the next priority group.

Order view is a GUI where the superuser can see a list of the boxes that cannot be released and the reason for them to be blocked(e.g. shipping label missing, recipe cards not ready, SKU OoS, etc)

9.15.3.1 Special functions for order release:

- Superuser can restart boxes without any reason. This is only in WCS dialog possible, after pressing the restart button the superuser must confirm. This functionality is possible with boxes in every state.

- Superusers can force the release of order with SKUs OoS. This can be applied to multiple orders simultaneously using advanced filtering and sorting functionality. After execution of possible picking the orders are then routed to OoS Buffer. For the selected orders the complete route will be released. In case of manually order release DiQ ignores the order release preconditions except:
 - The availability of PoD recipe media
 - the availability of SKU gross weight in DiQ (> 0.0)
 - order is on hold
 - SKU is blocked on SKU level
- In WCS dialog superuser can hold on orders. The selected orders are not released before the administrator unlocks this order. This order can be selected based on multiple criteria:
 - Orders containing a specific SKU
 - Orders from an specific route
 - Specific order numbers

9.15.4 Order Status

Beside DiQ standard order statuses additional statuses are required for tracking and fulfilling of HelloFresh order process.

Following table describes the several statuses of HelloFresh order

Status	Description	Flag/ Order Status
Pending	Order received from host successfully and crated in DiQ. Order stays in this status as far the route it belongs to, has enough priority . In this status the order can be updated.	Status
On Hold	Order paused by host and cannot released because of e.g. out of stock. This flag can be only removed by host. This does not block the complete route to be released. If the route is released and one order is in status on hold , this order changes status to preparedOnHold. In this status the order can be updated.	Flag
PreparedOnHold	Route of order has the right priority but the order does not meet the preconditions or is blocked by the host.	Flag

Status	Description	Flag/ Order Status
Prepared	Order is selected and ready to be released. For such orders alle preconditions are met and the route of the order has the right priority. The carton for this order can be already triggered but no label has been applied.	Status
Released	Box is erected and already labeled and connected with order	Status
Active	Box is being fulfilled. After the first pick is done.	Status
In QC	Box is in QC station. This status can help to find missing boxes	Flag
In OoS	Box is on the line and one of the order lines is out of stock. Or Box on out of stock buffer or in out of stock hold locations. This status can help to find missing boxes	Flag
Shipping label applied	Shipping label has been created and applied to the box. No update of shipping label can be considered by DiQ.	Flag
Finished	Box is completely picked and dispatched to chute	Status
Canceled	Box is canceled in the system and does not require to be finished. Or Internal cancel by DiQ in case of order restart. Creation of copy of order with slightly different ID	Status

All statuses of order will be used for Dashboard and tracking of order process.

DiQ creates facts for status or flag changes and informs the host system by sending an orderStatus message to the host.

9.15.5 Minimum cost routing algorithm

For the Simulation a special routing algorithm is used, called Minimum cost routing algorithm (MCA).

The basic idea of MCA is to assign the next job to the string and stations that have the lowest planned picks so far. MCA focuses on balancing the number of visits per pick station by incrementing the maximum number of SKUs which can be picked per pick station visit and per order carton, which in return should reflect the "cost" of visiting that specific pick station combination. A pick station combination is selected by minimizing the total number of possible picks.

The MCA seeks to balance the utilization of the pick stations by tracking the work (represented by a cost on the station) assigned to each station and selecting a valid route with the lowest overall cost. For a route to be valid it cannot contain more than one string from strings 1-5 and more than one from string 6-10.

The simulation report V1.9 provides a detailed description of MCA implementation. This will be used as basic for the implementation of MCA in DiQ. The simulation report is part of this document and added as annex:

- 20220204_HelloFresh_Simulation_Specification_v1.9.pdf

The MCA requires the usage and linkage of an solver algorithm.

The solver which will be used to implement MCA in Dematic optimize IQ will be decided in software design phase.

9.15.6 System Balancing

For Keeping the workload for each area balanced as far as possible, the system balancing of HelloFresh warehouse will be considered on two stages individually: whole system and picking area.

For each stage a capacity threshold will be defined as system parameter which can be changed by Super User.

9.15.6.1 Whole system balancing

If the threshold of whole system capacity is exceeded then no new routes allowed to be released.

Definition of whole system capacity

Carton	Box status	Simulation whole system capacity. Consider:	Implementation whole system capacity. Consider:
Not erected	Pending	No (big pool in simulation)	No
	On Hold	No (always 0 = in big pool simulation)	No
	Prepared on hold	(always = 0)	Yes
	Prepared	Yes	Yes
Erected	Released	Yes	Yes
	Active	Yes	Yes
	In QC	Yes	Yes
	In OoS	Yes	Yes
	Shipping label applied	No	No

	Finished	No	No
--	----------	----	----

Boxes which are booked on the QC position will be excluded from the whole system capacity. This includes the one box which is physically on QC position and all boxes already arrived the QC position and already removed from the conveyor. Such boxes will be considered once there are put again on the conveyor and get transport to next destination.

Boxes inside the QC buffer will be considered by the capacity

Attention: the above table contains the calculation rules of whole system capacity.

These rules don't match the simulation rules for calculation the whole system capacity.

In simulation as far as one route is selected from big pool to small pool to be released, all boxes of this route will be considered in whole system capacity independent of status of box.

These new rules are a new requirement, therefore HelloFresh take the responsibility for any impact on performance or in sorter area caused by the exclusion of boxes with OoS from the whole system capacity calculation.

9.15.6.2 Picking area balancing

If the threshold of picking area is exceeded, then cartons arriving at entering point of picking area which coming from upstream area, have to wait until the number of cartons in the pick area fall below the threshold of picking area.

Boxes which are booked on the QC position will be excluded from picking area capacity. This includes the one box which is physically on QC position and all boxes already arrived the QC position and already removed from the conveyor. Such boxes will be considered once there are put again on the conveyor and get transport to next destination.

Boxes inside the QC buffer will be considered by the capacity.

