Warehouse Management System (WMS)

Plugin for iDempiere

FULLY DESIGNED AND CODED BY

Redhuan D. Oon (red1)

sponsored by Zeeshan Hasan,

SYSNOVA Information Systems Ltd, Bangladesh

THIS IS TO EXPLAIN FULLY HOW THE PLUGIN WORKS AND HOW YOU CAN IMPROVE IT AS AN OPEN SOURCE PROJECT. PLEASE PRESERVE BRANDING AND CREDITS IN ANY IMPROVED WORK AND SHARE THEM BACK TO THE PUBLIC DOMAIN UNDER GPL.

THIS DOCUMENTATION IS PART OF A SERIES TO MAKE SURE ERP SOFTWARE IS CONSTANTLY REVIEWED, IMPROVED, TESTED AND DOCUMENTED WELL AND EASIER TO USE. PLEASE SUPPORT ME FURTHER AT MY PAYPAL RED1@RED1.ORG TO MAKE MORE OF THIS POSSIBLE. THANK YOU FOR SUPPORTING FREEDOM FOR BETTER AND SUSTAINABLE SOFTWARE.

iRoses e.V.

Institute for Research on Open Source ERP-Software
founded by Redhuan D. Oon

I STARTED WRITING THIS DOCUMENT IN THE SEASIDE VILLAGE OF ROMPIN IN EAST COAST MALAYSIA. THE WORK THEREIN WAS DONE MOSTLY WHILE TRAVELLING AROUND THAILAND, VIETNAM AND INDONESIA.

VERSION 1.0 - JULY 6, 2017 - KAMPUNG KUALA ROMPIN, MALAYSIA

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BANGLADESH

RED1's THREE LAWS:

Information is Free

YOU HAVE TO KNOW

People are Not

YOU HAVE TO PAY

Contributors are Priceless

YOU HAVE TO BE

THE BEST FREE* WMS SYSTEM

- ✓ Written from the ground up without impact to main core but within the design of pure plugin/meta-data injection into iDempiere's OSGi powerful framework.
- ✓ Gain full control over your warehouse floor flows. From Purchasing (inbound) till Sales (outbound) with full integration to core Receipt/Shipments and Material Movements.
- ✓ Warehouse Locators Aisle-Bin-Level matrix generated to full physical layout.
- ✓ FIFO/LIFO handling with floor route putaway/picking sequence.
- ✓ Locator size handles differentials in dimensions, volume and weight via unique Qty Pack Factor concept.
- ✓ Putaway process can be set for Preferred Product, Storage Types (such as Fragile, Expired, Testing, Slow/Fast Moving).
- ✓ Sale Order can pre-book item and reserve it at specific Locator.
- ✓ Forecast warehouse capacity analysis from undelivered purchases/sales.

- ✓ Part of a larger track and trace logistics framework together with Manufacturing, Vendor Contracting and Ship-Forwarding.

This WMS plugin is also built more easily, rapidly and visibly using Red1's Ninja Module Creator. Thus the whole design and structure is easily maintained and improved better than expected.

The use of FitNesse Testing is vital to the releasing of each version as it checks important logic against any creeping bugs thoroughly and within seconds.

Subject matter expertise is from the author himself with more than three decades in business computing industry as well as referring to other peers in the community such as Nakarat (Thailand), Norbert Bede (Slovakia), SAP's WMS, and other online research.

Been free* software, this project is based on other similar software and shall continue on.

**Free as in freedom, not free lunch.* - Richard M. Stallman, 1990.

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Introduction

Overview

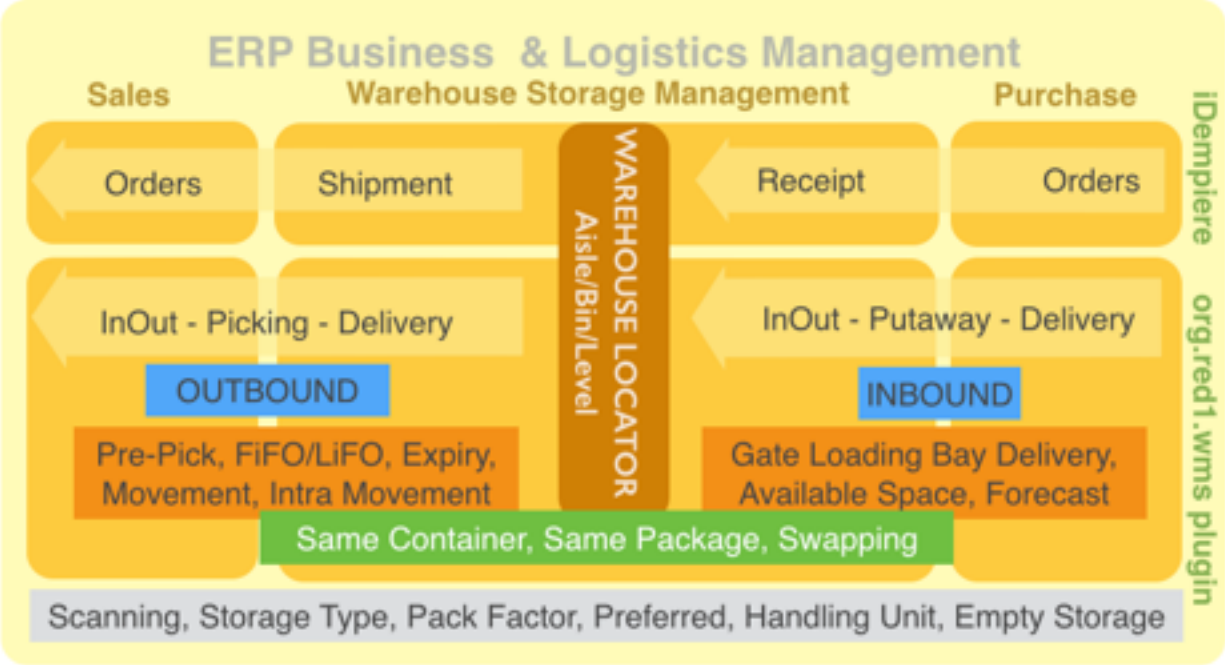


Figure pg 1 - Overview of how WMS is extension of the ERP system

Warehousing Management System (WMS) is the domain that sits between the S&D (Sales and Distribution) and the M&M (Material Management) domains in an Enterprise Resource Planning (ERP) software. A WMS manages the schedule of delivery of materials onto the premises, under the management of the Client, its proper offloading from transport vehicles, its grouping into logical packaging for easy transport further into a warehouse facility. Within the warehouse, it is properly putaway onto locator shelf space, and arranged in the manner most economical, safe and easily picked back upon demand, in accordance to business rules.

Upon picking, likewise, but in quite reverse fashion, it is sent to the loading bay to be put onto transport vehicles and sent off to its intended recepients. In a way, WMS is part of a larger Logistics domain i.e. Shipping and Forwarding. WMS also works together where applicable, a Manufacturing facility that internally produces FinishedGoods.

As a Financials based ERP is the base upon which the WMS works on, the Accounting interface is crucial in ensuring associated financials and costing data is also aptly recorded and managed.

Modern software is amiss if there is no decision support analysis or a dashboard showing aggregate data. Thus in this WMS, I attempt to provide a BI (Business Intelligence) Excel spreadsheet to examine a warehouse facility capacity management by forecasting over a timeline of planned purchases and sales.

Why Rewrite WMS?

As long-time users of iDempiere (since Compiere and ADempiere) probably know, Libero WMS was part of Libero Manufacturing (MFG) but hardly reviewed by actual users and upon my review as sponsored by Sysnova of Bangladesh, has found it to be poorly completed, lacking in certain features, and without a reasonable set of simple documentation. Most painful to review is the strewn spaghetti code inside the core.

In 2015, while in Slovakia, as a guest of Norbert Bede who took my reviewed WMS and extended it comprehensively, allowed me to examine his work but again suffers from the same symptoms as the previous contributor.

Late last year, SYSNOVA again came to the rescue and Zeeshan Hasan asked me what does it take to rectify this state of affairs. I replied that its better to try to rewrite everything from scratch.

Though it sounds drastic, it is mostly only in the data model and code base. The general ideas and lessons from the previous WMS and Slovakia use of SAP's WMS design in its version allows me to comprehend WMS as a whole before picking up the pen and craft it out completely anew.

The use of my Ninja ModuleCreator that lays out model properties relationships and code plans in a simple Excel spreadsheet allows me to draw up layer by layer, correcting gaps and ommissions quickly and effortlessly. Further use of FitNesse testing framework incorporated into iDempiere's stack of core plugins also allows me to quickly script out the new functionality steps for instant verification if anything breaks under a barrage of constant changes.

The new version is more imaginative and wholesome but most importantly as I am its creator from scratch, I pay attention to many important best practices:

1. Document well. Starting with the Excel data sets, it acts as a ready and visible artifact to examine what is been designed.
2. Refactor domain well. I tossed names around constantly to follow good convention. The prefix of old WMS such as DD_ or M_ are replaced with a clear simple WM_. I also kept the WMS to just the domain described in its title. The so called 'Distribution Order' or Shipping aspects are kept away and can be a later Shipping/Forwarding or Logistics module. Manufacturing dependency has also been removed from WMS.
3. Refactor code well. I make sure each code is properly factored and maximised for reuse in single minded short atomic methods. Exhaustive care is taken to name classes and methods and remark them for readability and understanding. It helps me myself too as one can easily get lost in the complexity of an ERP.
4. No change to core model. Besides not touching any part of iDempiere codebase, I also follow my proven practice (as testified by the key German developer implementer in the BlackPaper story) of not extending any core data model. Any change to M_Warehouse, M_Locator, C_Order or M_InOut is made as new children or sub-tab models.

5. No custom Info panels. I use extensively and heavily the iDempiere's abstract Info-Window design to quickly incorporate SQL views and selection of data for Processing (Ninja plugin easily produces such design on the fly.)
6. Solving many gaps. There are many key questions that are unheard of even among the community about WMS. Why nobody else speaks of additional locators that traverse the A-B-L matrix? What to do when the Locator is full? Or not able to fit in a Locator that is semi-full? Who has done FiFO/LiFO picking sequence? There seems to be no one sharing any WMS experience.

Thus I have to conduct self research and together with Nakarat of Thailand began to formulate sufficiently a decent usable common WMS that can be further extended to fit any more advanced and dedicated use.

The prime motivation behind my best practice is to make things work, simple, minimise long term maintenance effort and scalable. All models in the new WMS have their respective EventHandlers and ModelValidators automatically generated. All a developer needs to do is just focus on the new business logic. Of course solution design thinking when done well, can save a lot in the long run as proven here.

Is This WMS Suitable?

Been an Open Source software project, its nature is to share and collaborate and not set out to be a ready-made off-the-shelf product without guidance. Thus this manual is more of a implementor and developer guide rather than a straight forward user guide. There is no such thing as an off-the-shelf, out-of-the-box, ready-to-eat software product in ERP land.

No matter how good the intention and earnest the effort of a software maker, any ERP software by nature is difficult and complex. There is no single size fits all. The best option is to have a good enough framework experience curve to rely on and extend from there.

Such approach is the realpolitik option for any set of ERP requirements. The implementation team has to comprise of enough experience and expertise to study its design and approach, figure out the best practice of modifying or writing code without overwriting well designed core engine structures.

The right cases for considering this WMS should be the following:

1. SAP level cases where SAP has failed to give the users the access they need to the source-code. Though my recommended open source practice is not to overwrite core design, at least you have access, to decide what is the cause of a certain behaviour, and if needed how the remedy can be done elegantly without disturbing its compatibility with others.
2. Highly customised cases where no known ready made software out there can do the job. This WMS framework can then act as a half-way point to just focus on the business logic instead of the whole atmosphere from scratch.
3. The lone DIY case, who has lots of itch and free time on his/her side. Must be resourceful and well behaved.

This manual attempts to describe the project design features as thoroughly and that will mean a steep technical learning curve for mere users. I know that you know that such WMS vertical on an ERP horizontal can be very expensive out in the real world. And it is not in terms of just dollars but blood, sweat and tears. End of it, burn-out. For me, it has become both a passion and a vision to tackle such a complicated barrier to entry. For anyone willing to take this up and share their experience back is most welcome. But it has to be large enough a challenge to be worth it.

This WMS is not for a simple small outfit unless it is willing to bear the cost of complexity akin of getting a tractor to go to the market when a mere bicycle will do.

This manual will try to facilitate as much DIY (do it yourself) effort out there. Beyond that, those that require training or a hand-holding coaching through their roadmap may engage myself or the peers named here. My time is limited due to opportunity cost of not been able to be at two places at the same time or pay atention to issues that require full attention. Most of our experts are over-suscribed even of their leisure time. Thus we are selective on projects and have to charge accordingly to keep providing and maintaining such masterpieces at the same time. For those needing such services or even direct project development may write to me at my email above or alternatively at red1org@gmail.com. If I am not available or suitable I can give a one-liner advice of which direction to go. I shall outline my terms of reference for professional at the very end of this document.

For the interim, my sincere advice to any would be user, is to spend substantial time studying this as well as my other PDF books on 'large challenges' such as the Presales, ERPSoftware, The BlackPaper and FitNesseTesting PDFs.

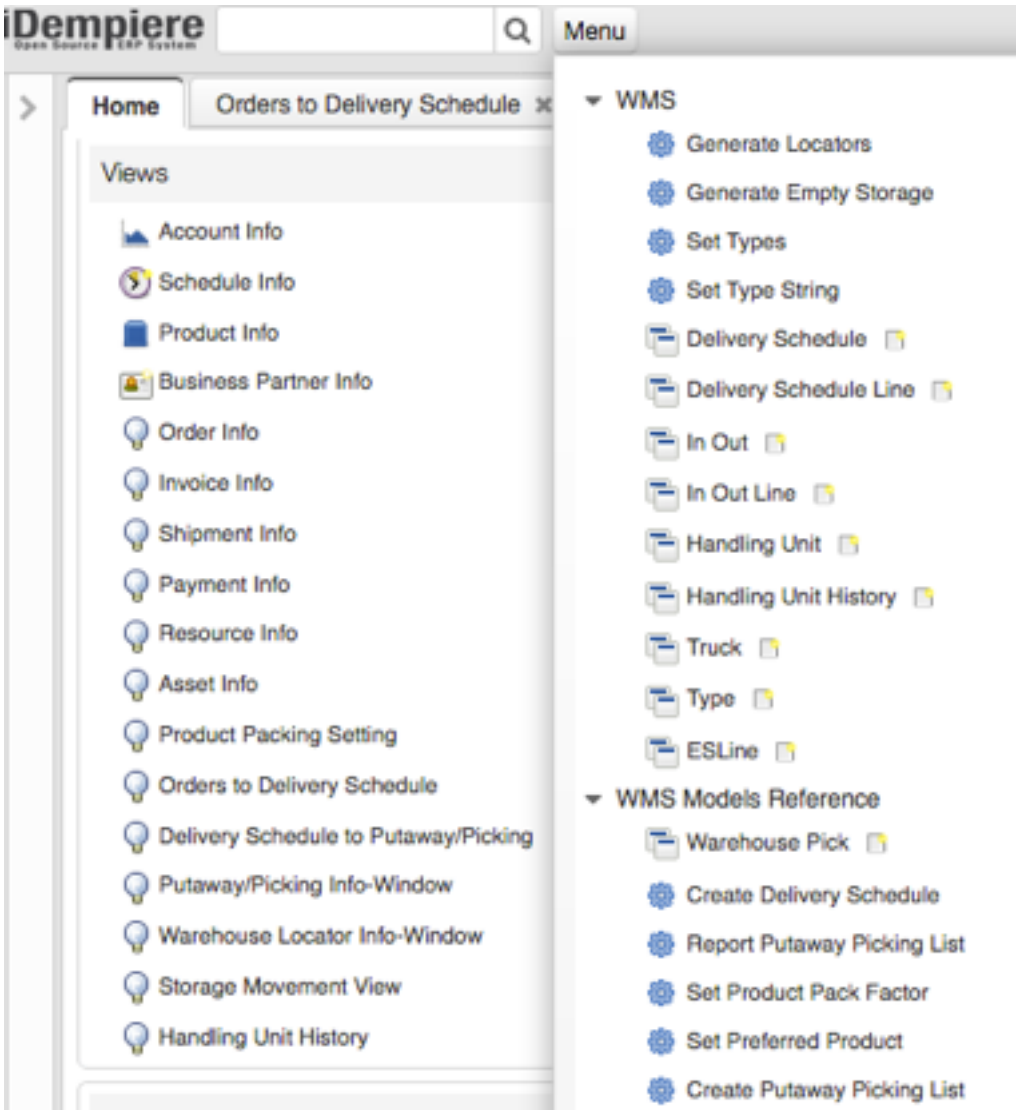


Figure pg 5 - Main Dashboard showing WMS Info-Windows and its Main Menu Items

We shall now go through some highlights of the new features that sets it apart from the previous semblance of a WMS. Then I will give a full rendition of each piece before a cheat sheet of setup steps. At the end will be a developer's guide.