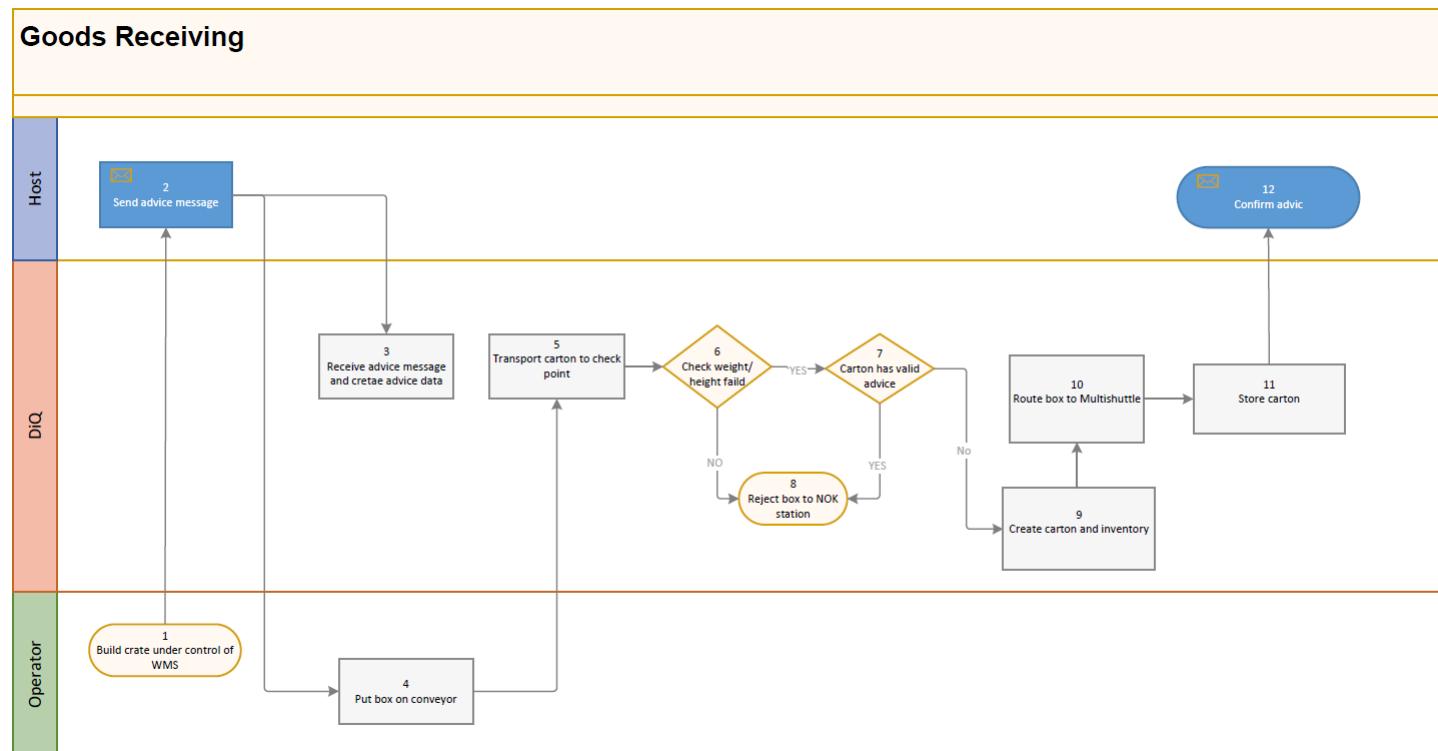
9.16 Meal Kits Storage - Multishuttle

9.16.1 Purpose

This chapter describes the business processes planned for Multishuttle area. The Multishuttle area will be used to store meal kits (SKUs) which will be used by replenishment process for the picking lanes.

9.16.2 Goods Receiving

For storage meal kits in Multishuttle the build of crates with meal kits are in the responsibility of WMS. The following diagram and description below provides the steps required by goods receiving process from build of box till store the box into Multishuttle.



Step	Description
1	The operator produce the meal kits and build the crate under control of WMS
2	Host system sends an adviceInsertUpdate message to DiQ contains the box barcode and decanted SKUs
3	DiQ receives the advice and create an advice in the database
4	The operator puts the box on the conveyor
5	DiQ transports the crate over the conveyor to a check point where the advice weight and height of the crate will be checked.
6	<p>DiQ checks the height of crate and if goods stick out of crate.</p> <p>The weight check is used to verify that the crates do not exceed maximum allowed weight in the MK Multishuttle</p> <p>If the weight or height of crate is over the threshold allowed for storage in Multishuttle, DiQ will reject the box. Proceed to step 8</p>

Step	Description
7	DiQ checks the availability of an valid advice for the box. the box will be rejected if no valid advice for the box exists in DiQ. Proceed to step 8
8	DiQ routs the box to NOK workstation of line. See 9.16.2.2
9	If the check of weight, height and advice was successfully DiQ create load unit and inventory of carton based on advice data
10	DiQ routes the box to Multishuttle and decides where the SKU will be stored dynamically. DiQ will do the putaway of the crates as follows: - Every empty flowrack channel is a potential channel for one single SKU - One flowrack channel can only allocate one SKU ID at the same time, except for NOK flow rack channels. These strategies will be used to prove the capacity of meal kits buffer. Further strategies as described in document "MK Buffer control strategies mitigation_v20220608" will be clarified by upcoming change request.
11	DiQ stores the box in determined channel
12	DiQ confirms the storage of crate on Multishuttle system by sending the message adviceConfirm to the host system (contains crate ID and its location on Multishuttle)

As emergency solution (e.g. in case that the host system is down and cannot create advices) Dematic optimize IQ will provide a decanting process without advices from the host system. By a special dialog the operator will have the possibility to create an internal advice. Operator selects one SKU defined in DiQ and decant it into the box. An internal advice for the selected SKU and determined box will be created automatically. The box can be received according to the steps in Goods Receiving diagram beginning from step 4. Such advices must be also confirmed to the host.

9.16.2.1 Infeed scales

Scales are located before the QC stations and have the task to check the box weight concerning the maximum allowed weigh for Multishuttle system.

For Multishuttle system there are 2 scales designed, one for each infeed conveyer.

9.16.2.2 NOK Station

In the crate induction conveyors there is one NOK workstation for each. Crates can be routed to NOK stations cause of following reasons:

- No Read

- No valid advice for the box
- Weight error
- Height control error
- No free capacity in Multishuttle

DiQ clarification will displays the error message and an instruction to handle the box on NOK station.

9.16.2.3 NOK Lane in Multishuttle

For each flow rack level there is a single NOK flow rack designed. If e.g. one flow rack channel is blocked, the Multishuttle can use the NOK flow rack channel to store the crates which don't have available flow rack. Several SKUs can be stored in NOK flow rack.