Features

Here we look at main features that is key on how this WMS is built upon.

Locator Aisle-Bin-Level

All this while we see only singular Locators in the GardenWorld example denoted as 0-0-0. In the old Compiere user manual, and also seen in the Locator type, one can create new additions on the fly. But what is the numbering convention? Thus I made it as standard to serially number the Aisle, Bin, Level. I have made a GenerateLocators process to layout for every or specfic Warehouse.

In other WMSes, there is a concept of Area, Zone or Section or even Quant. These can be extended in the present but I would advice a workaround of naming such elements more virtually. Thus a whole floor can be a specific Warehouse. A certain zone can be a StorageType (more on this later).

In my Youtube demo movies I have shown how to generate a conceptual Warehouse of 4 aisles, 4 bins and 2 levels. Their Values are set visibly as i.e. HQ Transit 2-2-1 (at second aisle, second bin, first level).

With this detailed physical coordinate based layout, the Putaway process can trace a warehouse floor in sequence and likewise the Picking sequence.

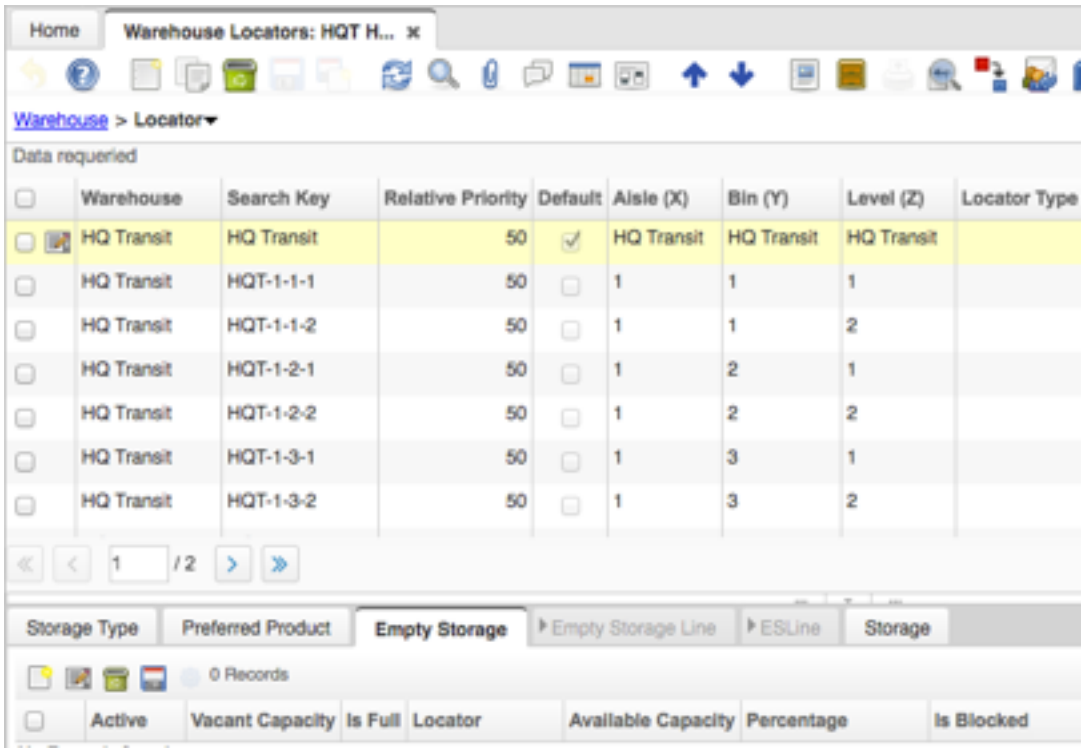


Figure pg 6 - Warehouse-Locator Tab

Storage Type

Each Locator can be set to a Storage Type. Examples are Fragile, Slow/Fast Moving, Low/High Altitude, Hazardous, Expired, Rejected, Testing.

Products also likewise can be set to similar Types. During Putaway, they are then matched and assigned to suitable locators.

In theory there can be a set of multiple StorageTypes. (I have not implemented in code on handling them, but that can be done also as the model is already well designed for that.)

To set such Types quickly we first have to create in Type window. I have made 2 ways to quickly import a long list of Types. One is via the Ninja Import Model and the other is in the FitNesse testing script. More on this towards the end of this manual.

After Types been defined, we then run SetTypes process and select which Warehouse and its parameters and the Product Category for a certain Type to be set to them. For example we can set a certain Aisle or even a whole floor, for example, Store Central 2-0-0 and Tools to type Heavy. Then when we are putting away Rake Metal, it will look for Store Central and the whole 2nd Aisle reserved for it will have its first available space set to it.

A Locator can also have a PreferredProduct. For example we can set HQ Transit 2-1-1 to Hoe.

When the preset spaces are fully occupied, the process will look at empty unassigned spots to allocate.

The concept of Zone, Area and Section can also be applied here (as a workaround for later the code can be outright extended to cover such dimensions). You can put such description as a Type and assign a zone or section of warehouse space to it.

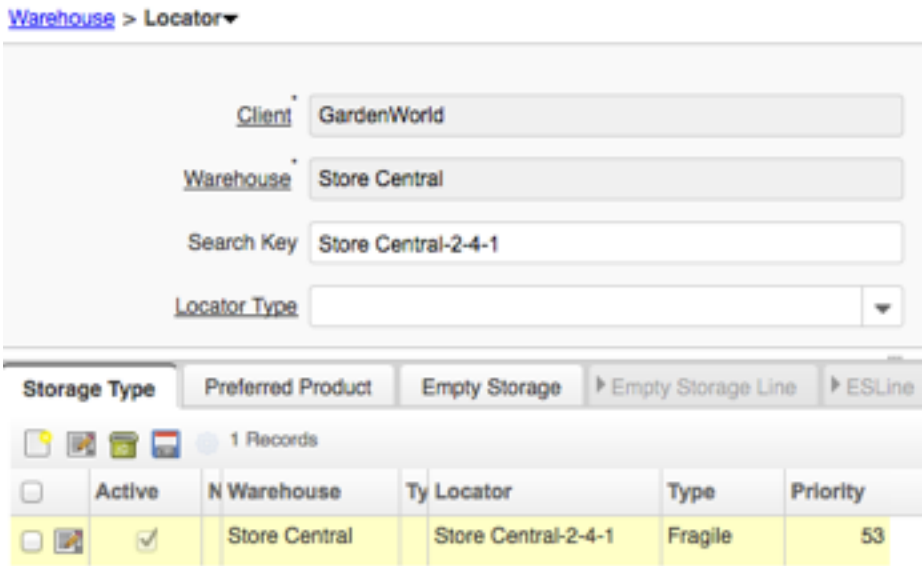


Figure pg 7 - Locator-StorageType Tab

Product Packing Factor

Dimension of a locator can be measured by length-width-depth or volume or even an open space quantity. The product items can also be equally measured in similar dimensions. Analysis can be done to calculate the capacity or maximum number of any items to fit into such a space. However it gets more complex when a locator shelf needs to house a wide spectrum of item types ranging from liquids, to boxes, to rolls and even incongruent shapes and sizes. I am introducing a new concept that can workaround any dimension type and packing. It is the clever use of a large base denominator measure and assign a PackFactor number to any product to be stored. It simply means the number of space units a certain item occupy. Figure below simply means it takes 4 units of space for each Patio Table.

For example lets say a locator bin or shelf is given a measure of 100 units as its VacantCapacity. Let's say that only 10 Hoes can fit into the locator. Thus its Product PackFactor is 10. Let's say another item, Seeder can fit 20 of them in the locator. Thus its PackFactor is 5. In this way it does not matter what is the dimension type in use, we can use the Product UnitsPerPack (as a ready made property without modifying the data model). The Putaway process will use this factor to calculate if the vacant balance is sufficient to put in and how many items of the product can fit into it.

One point to note is that the UOM may not need the Conversion approach. For example if we have a 6-pack box, we can still use the (Each) unit UOM. Thus a 6-Pack is 6 units to match with the measure of the locator.

How then is a '6-pack' or tbe packing box that the items are sent in handled? This is where the smart use of a HandlingUnit comes in.

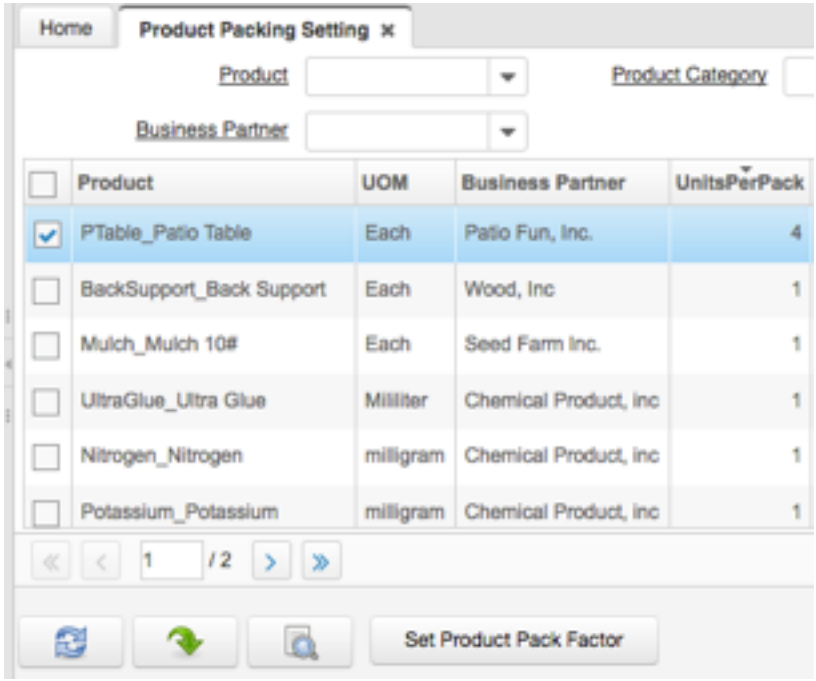


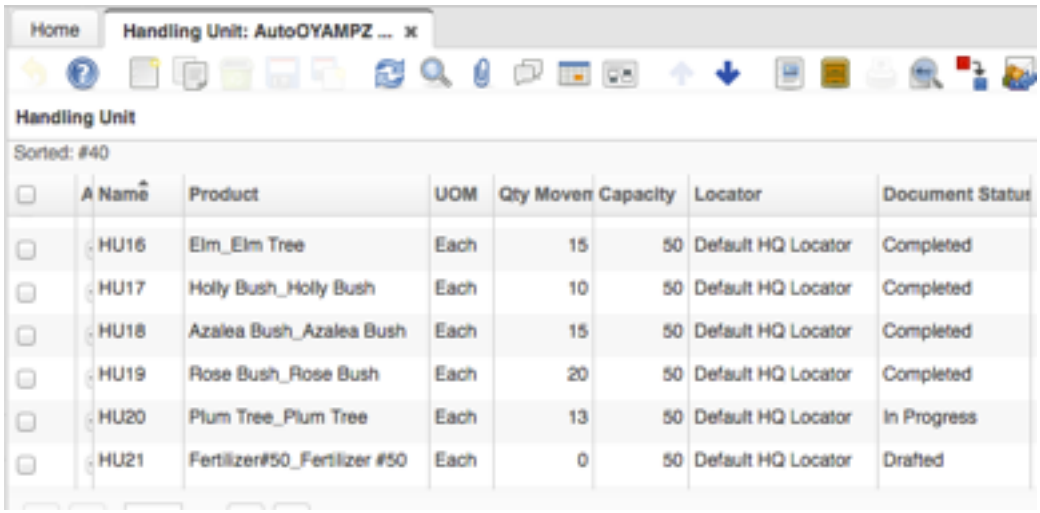
Figure pg 8 - Product PackFactor Setting

Handling Unit

The 6-pack box in the example above can be handled by a single HandlingUnit. The term is borrowed from SAP WMS but I am making it to stand for any form of packing or tracked grouping - a simple barcode, RFID chip, box, roll, drum, container or a pallet. Thus the 6-pack will be tagged as a single Handling Unit. Its UOM remains in units.

Imagine we are storing rolls of cloth. The measure is feet. One roll holds 50 feet length of cloth. Each roll can be assigned to a HandlingUnit. Let's say the Locator can store up to twenty such rolls of cloth. Thus its VacantCapacity measure is 1000 (20 X 50 feet) and the cloth PackFactor remains as 1 (if you are wondering about the PackFactor from the last discussion).

Each roll can be tagged by a RFID chip, or wrapped in a jacket with a barcode. Its UOM is always in feet. It is ideal and intuitive for each roll to be individual order lines in the governing document. Thus 3 rolls of 50 ft cloth is made as 3 order lines in a Purchase Order with each line Qty = 50.



A	Name	Product	UOM	Qty Moven	Capacity	Locator	Document Statu
	HU16	Elm_Elm Tree	Each	15	50	Default HQ Locator	Completed
	HU17	Holly Bush_Holly Bush	Each	10	50	Default HQ Locator	Completed
	HU18	Azalea Bush_Azalea Bush	Each	15	50	Default HQ Locator	Completed
	HU19	Rose Bush_Rose Bush	Each	20	50	Default HQ Locator	Completed
	HU20	Plum Tree_Plum Tree	Each	13	50	Default HQ Locator	In Progress
	HU21	Fertilizer#50_Fertilizer #50	Each	0	50	Default HQ Locator	Drafted

Figure pg 9 - Handling Unit Window with different assignments

What if we wish to break up the contents in a handling unit so as to sell part of it, or fit into a Locator bin leftover space? For example let's say a locator shelf has only 3 units of space left. The 6-pack has to be opened up to fill in 3 and its remaining balance to the next available locator. That can be an option.

This is handled by the parameters of SameLine during Putaway. If that parameter is checked Yes, then the Handling Unit will not allow the breaking up of its contents. It will look for the next Locator that has sufficient space for the 6-pack or 50 feet roll as the case maybe. if SameLine is No, then breaking up happens and another Handling Unit will be assigned to the balance quantity.

There is another parameter, SameHandlingUnit (SameDistribution), which when checked, will reuse the same HandlingUnit until it is full, irrespective of the Locators. It is like a big box or pallet that the user wants to fill all the selection of items in.

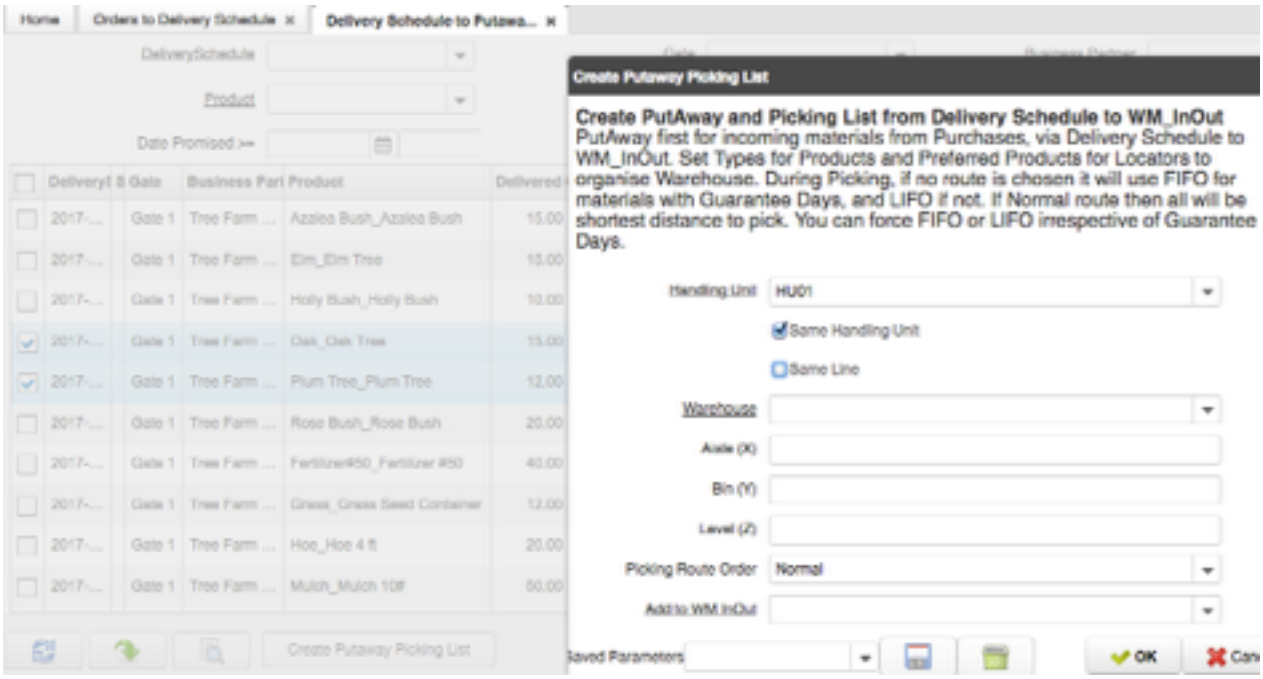


Figure pg 10.1 SameLine and SameHandlingUnit options during Putaway/Picking

Notice the above screenshot the Same Handling Unit is set for two selected items. Below is the result of the Putaway. Note that both items share the same Handling Unit. Note also the Putaway Sequence.

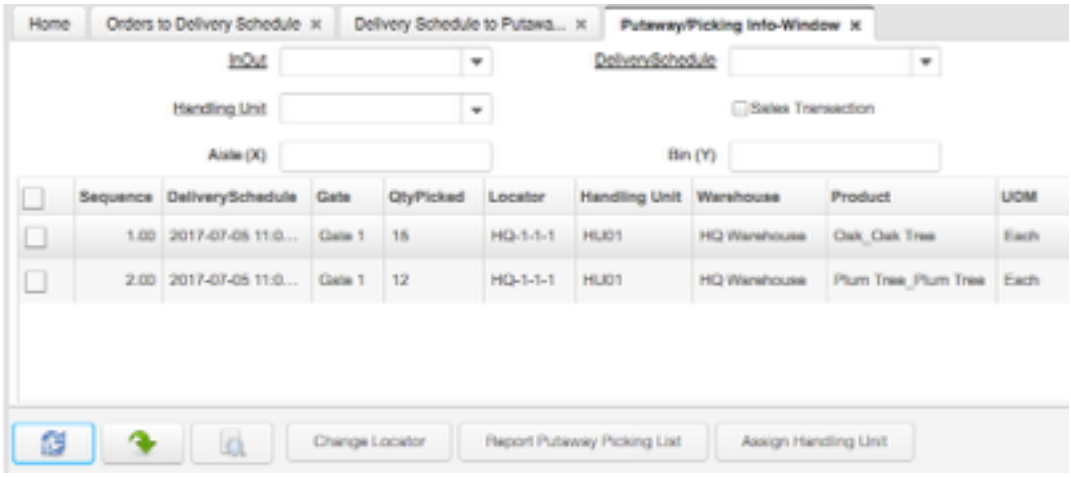


Figure pg 10.2 Putaway List with SameHandlingUnit HU01 assigned

You might then ask, 'How do you know when the Locator is Full or how much space is left?' In comes the concept of EmptyStorage, a term also borrowed from another SAP concept that Slovakia implemented in its large warehousing clients.

Empty Storage

I expanded on this idea with further imagination. This meta-model is attached to each Locator and keep track of its availability and give fast visibility over a large number of locators. It has a maximum VacantCapacity and a Percentage of AvailableCapacity. There is a box to see if its isFull status.

But there are so many items going in and out, and at same or different times, how do you keep track of them? First, both HandlingUnit and EmptyStorage have further information of such events namely HandlingUnitHistory and EmptyStorageLine. They keep track of their GuaranteeDate (to control expired goods), by having Timestamps to say when its DateStart and DateEnd for forecasting capacity over its timeline. These Timestamps type is full, not just Date but also Time of the day including seconds.

The DateStart during Putaway allows FiFO/LiFO picking based on respective DateStart. As an item is picked, its corresponding EmptyStorageLine records the current time as DateEnd. It is then removed fron contention and the AvailableCapacity is updated. So is the HandlingUnit, if all its contents are picked, it is then Released f,or reuse.

On the HandlingUnit side, it has its own MaximumCapacity that is based on the same measure of the Product PackFactor, that it can hold so that is also checked during processing.

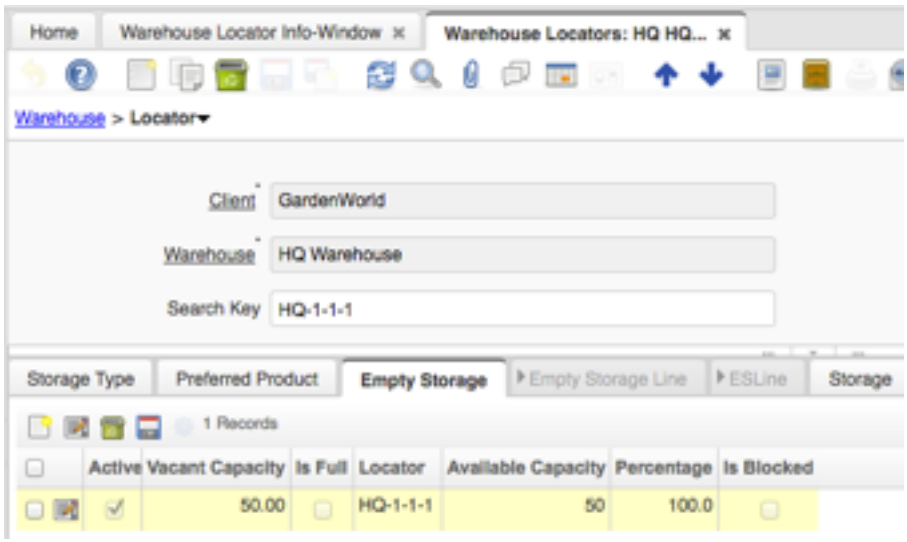


Figure pg 11 - Empty Storage Tab under Locator tab in Warehouse Window

Note in the screenshot above that Empty Storage keeps track of its available capacity in percentage also. It will have IsFull status when is true. It has an IsBlocked status that the user can gain full control to avoid certain locators been used or moved items into.

The Vacant Capacity remains constant as a denominator for percentage to calculate against. It can be manually changed by the user.

Process

These are main processes to setup the Warehouse Management System. There are mostly run one-time only at the onset of defining the parameters of a WMS.

Generate Locators

As explained, each Warehouse Locator can be extended to its various Aisles, Bins, and Levels instead of the singular 0-0-0. However to do them manually will take a long time. Thus you can use this Process to generate the Locators and populate them serially in a matter of seconds. Of course you can generate different set for a specific warehouse. It will overwrite the old settings. As long as this is done on the onset before Empty Storages are generated that depends on each Locator. Otherwise you have to delete the Empty Storages manually first before regenerating again.

Once these Locators are generated, you can then Generate EmptyStorage and begin using them.

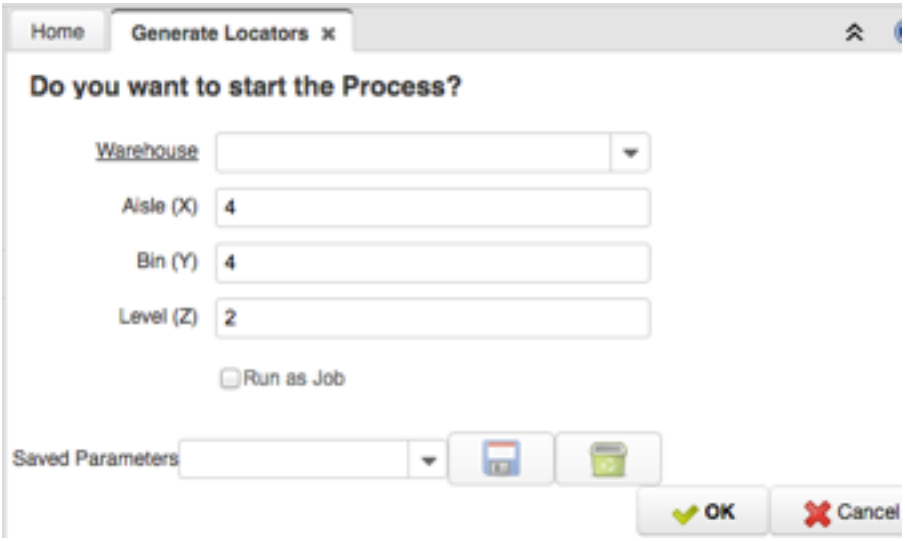


Figure pg 12 - Generate Locators from WMS Main Menu

Note the above example is put in Aisle = 4, Bin = 4 and Level = 2. If the Warehouse is selected, then only that Warehouse is generated these extra locators range. Otherwise all Warehouses will be iterated to generate such ranges throughout.

In this example, we mean there are 4 rows and each row has 4 vertical sections and also 2 levels horizontally.

Generate Empty Storage

After generating locators, you have to generate corresponding Empty Storage under each Locator. EmptyStorage is a sub tab under the Locator which in turn is a sub tab to the Warehouse window.

When generating you need not put in any parameters as it will follow the equal number of Locators.

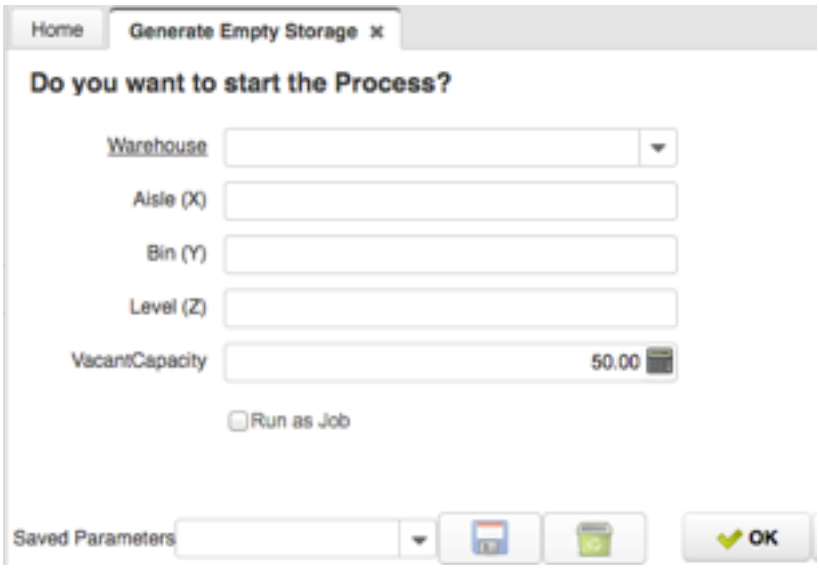


Figure pg 13 - Generate Empty Storage from WMS main menu

Note in above example, we have 50.00 as the Vacant Capacity. This can be manually changed later. Without giving any other parameters, it will automatically go through each new Locator to generate its corresponding Empty Storage. If you set a particular Warehouse or Aisle, Bin and Level parameter as range, it will produces within that range.

Be careful as it will overwrite previous settings. This is to facilitate faster populating of such entities. Of course not 2 Warehouses setup is identical, you can set ranges successively by defining smaller and smaller ranges to carve all of them out.

Set Types

Examples are Hazaard, Slow/Fast, Expired, Fragile, Testing and Bulky. Types form the basis on which StorageType and ProductType refers to. Once such types are defined, SetType process will set both models up. You can run it repeatedly for each Type and state which Product Category and Locator range it be set to.

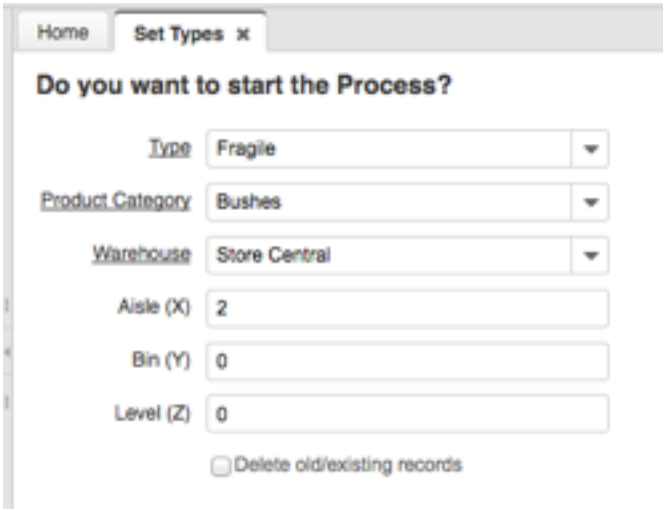


Figure 14 - Set Types from WMS main menu

Note in above, Type = Fragile, Product Category = Bushes, means that all products under that category is set as Fragile type. At the same time, Store Central locators along the 2nd aisle, with all its bins and levels therein are set to the same Fragile type.

This means that whenever a Bushes item such as Holly Bush or Azalea Bush is putaway, the system will locate any available empty slot along those locators to be stored in.

When defining the above, you have the option of deleting everything before in the same definition. Otherwise the system will add another Type. (I intend that the new WMS can handle sophisticated multiple types such as Fragile, Slow Moving and Non-Mixed but it won't be coded until I have a serious need to do so.)

Info-Windows

For obvious reasons as alluded to, I do not wish to replace another monster with an even bigger monster. My honed style over the decades of programming and system design have been to be simple, minimalist and reusable. Thus the use of the already ready-made abstract and easy meta-data configured Info-Window (created by Low Heng Sin) coupled with my Ninja ModuleCreator to churn out Info-Windows with their processes at the speed of thought (or Excel spreadsheet design).

Orders To Delivery Schedule

Records appearing here are from the C_Order/Line dataset where they do not appear yet in the WM_DeliverySchedule/Line dataset.

The first step in the WMS is to take Orders be they Purchase or Sales and copy them into Delivery lists that states which Gate or door and what dates and times they are to be offloaded. The design of WM_DeliverySchedule also uses the old Compiere isSOTrx (Is Sales Transaction?) property to determine if they are inbound or outbound.

The selection of Orders will let you create records in WM_DeliverySchedule data-set. (See Info-Process section later.)

This detail listing is then printed and conveyed to the suppliers when to send in the ordered goods, their exact delivery time and at which Gate or Door.