HelloFresh wants to configure the NOK flow rack with unlimited capacity. That means all crates which have been routed to this flow rack are allowed to be transported to it. This flow rack will be determined as full if no physical capacity is available. In this case the Multishuttle will stop and a manual handling is needed.

Clarification process:

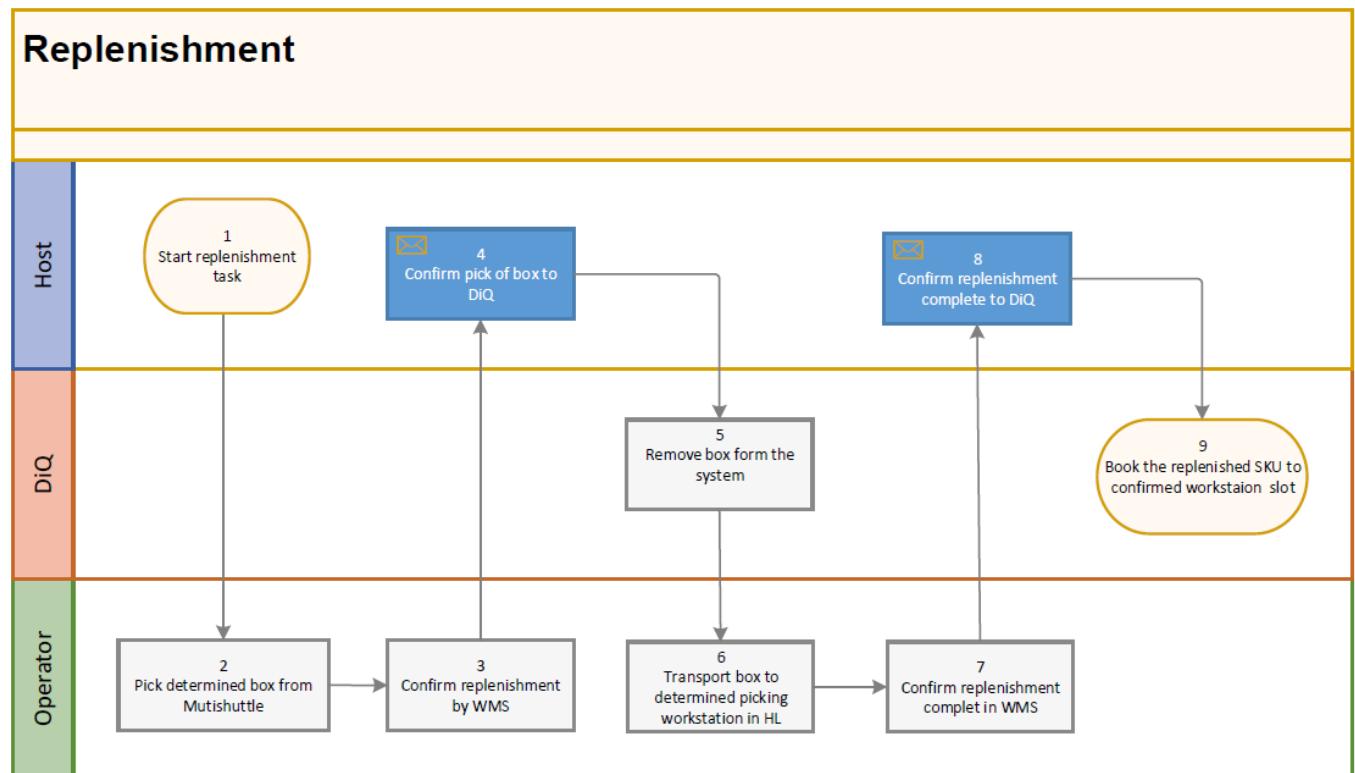
NOK flow rack has infinite capacity. Crates diverted to this lane will be considered as "in receiving" (this means not arrived at the final destination). Operators picks the crate out of NOK Flow Rack. Use cases:

- If the crate is scanned in the multishuttle (by placing it in the infeed conveyor by QC stations) it will be stored in Multishuttle following normal procedure. The advice will be confirmed to the host.
- If the crate is not placed back on the infeed conveyor but replenished to the line directly. Picker needs to scan the crate (crateDepleted message is required). The advice will be cancelled. The inventory is available for picking in HL.
- Crate is removed from NOK flow rack and forgotten. This crate will be booked in the NOK lane all the time. The crate needs to be "removed" from WCS before being used again for new SKU. The removing of the crate is done in a UI in WCS by the line lead.

9.16.3 Replenishment

Replenishment out of Multishuttle to hybrid lines will be managed mainly by the host system. Replenishment process will be used to initiate and update the rack plan of HelloFresh and also to resolve the out of stock of SKUs during the picking process.

The following diagram and description below describe the replenishment process and the responsibility of each system.



Step	Description
1	Replenishment process will be initiated by WMS
2	The operator picks the needed load unit out of the flow rack channel manually with an RF-terminal provided by HelloFresh
3	The Operator confirms the pick of determined box in WMS
4	The host sends a "crateDepleted" message to DiQ for every picked crate
5	DiQ booked the box out from Multishuttle.
6	The Operator transports the box manually to picking workstation.
7	The Operator confirms the completion of replenishment on WMS
8	The host system sends the message "replenishmentCompleted" to DiQ contains the box ID and the target location in picking workstation
9	DiQ books the inventory on the determined location and consider it as available for order fulfillment.

HelloFresh can also replenish SKUs to picking workstations from other locations outside MK buffer. This replenishment will be also proceed according to the description in above table beginning from step 6.