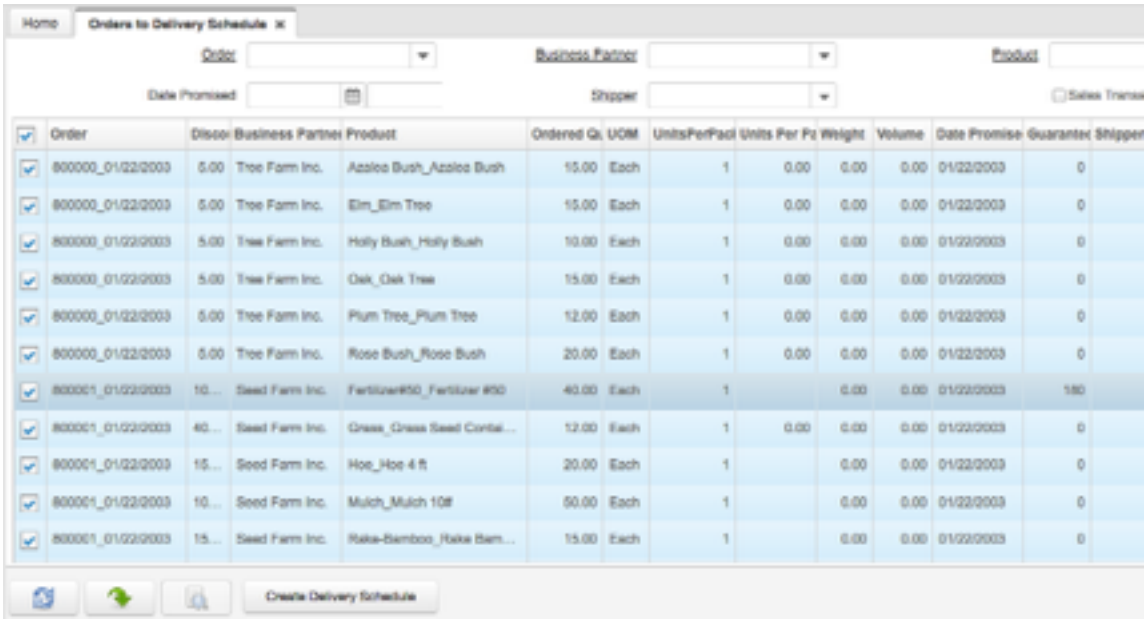


Figure pg 15 - Orders to Delivery Schedule Info-Window

Delivery Schedule to Putaway/Picking

Records appearing here are in the WM_DeliverySchedule/Line dataset where they do not have associated WM_InOut/Line yet.

This detail list is used to plan the next stage which the Putaway (for inbound). As items are offloaded, each has to be checked as Received. If not, they will not affect the EmptyStorage AvailableCapacity but are still recorded as part of the Forecasting Capacity over its timeline.

Receiving them can be done using QR-Code scanners which I have made a good POC that directly writes a value in the record. In this case it just has to set IsReceived='Y' in the WM_DeliveryScheduleLine record (more of this under the Developer's Guide).

So, DeliverySchedule records may or may not be marked as received. This allows them to be recorded first for further forecast analysis.

By using criteria in selecting the records, the user can decide which set of items to put in Putaway/Picking lists. Some may be bunched together for a single huge pallet (Same HandlingUnit). Some may be place in a certain zone separately.

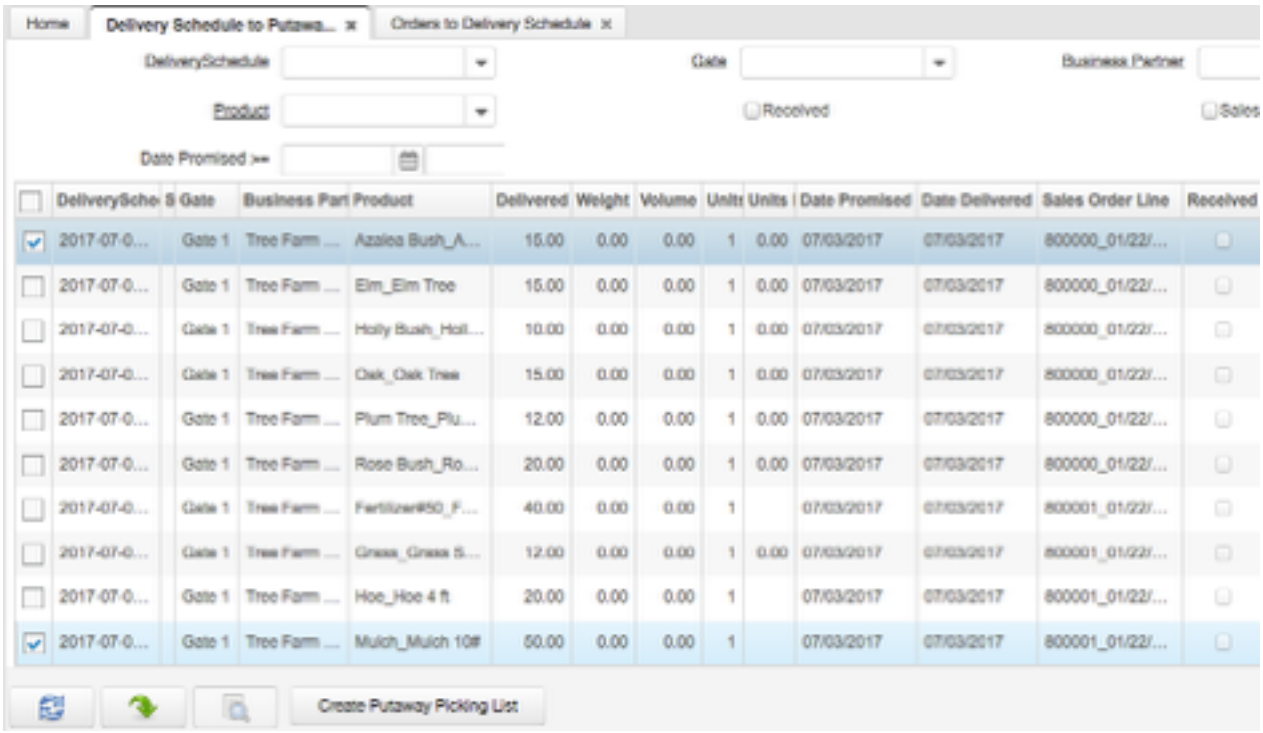


Figure pg 16 - Delivery Schedule to Putaway/Picking

The same window is also used for Picking by setting the Sales Transaction to true (isSOTrx='Y').

If items are not marked Received, they will also not be assigned Handling Units when required.

Putaway/Picking Info-Window

Records appearing here are present in the WM_InOut/Line dataset where it has no M_InOut record yet. They are produced from the last Info-Window with Locator floor sequence to guide the Forklift or person doing the Putaway/Picking process. Records that are not completed into Material Receipts or Shipments (M_InOut) will remain in this window for processing. Here we can still ChangeLocator. This is helpful particularly during Putaway routine when the operator could not reach a certain locator or chose not to use that Locator assigned due to laziness or otherwise some valid reason.

This Info-Window allows viewing of created Putaway/Picking Lists, in route sequence and drilling or zoom into the core related WM_InOut window and Complete them to produce their respective M_InOut records. Then their lines will disappear from this Info-Window.

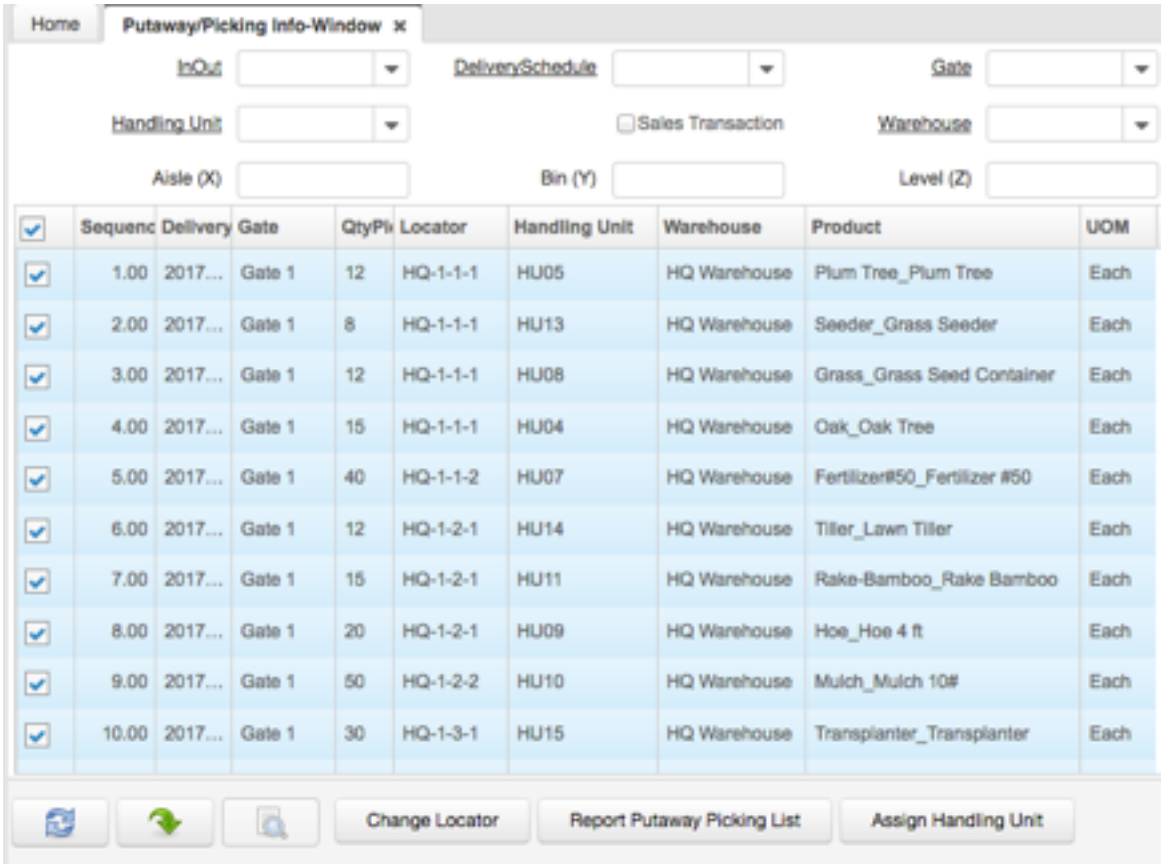


Figure pg 17 - Putaway/Picking Info-Window

Note the three buttons at the bottom. The Report List is to print out for the warehouse floor to use as a guide in sending or picking the items. There can also be a hand held mobile scanner to assist.

Warehouse Locator Info-Window

This info-window gives a high level view to quickly go through Warehouse Locators and see their AvailableCapacity and Percentage.

You can select a particular record and zoom into its Warehouse normal Window to view each of the new sub tab of information right down to its content lists.

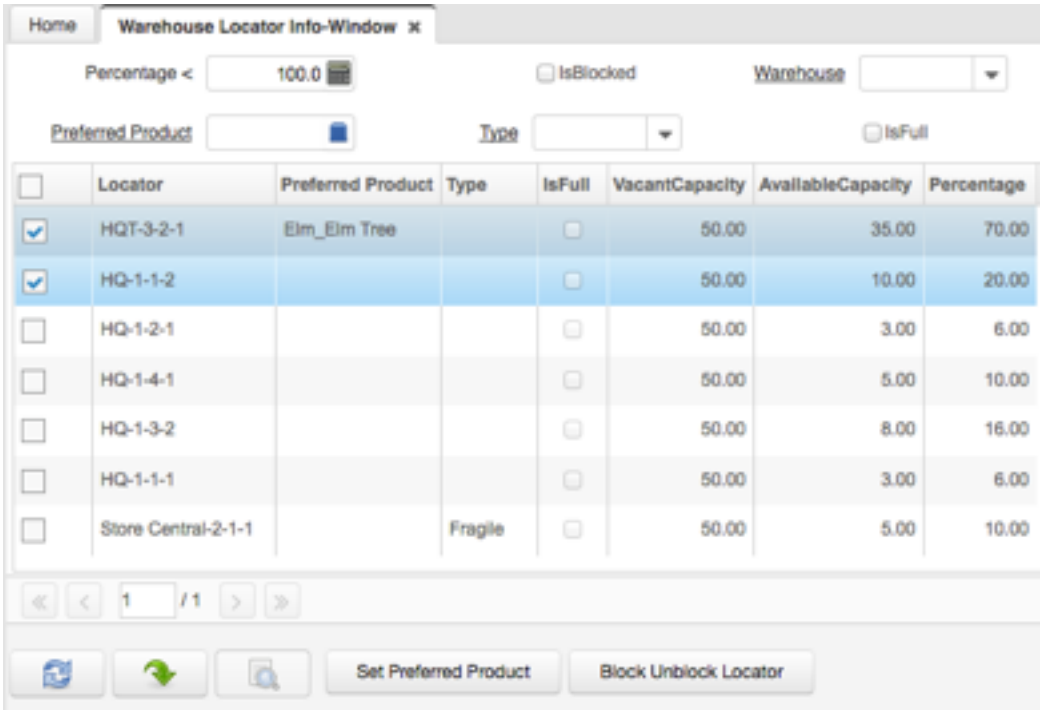


Figure pg 18 - Warehouse Locator Info-Window

The above criteria of Percentage is set to < 100% to mean all Locators that aren't full yet. After the last Putaway, these are the results. There is one only that isFull, but you have to check the isFull box to view it.

In this Info-Window you can also Set Preferred Product or Block Unblock Locator.

Storage Movement View

The records appearing here are created during the Delivery Schedule to Putaway/Picking Info-Window process. They allow analysis and filtering of items that are placed (or to be placed if they are not received yet) in each locator.

Any items can be transfered via StockMovement to another Type of Locators. This is useful particularly for Expired Goods.

This Info-Window is powerful in that its ReportAnalysis will export out CSV data for an Excel BI template to slide around its data sets identifying which area or period may hit under or over capacity.

Lines will only disappear from here when the storage is emptied out by picking. Picking lines in progress or pending will also appear here under the isSOTrx='Y' criteria and will disappear (IsActive='N') when are actually picked (IsDelivered="Y').

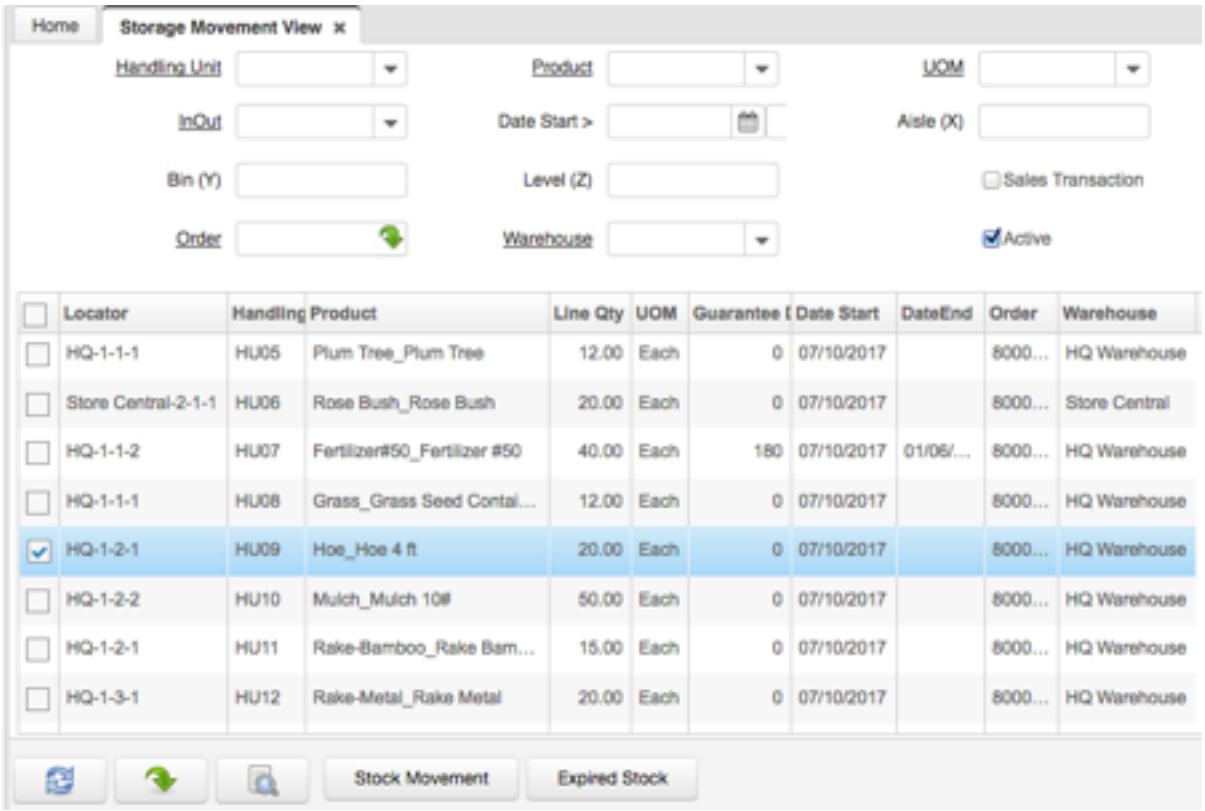


Figure pg - 19 Storage Movement View after Putaway process

This Info-Window is important for analysis to forecast capacity insufficiency and space wastage. It also allows for further Stock Movement to fine tune inventory organisation.

Info-Process

Now we go through each Info-Window and examine their related Info-Process in detail. First we go to the utility Info-Processes of main core windows. Then we go into the WMS cycle of inbound/outbound processes.

Set Pack Factor

This process is in the Product Packing Seting Info-Windows. Select any rows of records and press the Set Product Pack Factor button. Then enter the Units Per Pack, in this case is 4 for Patio Table, meaning each of this requires X4 units of space in the Locator.

There is also Units Per Pallet property been kept in play but I have done no logic for this yet.

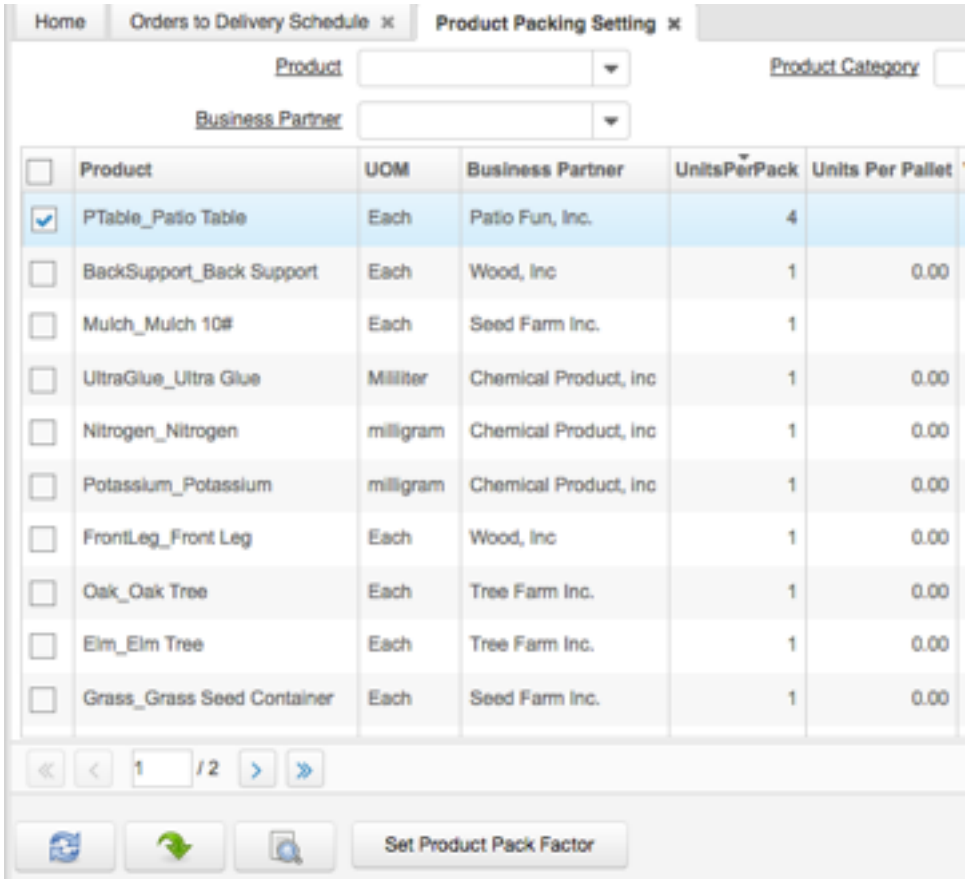


Figure pg 20 - Set Product Pack Factor process

Create Delivery Process

This process is in the Orders to Delivery Schedule Info-Window. It will take the selection and create WM_DeliverySchedule/Line records, that appear in the next Delivery Schedule to Putaway/Picking Info-Window.

Its parameters during the process is Gate No, and Date/Time Promised.

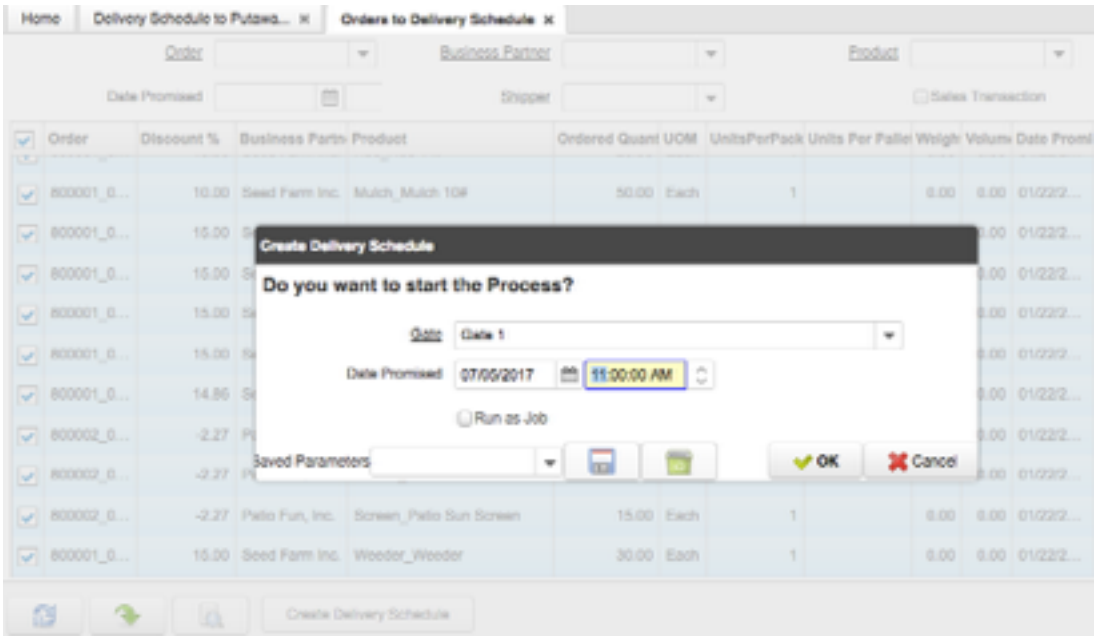


Figure pg 21 - Starting the Delivery Schedule creation process

Create Putaway Picking List

From the above Info-Window, we can Create Putaway/Picking which creates WM_InOut/Line records.

During issuing such lists, we can choose to assign available HandlingUnits or assign them later. We can also choose to group selection under a single HandlingUnit such as a big pallet by checking the Same Handling Unit option.

Packed items can be retained of its QtyMovement without opening up using the SameLine option.

The Putaway process will check each Locator available capacity and decide accordingly if it needs to go to the next locator in line.

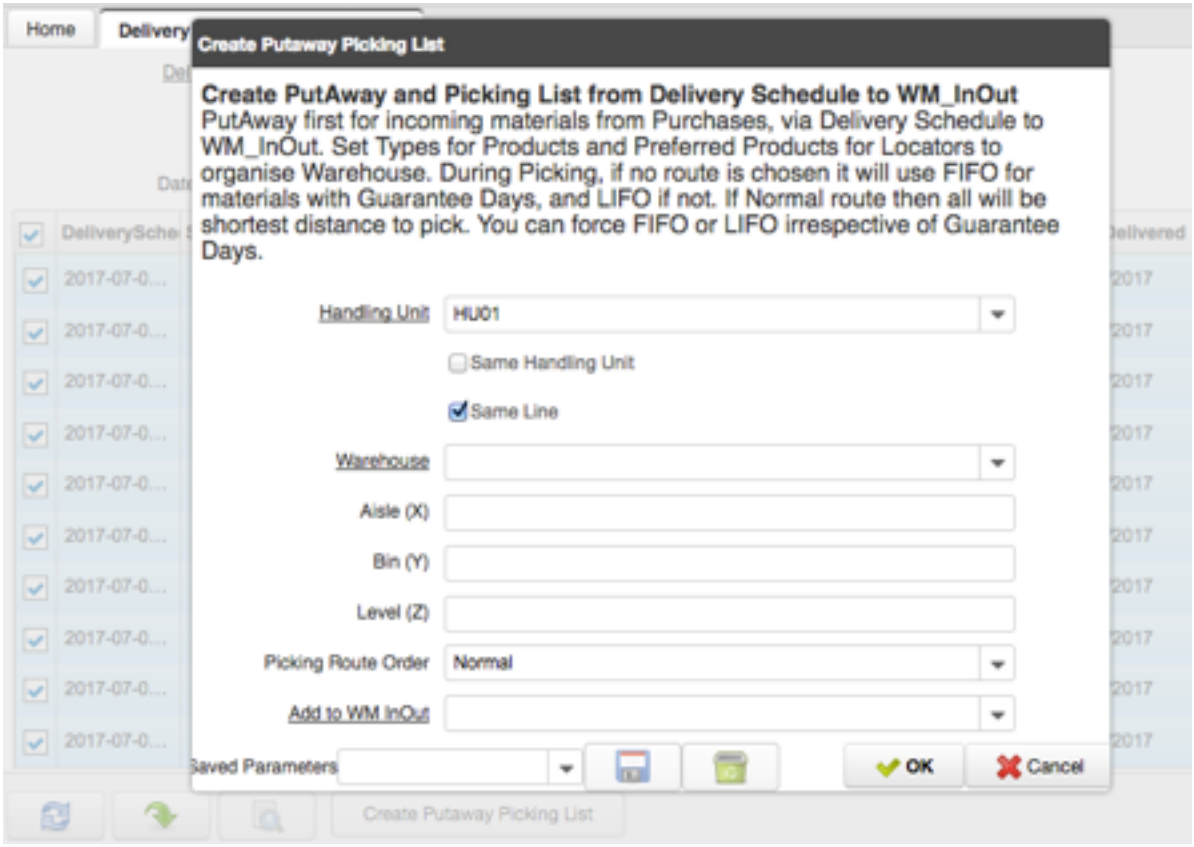


Figure pg 22 - Create Putaway Picking List

You can also add onto previous list at the 'Add to WM InOut' pull down. The Picking Route Order has three options of Normal, FiFO and LiFO. Normal means shortest physical path according to Locator values. If it is set to blank, it will apply both FiFO/LiFO according to presence of DateEnd due to Guarantee Days of the Product.

Assign Handling Unit

This is needed when Handling Units were not added during initial Putaway. If the Delivery Schedule items are not Delivered, they also will not be given Handling Units. Thus a Handling Unit is a real instance or occurence in the system.

However even if Handling Units are already given, the user can still reassigned new Handling Units and released the old ones.

The same occurs during the Picking process.

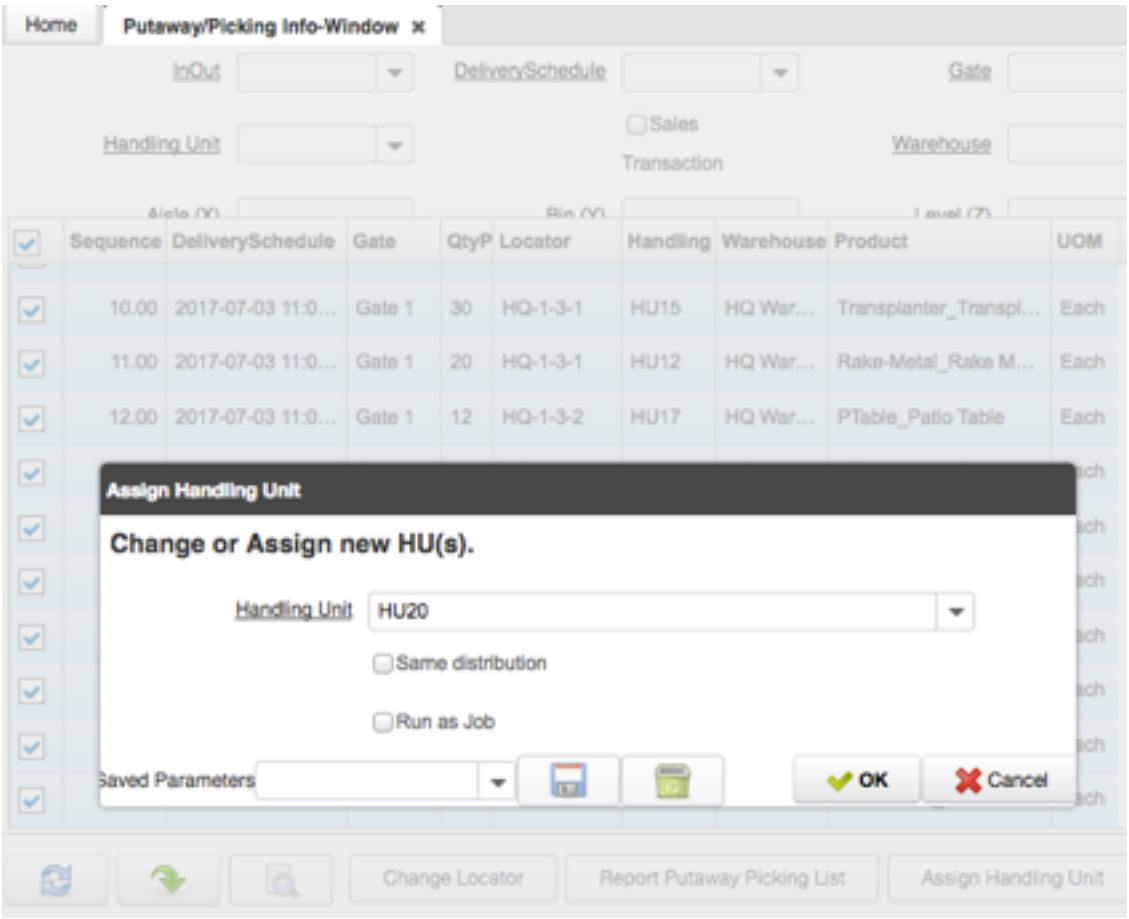


Figure pg 23 - Assign Handling Unit process from Putaway/Picking Info-Window

During assigning, you can select Same Handling Unit (Same distribution) so that all those selected be handled by the same handling unit. This is useful when bundling some items onto a single pallet for example.

Stock Movement

This makes the WMS versatile and flexible. There will be instances where the stocks are allotted wrongly or needed to be moved on purpose, from one locator to another and with different set of handling units. They maybe merged into one locator or split into multiple locators.

For the time being this also acts as Expiry Control. However you must have an Expired type defined and assigned to certain locators before moving certain good to the Expired section. The Guarantee Days and Date End of a storage line will give a hint to which need to be moved. You can filter these out by putting a Date End criteria.