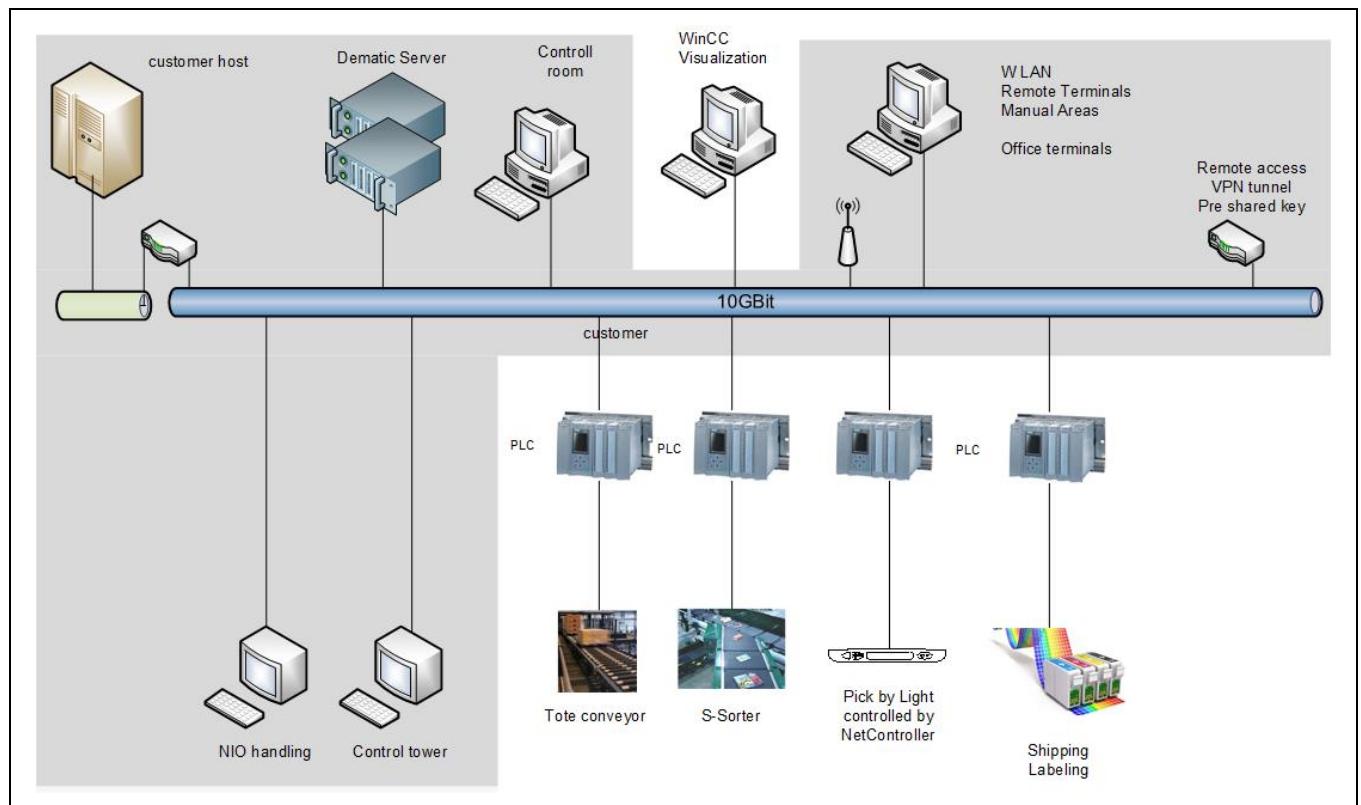
10 System Concept

Purpose

This chapter provides a high-level overview of the Dematic iQ solution from a technical as well as from a functional point of view.

10.1 System Architecture – Network Perspective

This chapter describes the integration of the Warehouse Control System (WCS) Dematic iQ into the network and IT architecture of HelloFresh.



ERP Server

The ERP server hosts the ERP System of HelloFresh.

Control Center

The Control Center offers capabilities for system supervision and system management.

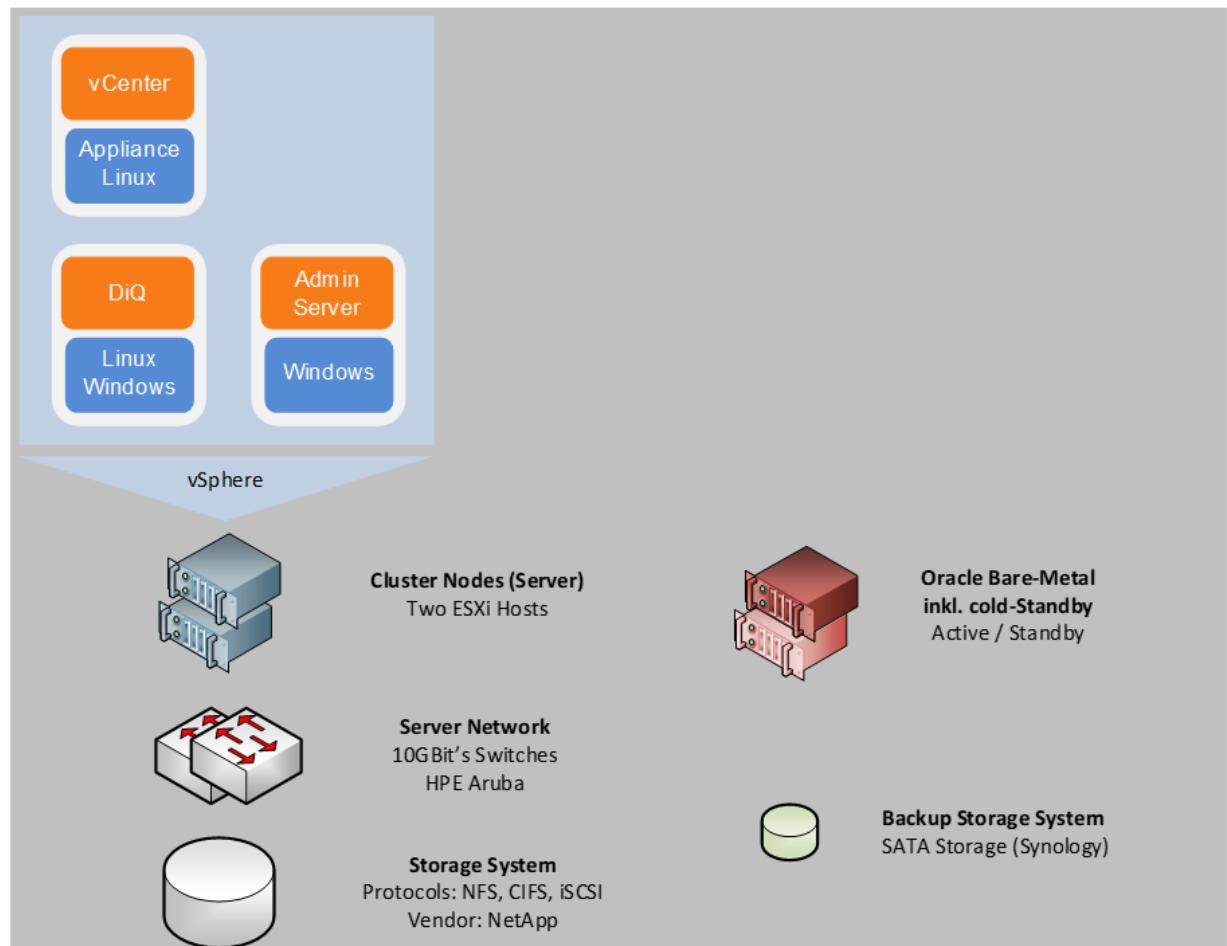
PLCs

PLCs control the mechatronic systems for pallet and case conveyors as well as the Miniload SRMs.