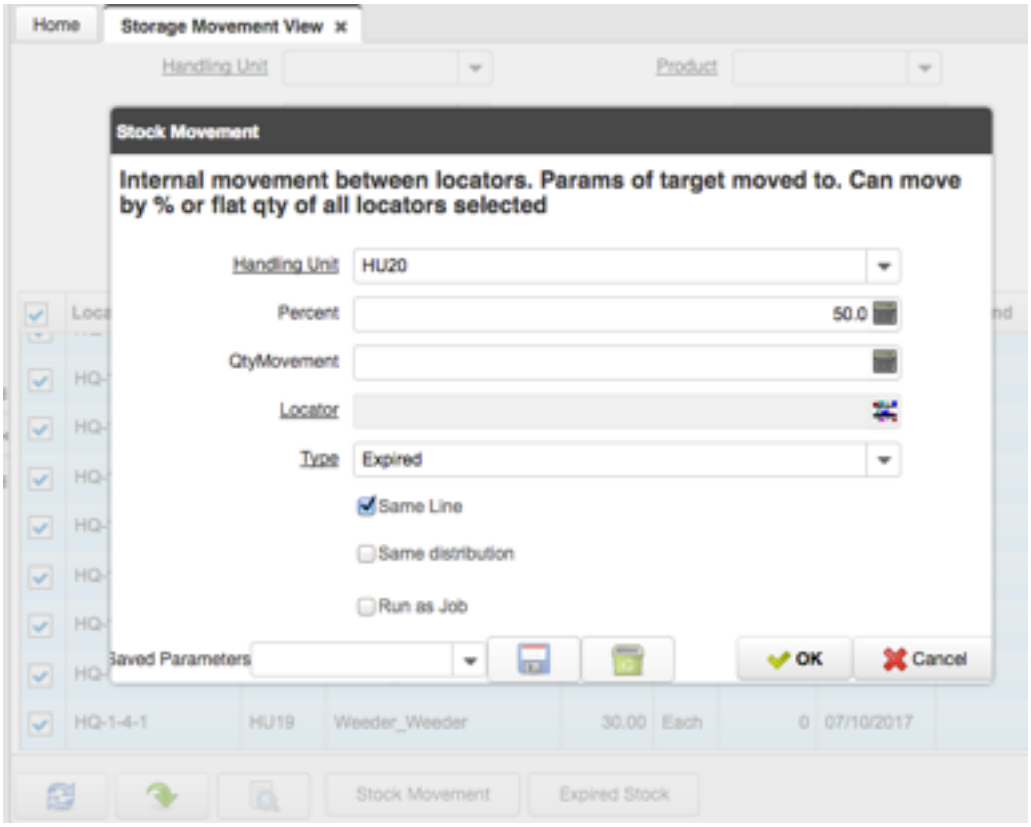


Figure pg 24 - Stock Movement process in Storage Movement View

Report Listings

All windows of models within the WMS are readily reportable by the system's inbuilt Print Format engine. However some Info-Windows are made to export out too its selection and they are readily generated by the Ninja plugin for WMS. All the user has to do is just select and click.

Putaway/Picking List

This list is useful furing the putaway or picking process for the warehouse floor operations personnel to refer to. The user can modify this report format further and save it as a new report name. During first time printing, it will take a longer time as it has to generate its Print Format. That is done one time first time. After that, it works fast.

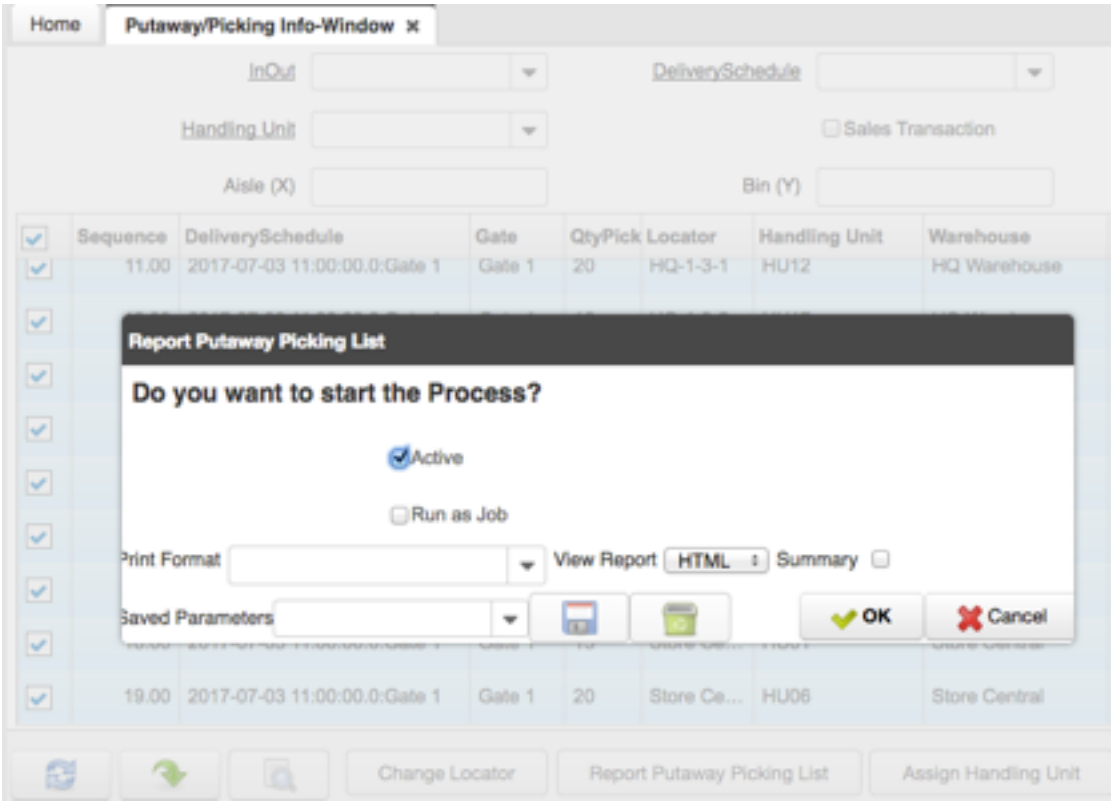


Figure pg 25 - Printout Putaway/Picking List for operations

Storage Movement

This Storage Movement report exports out Excel format also for Forecast Analysis of the inventory over pending orders and planned putaway/pickings.

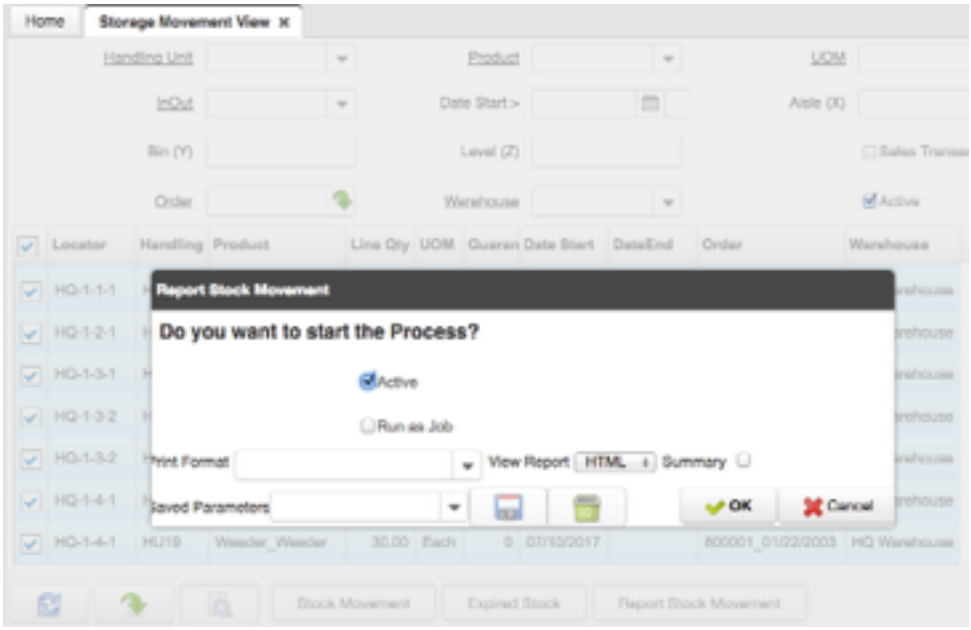
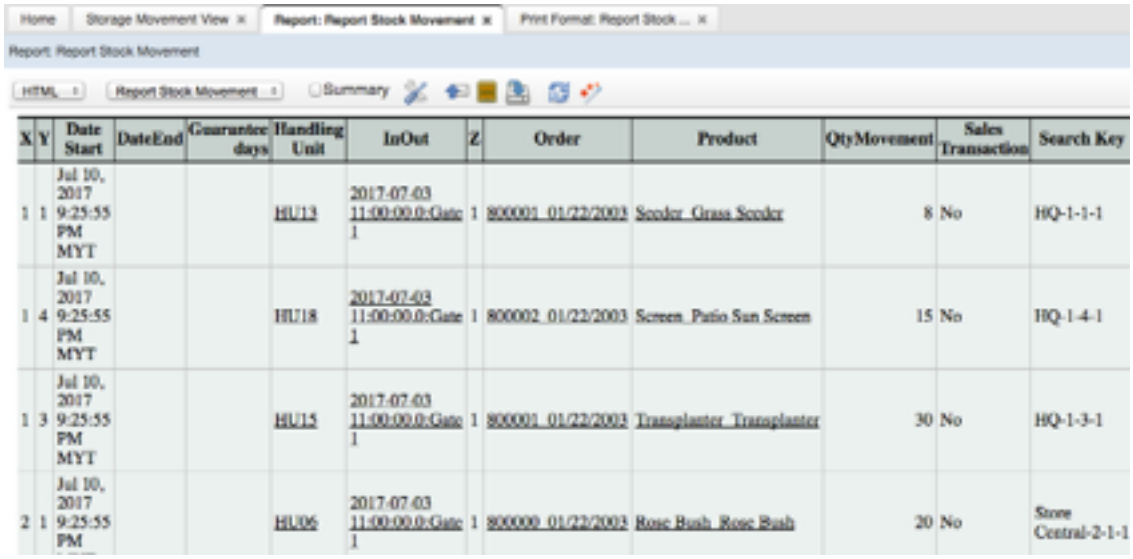


Figure 26-1 Check Active to get all details displayed for printout and export to Excel

Same like the previous one, the report may not come out in proper order or appearance of columns. The user has to go to the Customize Report icon and call out the Print Format window to adjust the arrangement. Then saving it, will keep to the new format from there on. (This will be shown in detail in the Developer's Guide.)



X	Y	Date Start	DateEnd	Guarantee days	Handling Unit	InOut	Z	Order	Product	QtyMovement	Sales Transaction	Search Key
1	1	Jul 10, 2017 9:25:55 PM MYT			HU13	2017-07-03 11:00:00.0:Gate 1	1	800001_01/22/2003	Seeder_Grass Seeder	8	No	HQ-1-1-1
1	4	Jul 10, 2017 9:25:55 PM MYT			HU18	2017-07-03 11:00:00.0:Gate 1	1	800002_01/22/2003	Screen_Patio Sun Screen	15	No	HQ-1-4-1
1	3	Jul 10, 2017 9:25:55 PM MYT			HU15	2017-07-03 11:00:00.0:Gate 1	1	800001_01/22/2003	Transplanter_Transplanter	30	No	HQ-1-3-1
2	1	Jul 10, 2017 9:25:55 PM			HU06	2017-07-03 11:00:00.0:Gate 1	1	800000_01/22/2003	Rose Bush_Rose Bush	20	No	Store Central-2-1-1

Figure 26-2 - HTML version for Customizing

Implementation Brief

This WMS is a general version for easier customistion into any type of particular dedicated and unique WMS scenario. Been open source and well laid out and documented serves to allow adapation by implementors and their developers.

First we have the usual setup process that should cater for most scenarios. Later next section, we shall look at the data model structure and the plugin source code to see how to modify for any type of difference in requirements.

Project Forum - http://red1.org/adempiere/viewtopic.php?f=45&t=1839

Below are 3 summarised set of activity - one for installation of WMS plugin and setting up, the others for operating it.

Install Steps

1. Download org.red1.wms: http://sourceforge.net/projects/red1/files/Warehousing/
2. Install in iDempiere and wait till its 2Pack completes Pack-In successfully
3. Login into Garden World or your new Client
4. Define Gates
5. Define Handling Units
6. Define Types
7. Setup Locators
8. Setup Empty Storage
9. Setup Types (to Product Category and Warehouse-Locator Range)
10. Setup Preferred Product (to Warehouse-Locator Range)
11. Setup Product Pack Factor (sizing quantity over locator space)

That is it! Later chapter shall give its detailed explanation and show how with shortcuts.

Operations

1. Order to Schedule Process - Generate Delivery
2. Schedule to Putaway/Picking Process - Delivery to Locator
3. Intra-interim Operations (if any) [Add HandlingUnit / Change Locator / Stock Movement]
4. Completing Document Actions [Delivery Schedule / WM_InOut]

Executive Management

1. Exporting Reports to Excel
2. Business Intelligence from Excel

Implementation Full

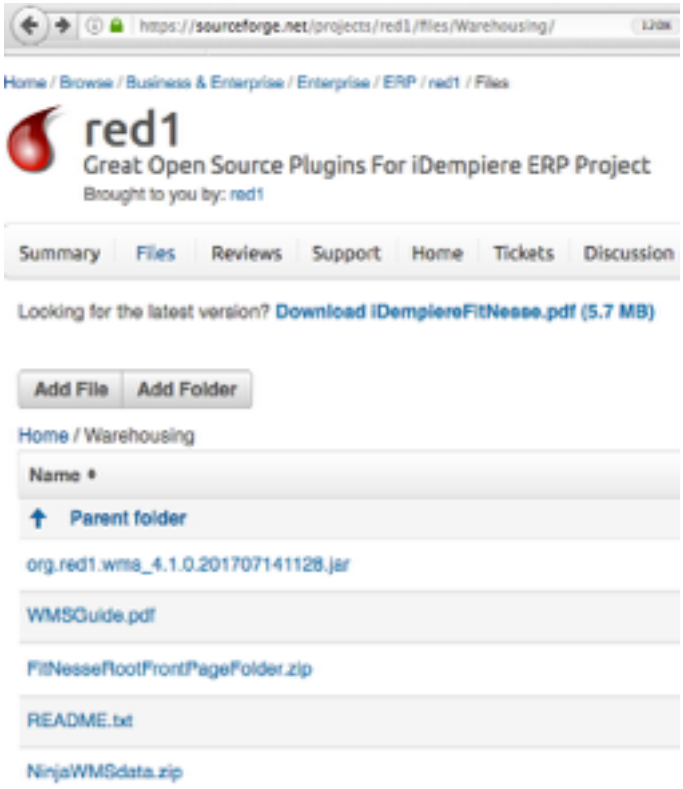
Here I lay down in full exhaustive detail how to do the WMS from start.

Download and Start Plugin

Download org.red1.wms: http://sourceforge.net/projects/red1/files/Warehousing/

Figure pg 28.1 - Download page in SourceForge repository of 'red1'

Download the org.red1.wms with its timestamp. It gets updated from time to time so the timestamp is the date of its issue. I usually update it whenever there are mistakes and new changes done to it.



After downloading, go to your running iDempiere OSGI console or via the Felix Web Console.

Figure pg 28.2 - Felix Console to install plugins

Press Install/Update and select the downloaded plugin and make it start. Wait until you see the log has finished Pack-In and given a 'org.red1.wms installed' line.

Login into WMS Menu

Login into Garden World or your new Client, you shall find the WMS appearing in the main menu.

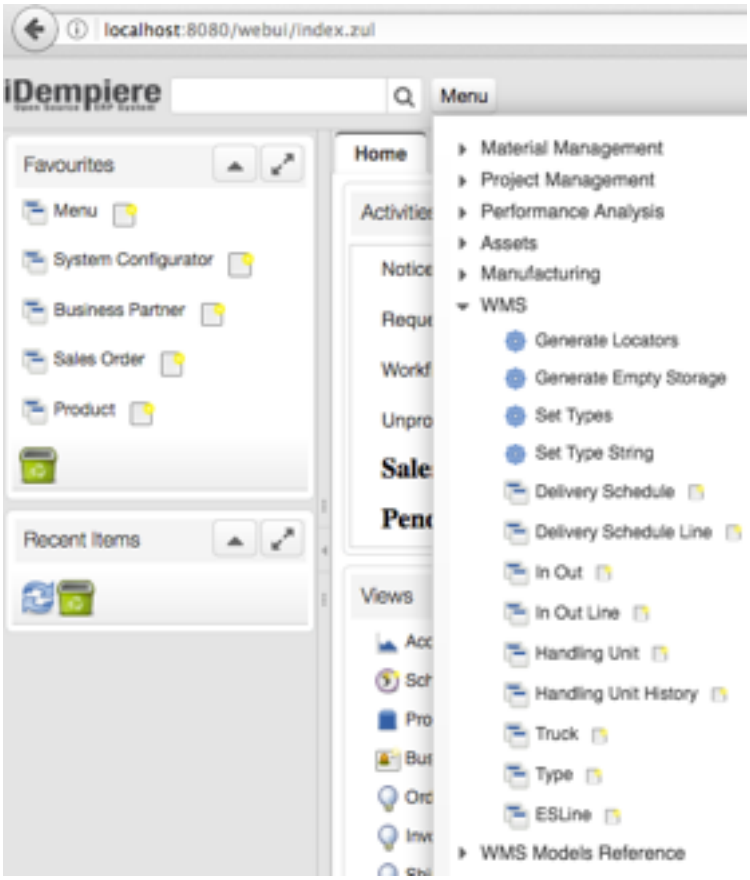


Figure pg 29 - WMS in Main Menu

The WMS Models Reference is just to allow its underlying models to appear in the ERP and of no operational use usually. It is the WMS menu tree that are of significance.