10.1.1 Dematic iQ Server

The Dematic iQ Server hosts the Warehouse Control System (WCS) Dematic iQ. Dematic iQ is planned to run on clustered servers which offer high availability and performance.

According to the size and complexity of HelloFresh warehouse, Dematic decide to use the implementation of Mid-sized Cluster which is the most used configuration for Dematic projects. The design proposal emphasize on stable hardware in combination with proper maintenance.



The Setup of Mid-sized Cluster includes the following hardware systems:

- Esxi Nodes
- Oracle Bare-Metal

- Server Network
- Storage System
- Backup Storage System

The production and backup data will be stored on two different storage devices.

The Storage System is connected via NFS or iSCSI (Cluster Nodes), NFS (Linux Servers) or CIFS (MS Servers).

Network:

The logical setup includes four major VLAN's within the cluster:

- Server VLAN: Production IP
- Management VLAN: All management interfaces (network switches, ILO, ESXi management, Storage SP etc.)
- Storage VLAN: Non-routed network to connect Oracle NFS and ESXi Datastores (iSCSI / NFS)
- Cluster Interconnect: Non-routed network for vMotion

The cluster components are connected via redundant network switches. The vendor will be chosen according to existing network components. A minimum of 10Gbit/s per port is mandatory. All systems are connected via ethernet only.

10.1.2 Failover Mechanisms

Duration of failover takes approximately 30 minutes including checks.

10.1.2.1 Virtual Machine Failover

If a virtual machine hangs or an ESX host has a critical failure, the affected VM will be started manually on a different ESX host. Standard vmware procedures are being followed.

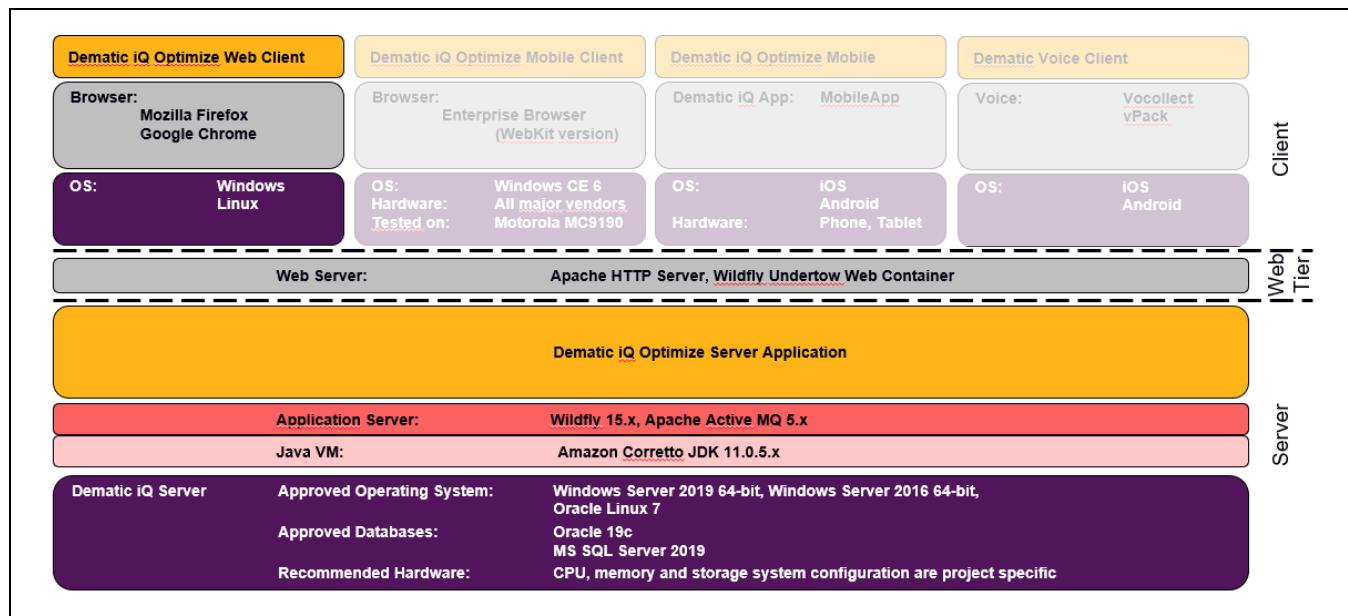
10.1.2.2 Oracle Failover

Oracle Failover is being handled manually as well.

Oracle Linux is installed locally on mirrored SSD hard drives on both database servers. The MSA provides both database servers with an NFS drive on which the database is installed. The database is started and executed by DB Server A during normal operation. In the failover scenario, the database on DB server A is stopped and will be started and executed by DB server B.

10.2 System Architecture – Technical Perspective

This section describes the software components that are required for the Dematic iQ runtime environment.



10.2.1 Layered Architecture

The Dematic iQ runtime environment is distributed across three different tiers for the Dematic iQ implementation:

Server

- The server tier is where most of the real work happens. Dematic iQ runs as an Enterprise JavaBeans (EJB) application on an application server. The application server provides many underlying services that Dematic iQ requires, such as Apache ActiveMQ (to handle messaging), Hibernate ORM (to handle object-relational mapping and persistence), and more. Dematic iQ uses WildFly as the application server.
- The application server runs on a computer (or several computers, if a multi-server deployment is used) and uses a Java Virtual Machine (JVM). To support this, we currently use the Java Development Kit (JDK) version 1.8, which provides features from Java Standard Edition (Java SE) 8. For EJB features, we use Java Enterprise Edition (Java EE) 6.
- Finally, there's the underlying operating system and database. We recommend Windows Server 2016 (64-bit), and we support Oracle (version 12) and Microsoft SQL Server databases.