To proceed further we shall be doing things manually. After that I shall show shortcuts to do the same thing much faster and better. You may wait or go straight to the shortcuts to do those things. This manual normal way is for starting or beginners' understanding of the system.

Define Gates

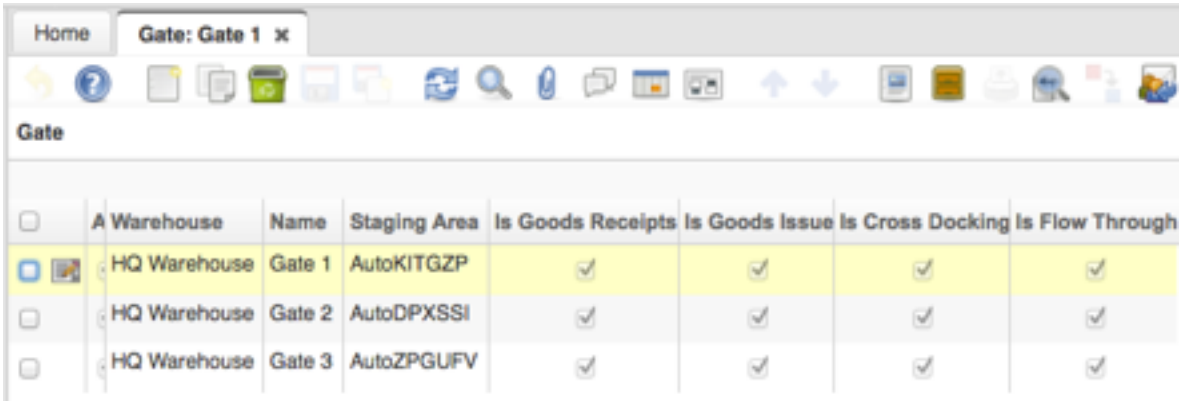


Figure pg 30 - Defining Gates for Loading Bays

Gates follow the concept of Doors in SAP WMS. It is the main entry and exit points into the Warehouse facility. Thus this is stated in the immediate document that relates to such activity - The DeliverySchedule.

After arriving at the Gate, the goods are to be putaway into locator spaces. When they are picked they are also sent to the Gate for loading onto transport vehicles.

The Gate can have other qualities such as shown in the columns above. But it is not referenced in any present WMS code. It is free to be utilised in future as these are advised in SAP WMS. The intent of such values is to segregate (later) the right activity during receipts or shipments or flow through or cross docking.

A facility can have multiple Gates.

Just define each gate in use and associate them to the Warehouse they located at. The Name is mandatory as it be used during lookup processes.

The data model for this is WM_Gate and is not part of any parent table.

Define Handling Units

As explained earlier, Handling Units can be a simple tag, pallet, box, container, roller, drum or any trackable device temporarily attached to a certain package of items or set of items or just an individual item. It is for track and trace of that item within a facility. It can be extended to outside a facility when the pallet or drum leaves the premise and due to return in future.

Handling Unit is vital as it keeps information that is peculiar in the movement and arrangement of goods and resources within the facility. It can handle multiple goods or type of goods or it can keep intact a package of good.

The processes that assign Handling Units use them to maintain such requirement and more such as breaking up a package into different handling units, or combining multiple packages into a single handling unit.

Handling Units can be many and should be sufficient in number or else the easy running of the main processes may halt.

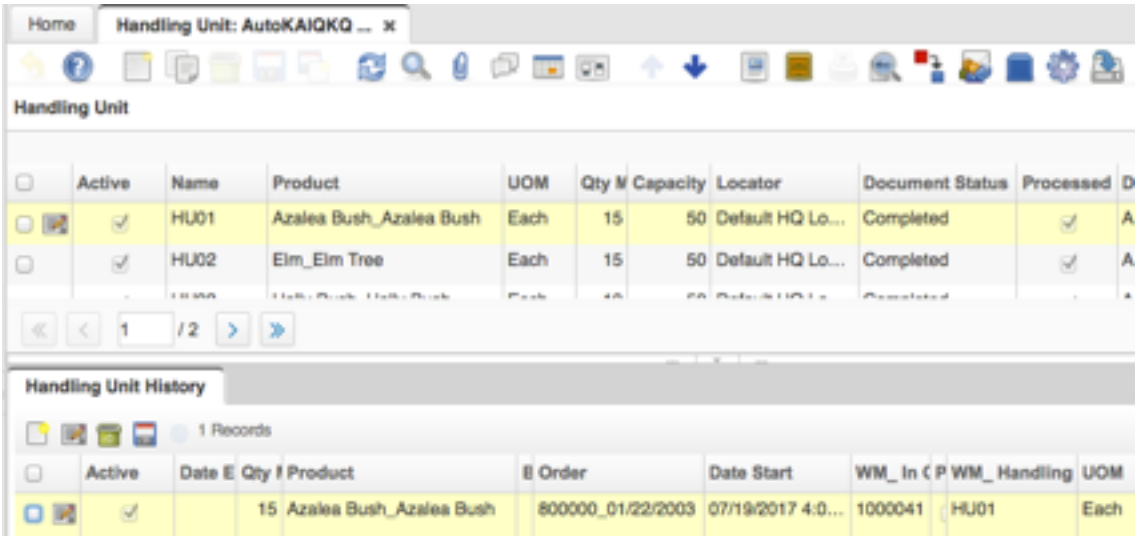


Figure pg 31 - Handling Unit with History

Each Handling Unit will have its History tab to keep track of its status. When it is 'Released' from holding any item, it will set DateEnd and its Document status returns to Draft mode.

Document Status of Completed means it is used as a Putaway handling unit.

If it is 'InProgress' then it is assigned during Picking.

The data model for these are WM_HandlingUnit which is not part of any parent model, and its child, WM_HandlingUnitHistory.

Define Types

This can be done conveniently and quickly in Set Types process shown above.

The data model for this is WM_Type, and is not part of any parent window. It is used in WM_StorageType (under M_Locator) and WM_ProductType (under M_Product) during Putaway and Picking of products.

They are usually defined one-time during setup and can be added from time to time. I made it aribitrary so that the users can define any number and of what types they wish. There are no hard code usage so there is no worry of mandatory values. However once defined and used, they cannot be deleted. Only deactivated.

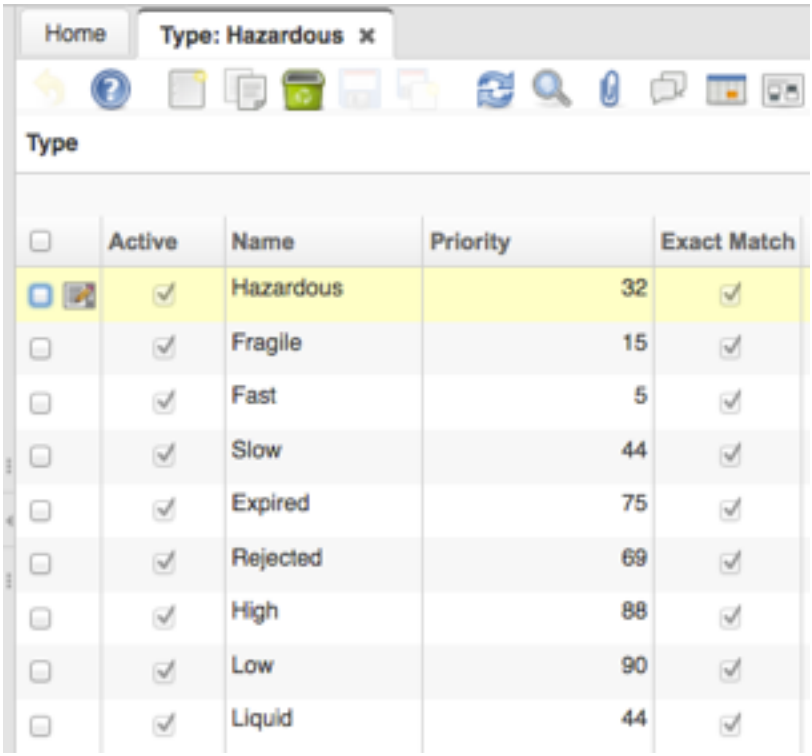


Figure pg 32 - WM Type window

Setup WMS

After defining the above, we have the essential data set to begin the long process of defining all the locators in the warehouse(s). As shown before, there is a series of processes to do the following very quickly and accurately

1. Generate Locators
2. Generate Empty Storage
3. Setup Types (to Product Category and Warehouse-Locator Range)
4. Setup Preffered Product (to Warehouse-Locator Range)
5. Setup Product Pack Factor (sizing quantity over locator space)

Take note that all of the above data setup until this section, step 4 above can be done within 30 seconds using the following two methods:

a. Use of Ninja plugin Import Model where the data is in Excel format.

b. Use of FitNesse testing where the data is in wiki script format and commited directly at end of test.

Please refer to later section on 'Developer Section' to see how these are done.

Once this is done, we can then look through the Warehouse Locator Info-Window to see the Locators layout and its set values. You can refer to figure pg 18 earlier. You can select Warehouse criteria for HQ Transit to see the Preferred Product of 'Elm' in one of the locators. Then Store Central to see the Fragile type locators.

Let us try to block one locator just for testing purposes. Choose HQ Warehouse and select HQ-1-1-2. Click on Block Unblock Locator, check IsBlocked box and click OK.

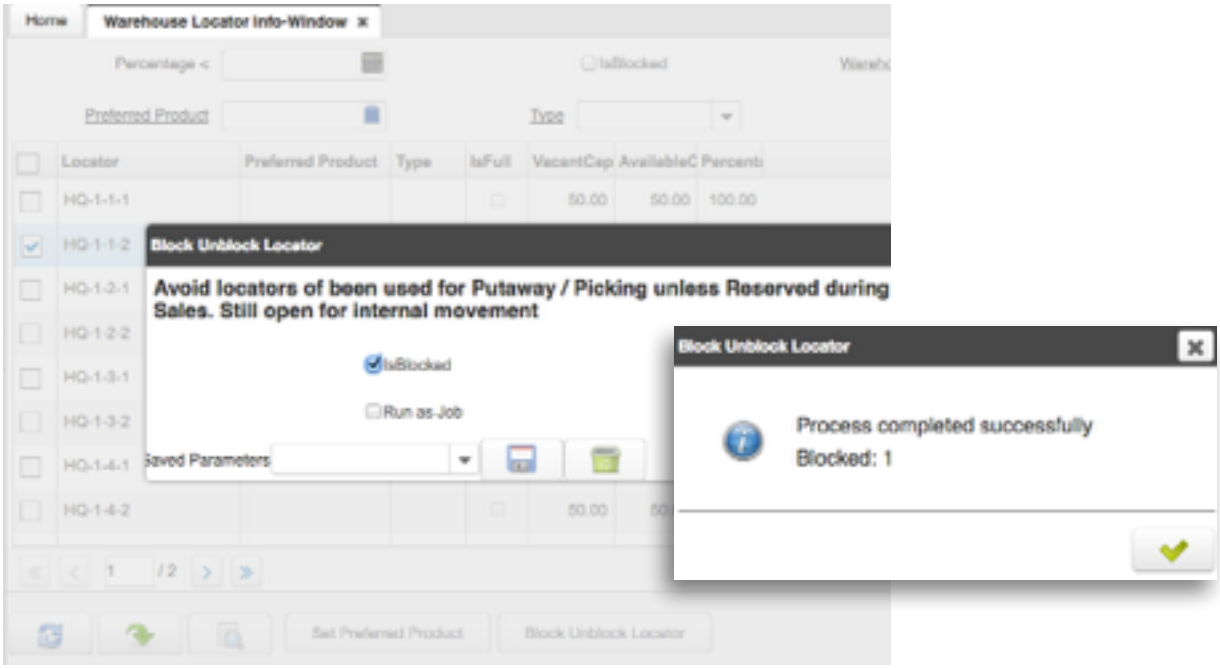


Figure pg 33 - Blocking HQ-1-1-2

Generate Delivery

There are two types of ready orders in any ERP - Purchase Orders and Sales Orders. Both will be generated to Delivery Schedules by the WMS.

For Purchases, they will be easily planned for the right time and gate to receive the incoming purchases from the suppliers. For Sales, they will also be planned so that the transport to send to customers' regions are also scheduled properly. First we look at the Purchases below:

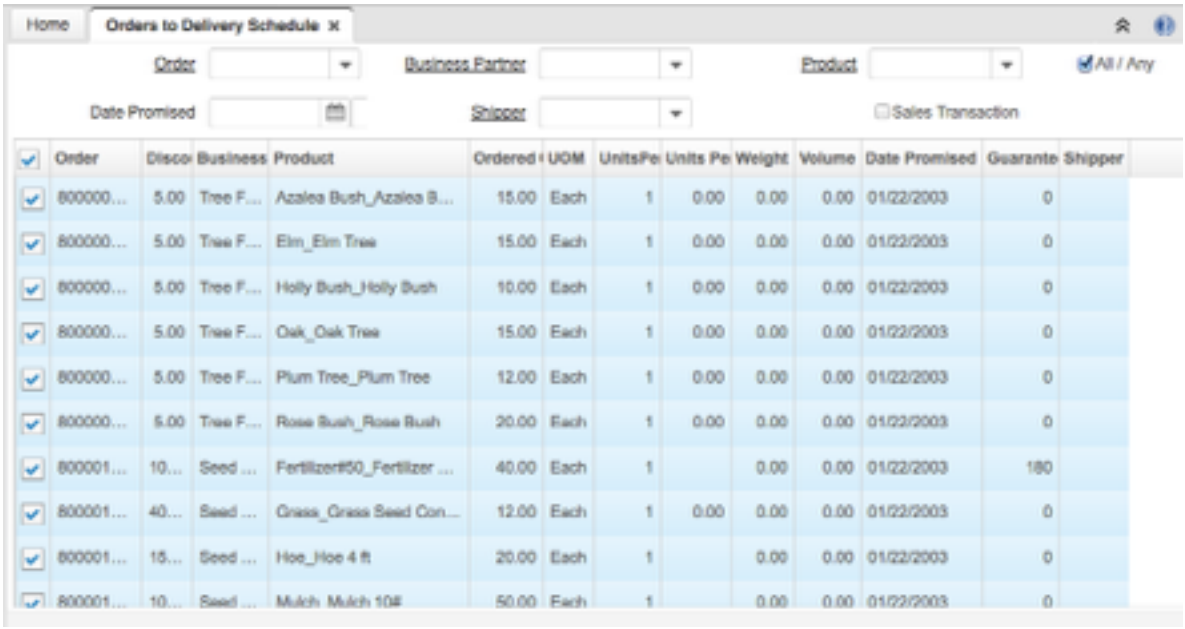


Figure pg 34 - Preparing Delivery Schedule

You can follow the same Info-Window description earlier to understand how these lines appear. You can then plan further by entering selection criteria in the parameter params.