Web

- The web tier includes a web server that allows calls from the client tier to be processed and routed to the correct Dematic iQ component. We use Apache HTTP Server to process web requests, and the application server (WildFly) provides a web container.

Client

The client tier includes components that we use to access the features and functionality of Dematic iQ, typically through a graphical user interface:

- The Dematic web client is accessed by using a web browser on a computer, and supported browsers include Mozilla Firefox, Google Chrome, and Microsoft Internet Explorer. These browsers can be used on computers that run Windows or Linux operating systems.
- The Dematic mobile client is accessed by using a handheld device such as a scanner or radio frequency (RF) device. These devices are typically used for operative tasks in warehouse environments, such as putaway, picking or stocktaking. The Dematic mobile client includes specific functions and screens to support these processes.
This client is currently not foreseen for this project.
- Dematic iQ for mobile is accessed by using an App on a smartphone that's running iOS or Android.
This client is currently not foreseen for this project.
- The Dematic iQ Voice Client supports bi-directional voice controlled interaction with operators. As voice control system, we use Vocollect on iOS or Android devices.
This client is currently not foreseen for this project.

10.2.2 Java-based Technology

Dematic iQ is fully implemented in Java and, thus, in principle not dependent on a specific operating system.

Software, deployed on the server, comprises system components based on Java SE (Standard Edition) as well as on Java EE (Enterprise Edition).

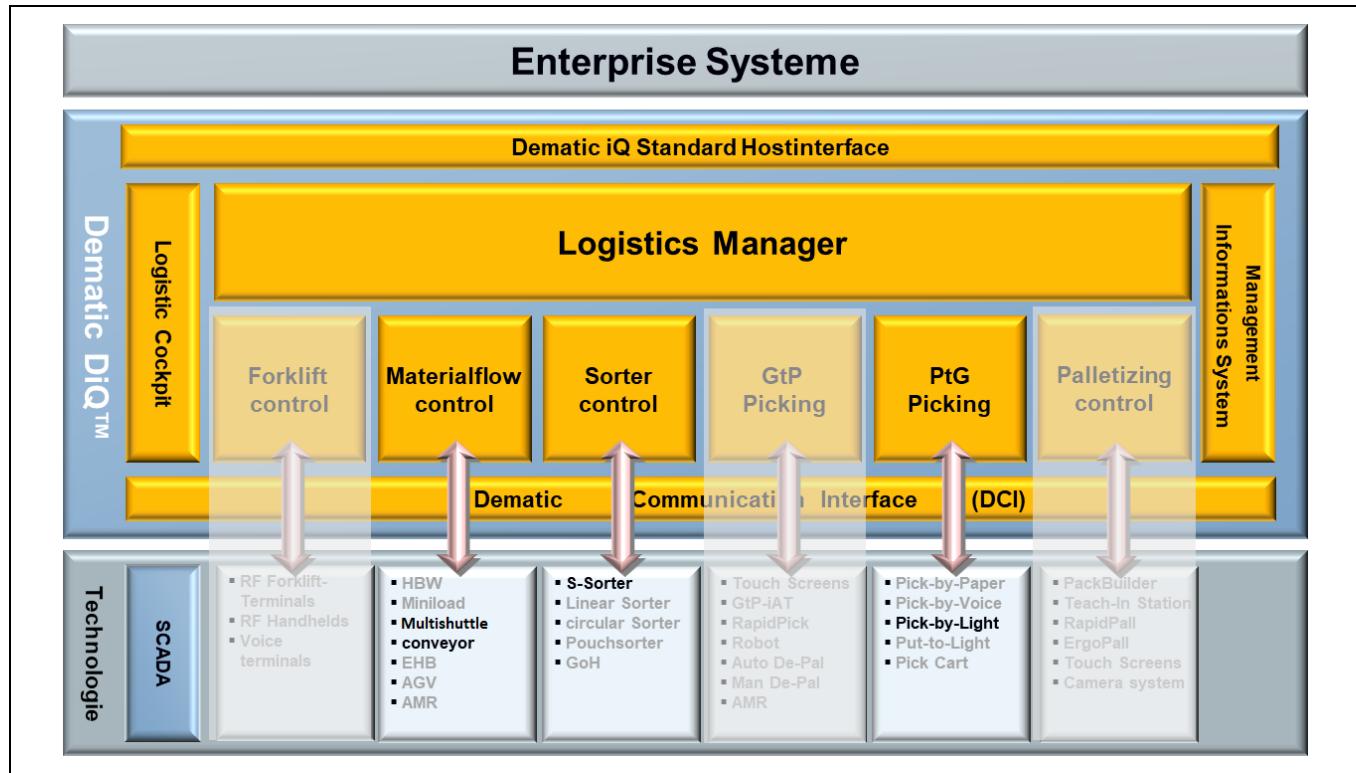
10.2.3 Java Application Server

The Java Application Server, WildFly is used as runtime environment for Java EE components on the server. WildFly is license-free.

10.2.4 Approved System Configurations

The Dematic iQ architecture makes it portable across hardware platform, operating system, and database. However, each implementation always requires full testing of the components in the configuration.

10.3 System Architecture – Functional Perspective



The picture above shows a functional decomposition of Dematic iQ subsystems.

This parts which are not required for the current solution are greyed out.

Dematic iQ Application Platform

The Dematic iQ Application Platform (APP) is the technical foundation of all Dematic iQ business functions.

In addition to the technical infrastructure and implementation patterns, it provides also general services which are essentially independent from specific business functionality.

Some of those, which are important for the current project, are mentioned below.

Component	Description
User Management	Management of users, roles and permissions
Shift Management	Management of shifts for reporting
User Interface	Infrastructure and common features for Dematic iQ user interfaces
Terminal Management	Management of terminals
Printing Infrastructure	Infrastructure for printing of labels and lists

Component	Description
Cron Jobs	Management and scheduling of batch processes and demons
Alarming	Configuration and management of alarms with alarm subscription
Configuration	Management of mainly static configuration parameters
Audit trail	Generic mechanism for configurable auditing of all modification of business entities
Archiving and Purging	Infrastructure for purging outdated data from the production system and archiving selected data in an archive system
KPIs and Facts	Facts management for capturing statistical data and configurable aggregation for dashboards and reports
Business journal	Journaling of business events such as inventory modifications, order management and transports.
EAI / Host interface	Infrastructure for communication with external systems including connector architecture

Logistics Manager (LMS)

This subsystem includes the essential logistics functions

Component	Description
Warehouse Resource Management	Management of resources such as facilities, areas, locations, and load units
Inventory Management	Management of inventory with systematic tracking of all inventory-related movements including blocking
Inbound Operations	Handling of advices and receiving of inventory and putaway
Order Management	Management of orders with transfer from host and confirmation to host systems
Order Fulfillment	Various variants of picking and order processing
Internal Operations	Replenishment, relocations and stocktaking

Material Flow Control (MFC)

This subsystem manages all transports of load units within the warehouse through communication with the relevant devices, such as conveyor PLCs.

Carton Routing and Sortation

This subsystem is responsible for support of sortation processes using sorters.

Goods-to-Person Picking

This subsystem is responsible for support of picking at stationary workstations.

Logistics Cockpit

The logistics cockpit includes dashboards for monitoring and controlling the entire system.

Management Information System

This subsystem provides reports and statistics on business processes for which KPIs were captured during business operations.

11 Datawarehouse

For long time analyses HelloFresh requires a 1:1 copy from productive database.

To avoid any side effects on the warehouse live processes the database copy will be created from the database backup. Dematic will implement a copy job which transfers the database copy to HelloFresh target database in predefined time slots.

HelloFresh prefer to use Cloud solution (AWS RDS) as target for the database copy.

The risk for Cloud solution compared to create the copy on physical server can be related with performance and network, which cannot be evaluated from Dematic side.

The delivery, configuration and support for target (physical server/Cloud system) is not in the responsibility of Dematic.

12 External Interfaces

12.1 Purpose

This chapter describes interfaces to external systems within the overall solution.

Dematic is responsible for the Dematic iQ Optimize side of this interface. The host portion of this interface is the responsibility of HelloFresh.

12.1.1 Host Messages

The Dematic iQ Optimize host communication method uses REST services with JSON messages. Dematic will provide a Host Interface specification describing the protocol and message formats.

Following messages are required to fulfill HelloFresh processes:

Message	Direction	Description/Use Case
skulInsertUpdate	Host > DiQ	SKU master data
orderInsertUpdate	Host > DiQ	order data to create orders
orderStatus	DiQ > Host	Required when an order get new status, e.g. pending, released, in QC, in OoS, .. etc.
orderQuery	DiQ > Host	Check the availability of print out data before order release
queryResponse	Host > DiQ	printout is ready to dispense
printRequest	DiQ > Host	Send from DiQ to trigger print out
shippingLabelPrint	DiQ > Host	Confirmation that shipping label is printed
PickComplete	DiQ > Host	Send for each confirmed pick
orderConfirm	DiQ > Host	Confirmation of order fulfillment
setOrderOnHold	Host > DiQ	Hold an order from being released
OutOfStock	DiQ > Host	Channel of picking workstation is marked as out of stock
crateDepleted	Host > DiQ	Box has been taken out of the Multishuttle by replenishment process
replenishmentComplete	Host > DiQ	Replenished box is located in picking workstation slot.

adviceInsertUpdate	Host > DiQ	Send to store box in Mealkit buffer
adviceConfirm	DiQ > Host	Send when box stored successfully in DMS
workstationStatus	DiQ > Host	Send when the status of a station changed, e.g active manned, closed, ..etc.
orderCancel	Host > DiQ	Cancellation of an order on the host level
orderLineChange	DiQ > Host	Send when SKU is not needed for the order or is substituted

The details of these messages are described in Host Interface specification.

12.2 Monitoring

12.2.1 Monitor the current status of all interfaces (Host / Ricoh)

Each system can check the availability of other system by monitoring the status of messages. That means if DiQ cannot send a message successfully to the host system then the status of message will stay on “pending”. That means the host system cannot receive the message and is for messages exchanges not available. The same monitoring should be done on other side to check the availability of DiQ.

12.2.2 Monitor current status of uploads and data transfers

All received and sent messages are stored in DiQ staging table and can be checked in DiQ User interface by the screen HostIn and HostOut

12.2.3 Manual upload of host files

as fallback option in case the host systems are down HelloFresh requires a new function to upload the host messages manually in DiQ. This function is needed for following messages:

- orderInsertUpdate
- replenishmentComplete
- skulnsertUpdate
- crateDepleted
- adviceInsertUpdate

The host JSON files will not be uploaded via the DiQ GUI. The files will be stored in a folder which located on the DiQ server. Super User copies the JSON files of the messages in this folder. DiQ reads these messages and imports them into DiQ staging tables. The messages will be proceeded by standard processes.

The name of manual uploaded files must have the following format:

- 12 numbers + underscore before the message name
- Underscore + 2 numbers + underscore + WF after the message name

Following are examples for all message types:

- 000000000001_OrderInsertUpdate_01_WF.json
- 000000000001_ReplenishmentComplete_01_WF.json
- 000000000002_SkuInsertUpdate_01_WF.json
- 000000000002_CrateDepleted _01_WF.json
- 000000000002_AdviceInsertUpdate_01_WF.json

12.2.4 Errors and warning of individual host messages

Errors and warning of individual host messages are available and clearly displayed in staging table screens or in alarm monitor

12.2.5 Ability to actively check for the status of messages Interface messages status

Error messages available in staging table and screens. API is not available.

In case interface failure messages are stored and marked as “in error” and can be sent to the endpoint as soon as the interface is established by manually triggering them.

12.2.6 Access the log files for every interface

All logs are available on server. Logs for inbound message can be found in one log. The logs of each outbound message can be found in the log file of business process which sends this

13 Dashboards and Reports

13.1 Purpose

This chapter describes the predefined dashboards, KPI's and reports provided with Dematic iQ Optimize.

13.2 Overview

The Logistics Cockpit, a collection of dashboards, provides the user with an overview of the system health as well as the current operational status. Current operational data provides decision support to the system supervisors. The Logistics Cockpit is launched from any customer PC.

Dematic iQ Optimize collects trend information for defined key performance indicators (KPI's). The KPI's tracked include; external interfaces, equipment availability, storage utilization, receiving and order fulfillment.

Dematic iQ Optimize provides operational reports including storage utilization, inventory details, warehouse performance, outstanding and completed work and picker performance.

13.3 Operational Dashboards

Following are standard dashboards were included in Dematic proposal. These dashboards will be delivered with standard design Dematic optimize iQ and doesn't contain extends diagrams or values.

13.3.1 Cockpit Overview

The Cockpit Overview screen displays the Key Performance Indicators of the warehouse and an indication of potential problems including late orders, missing deliveries etc.

13.3.2 Receiving Overview

The Receiving Overview screen displays the current receiving process information. Receiving information includes; advices and expected load units for both manual and automatic receiving areas. Additionally potential problems such as missing deliveries are highlighted.

13.3.3 Storage Overview

The Storage Overview screen displays the current storage information for all storage areas. Storage information includes; capacity, movements, housekeeping and equipment availability.

13.3.4 Picking Overview

The Picking Overview screen displays the current picking information for all pick areas. Picking information includes; open picks, pick containers, pick orders, outstanding work and completed work.

13.3.5 Shipping Overview

The Shipping Overview screen displays current fulfillment information for shipping orders. Fulfillment information includes; potential problems i.e. Late orders, and an overview of the outstanding work. Outstanding work shows the number of "released" or "active" shipping orders, the number of "released" or "active" full load unit retrievals and completed work.

13.4 Reports

HelloFresh don't require specific reports. Dematic will deliver the required data by using the facts concept of Dematic optimize iQ. The List of specific facts and the details of required data will be specified in separate document as change request.

As far as the FACTS have an impact on Go-Live, the following reports from sales Document will be delivered:

- Shorts Report
- NOK Mode Report
- Barcode Error Report
- Daily Receipts Report
- Completed Work Report
- MFC Reactivity Report
- Finished Shipping Orders Report
- Announced Shipping Orders Report
- Host Document Movement Report
- Transport Request Report

According to Dematic proposal 12 additional reports will be delivered.

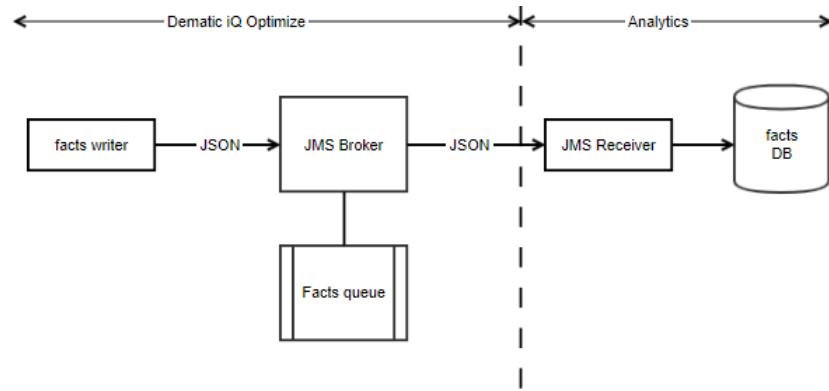
13.5 Facts

The analytics interface provides a mechanisms for writing a fact to a data storage so that the concrete implementation of this data storage is transparent to the generator of the fact.

There are two prominent flavors of such data storages:

- The Dematic iQ Optimize database itself. In this case facts data are written either synchronously or asynchronously.
- The "Analytics" database which is a completely different system which in general runs on a different host (maybe in the cloud). For the analytics system there are two ways to receive the data:
 - receiving each individual fact via a JMS queue
 - receiving a bunch of facts via exported data files

The following picture shows the details of how Dematic iQ Optimize interacts with the Analytics System:



- Whenever a fact is to be created on the "Dematic iQ Optimize" side, the facts writer converts the data structure of the fact to a JSON String which is sent via the JMS broker (Active MQ) to a dedicated "facts queue".
- On the "Analytics" side a JMS receiver connects to the "facts queue". Whenever a new fact is received it will get stored into the facts DB for further processing (translation, aggregation, ...).
- The "facts queue" is managed on the Dematic iQ Optimize side. This has the advantage that facts messages are queued persistently in case "Analytics" is not reachable.
- The facts queue resp. the whole broker storage is monitored. In case of a reached threshold, further writing to the facts queue is inhibited. This should prevent storage exceptions in case when the Analytics system is down and can not process the messages.

14 Purging and Archiving

14.1 Purpose

This chapter describes purging, archiving, and auditing features in Dematic iQ Optimize.

14.2 Overview

The purge feature in Dematic iQ Optimize allows for the deleting of operational data from the production tables. Data must reach its final state, if applicable, before it is permitted to be purged.

The archive feature in Dematic iQ Optimize copies relevant operational data from the production tables to archive tables.

At the beginning audit trail and archiving will not be activated. Afterward Dematic and HelloFresh determines the relevant entities for which these features should be activated.

Data available

The following rules will be used to retain operational data:

Function	Production Retention (Days)
Orders	14
Advices	14
Inventory Journal	14
other tables	14

15 Test Policy

15.1 Mission

Satisfy end user requirements resulting in client satisfaction by continuously verifying, validating and measuring the quality of solutions, focusing on defect prevention and encompassing efficient, quality risk management.

15.2 Test levels

promote mitigation of quality risk as early as possible and to the highest practical extent.

Level	Owner	Objective(s)	Key Area of Testing
Requirements	Quality Assurance	Detect missing or vague requirements	Functionality and performance requirements
Unit	Development	Detect defective code in units	Functionality and performance
Integration	Development & QA	Detect defects in unit interfaces	Functionality, data quality, unit interoperability and compatibility, performance
System	Quality Assurance	Detect defects in use cases and end-to-end scenarios	Functionality, data quality, performance, reliability, usability, resource utilization
Acceptance	SIM/Project	Demonstrate readiness for deployment	Functionality and performance

15.3 KPIs

Project teams are responsible for establishing KPIs at each level for test activities that address the following areas:

- Defect detection effectiveness
- Risk coverage and sequencing

15.4 Unit-Testing:

Unit-Testing is a special requirement from HelloFresh to have the possibility to do Unit-Testing. Unit-Testing means that a QA resource will test the software during the development phase of Dematic.

Unit-Testing will be executed on the HelloFresh Test Server. The update of DiQ on test server depends on development progress. When an area is implemented and already tested by Dematic QA team, the new version will be deployed on the HelloFresh Test Server.

Following support will be provided by Dematic resources:

- Introduction to DiQ: 2 weeks (80 hours)
- Creation of test plan: 2 weeks (80 hours)
- Review of test result one session (day) per week, in total 15 sessions (total 120 hours)
- Technical support and updates: 2 weeks (80 hours)