You can then choose only those you want to plan for a Delivery Schedule that goes to a particular vendor, informing them of which date, time and gate to send the items.

We are going to go through this exercise in a simple flow that will be the same as the testing chapter later so that a comparison can be made that both this and the testing yields the same results. Thereafter you can use the testing framework without wasting time in manual testing.

A sudden latest idea pop up during the writing of this manual. Our reference user gave a use case a Purchase Order for 1000 yards of cloth goes out but does not know what kind of packing of the ordered items will be in. That means the Delivery Schedule though containing 1 line, will have a series of delivered goods in various lengths of cloth, say 8 X between 100 and 120 yards.

The Delivery Schedule details will thus have to be extended (not a problem and can utilise the use of RFID tagged Handling Units to scan into the Delivery Schedule and Putaway lists).

However during Complete of the Putaway/Picking List (WM_InOut) it will create a Material Receipt (M_InOut) and this should not create extra lines but reconcile back to the single

order line. This is so as to maintain integrity of the core model and integration. Only the WMS is concerned of the break down into handling units and its locator placement.

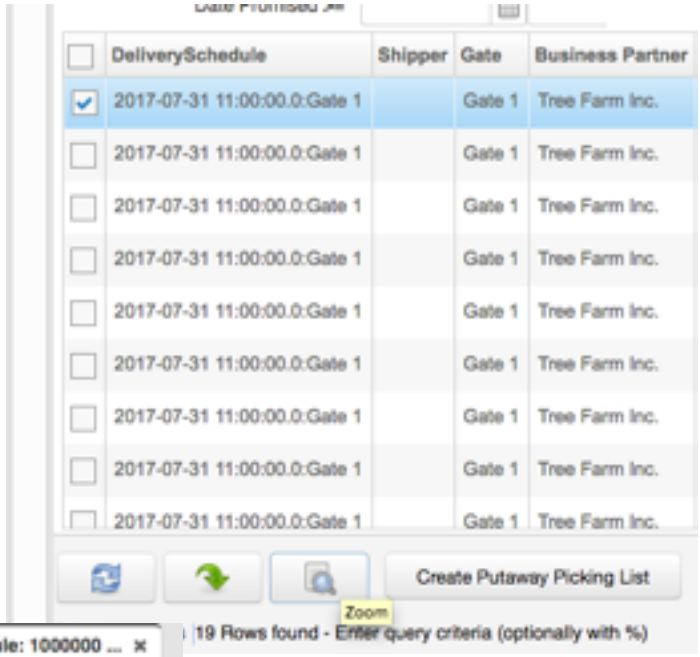
The unchanged order line is also vital in the use of Project (Line/Issues) to track the outstanding issuance of balance quantity still undelivered.

Bear in mind also the capability of the WMS to track pending status for forecast purposes. The Delivery Schedule lines need not be marked 'Received' and the processes proceed on.

Confirming Inbound Delivery

When a delivery has arrived, the user can either scan it in or manually tick the Received status in the Delivery to Putaway Line tab. Below is how we do it manually by Zoom to the main Delivery Schedule and running Complete to make every child line as 'received'.

First select only one line of of the details in the Delivery to Putaway/ Picking Info-Window. Then click on the Zoom button at the bottom.



The Delivery Schedule detail tab will open up.

You may individually check the Received status box of each line or go to the main tab and click on the Process gear icon and run Complete.

After Complete, you can see that each line is marked as 'IsReceived'. You can now return to the Info-Window to do the Putaway process.

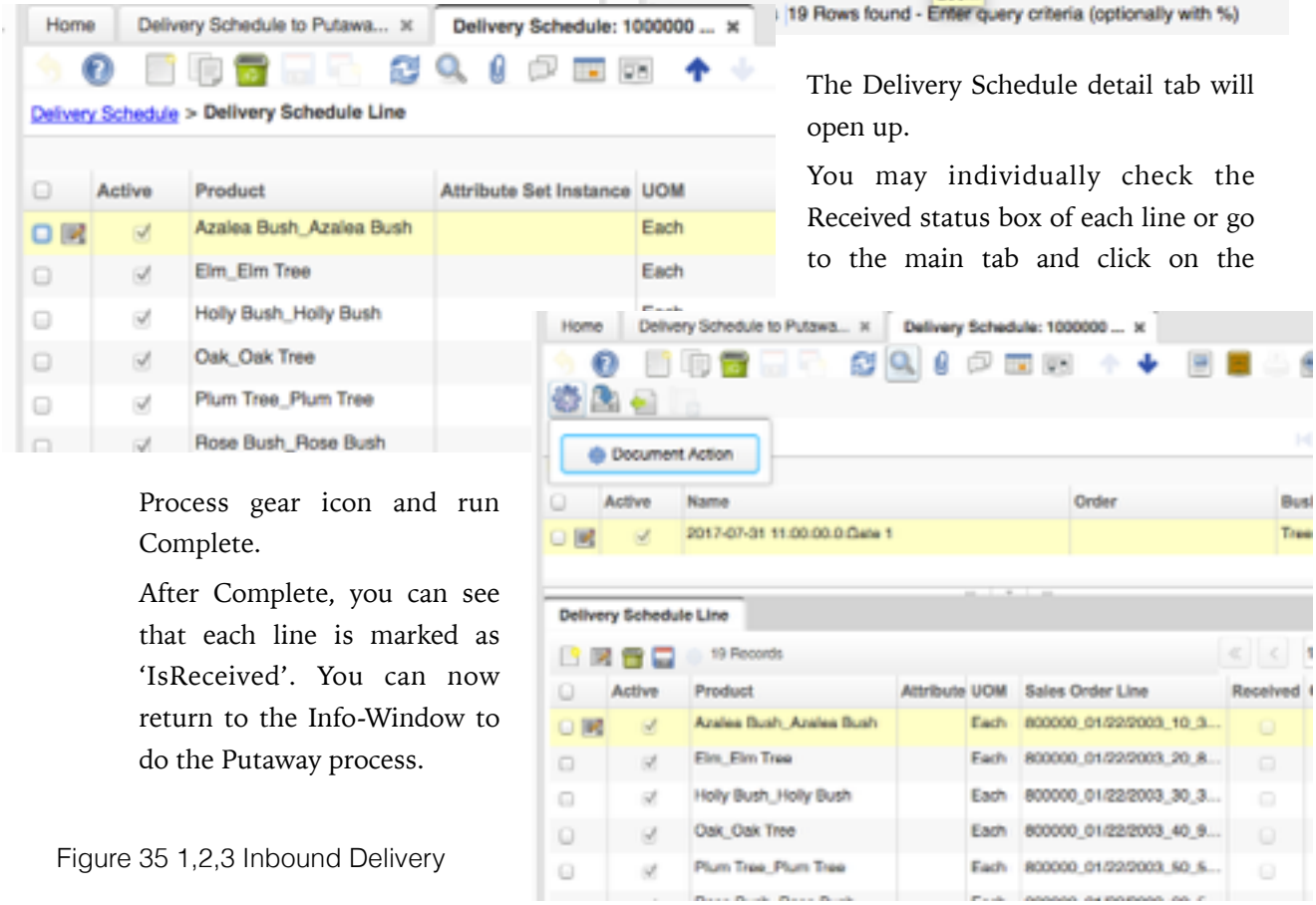


Figure 35 1,2,3 Inbound Delivery

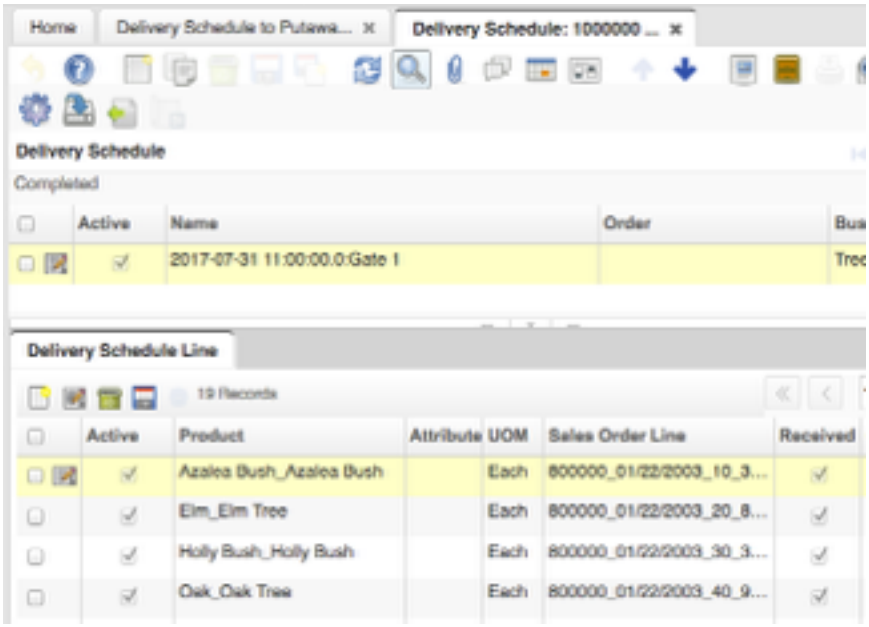


Figure 36 - Delivery Schedule window with Received details

During Putaway, remember earlier I mentioned that there is a choice of the Delivery been marked as received or not. At this juncture, if its still not received, there will be no Handling Unit assigned. However even if it is Received, you can still reassign new Handling Units later. This is to allow flexibility to cover as much realistic scenarios as possible and not let the system be too tightly locked to circumstance and its self induced properties.

So in this case, we did received them.

Putaway Process

On opening the Delivery Schedule to Putaway/Picking Info-Window we click the 'Received' criteria and not Sales Transaction will show all the incoming received delivery schedule from purchases sent to the vendor(s).

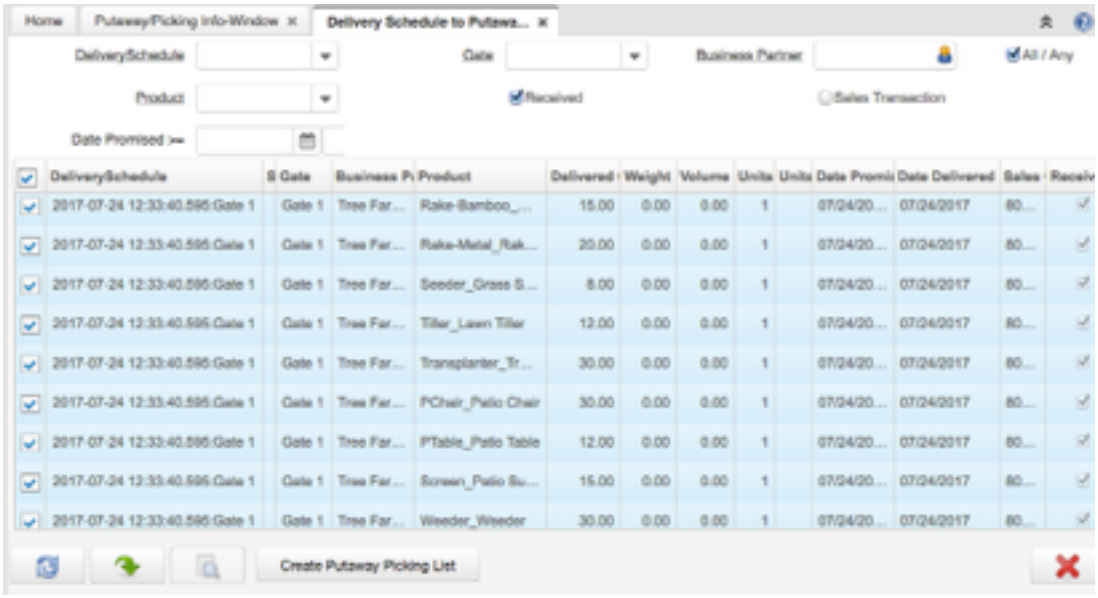


Figure pg 37 - Received lines ready for Putaway

Here we choose to select all and began to put them away. The Create Putaway/Picking List is highlighted. Pressing it will open up the dialog box.

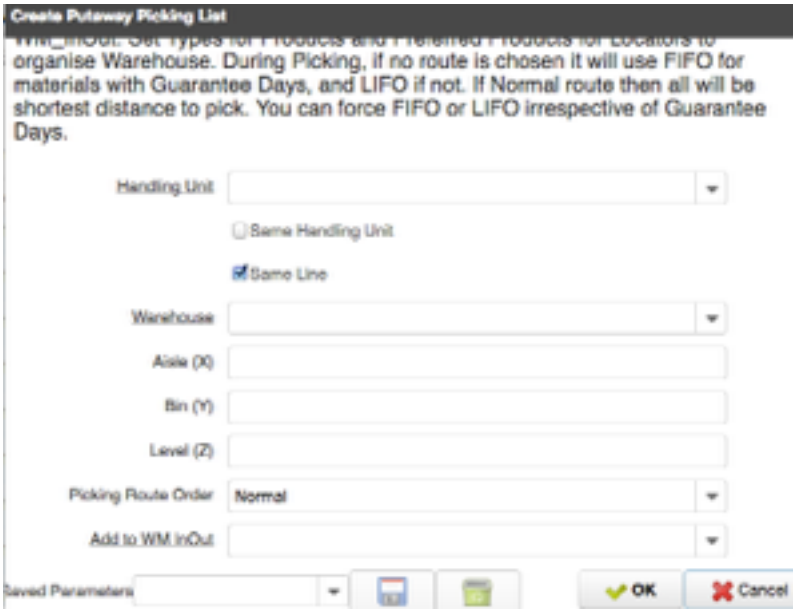


Figure pg 37-2 - Create Putaway Picking List dialog box.

User will then assign the starting available Handling Unit from its list. Only those not in use will appear in the list. When more than one is needed, the process will automatically select the next available one. So stand by your tags or containers or pallets ready. If any are not readily available or faulty, no worry. We have another process to Assign Handling Unit after this process is run.

If the user selects Same Handling Unit (reusing the Same Distribution field from iDempiere), then only that same handling unit is used for all the selected items.

If the SameLine is checked, then each order line is assigned to a handling unit intact. No breaking up of the line quantity. So if the locator bin space is not enough to put the whole line quantity in, and require break up in order to do so, that will not be allowed.

If the SameLine is unchecked, then the breakup is allowed, and the remaining balance is placed in another handling unit.

Now of course this seems to take care of general cases, there can be very distinct unique and different use case. Been open source, go ahead and modify the model and code concerned or use model validators to do it seperately. You may also engage someone like me to study your case and propose an equally elegant solution.

In my above case, I set the first handling unit and IsSameLine.

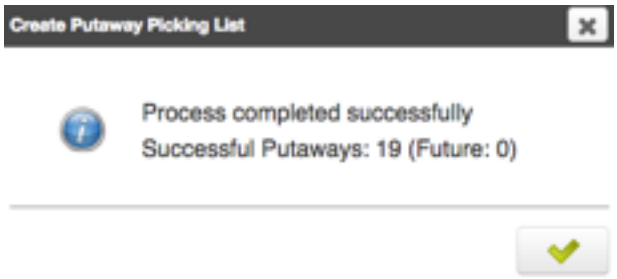


Figure pg 38 - Successful putaways feedback

The process takes a few seconds to allocate correct and available locators according to the rules defined before this. The (Future:0) means none of the 19 are still pending 'Received'. If you get Future:19 then it means those lines were not marked as received and they are still allocated to locators and 'putaway' virtually there. However they are not alloted Handling Units. There are merely stated in EmptyStorage Lines under each Locator. These info will be used in forecasting availability and under usage over the period the items are already expected to be in but pending actual delivery.

You can refer to earlier pages screenshots to see the same results. Now we shall look at individual records to prove that they are alloted correctly. We like to know if the Preferred Product of 'Elm' is actually working. Also to see that the Fragile product type ending up in the same storage type under Store Central locators. Finally the blocked HQ-1-1-2 should not be touched but skipped.

The best way to view results at one go is to call up the Warehouse Locator Info-Window and put in 100 at the Percentage field so that any locators less than 100% vacant will be listed. See the screenshot below.

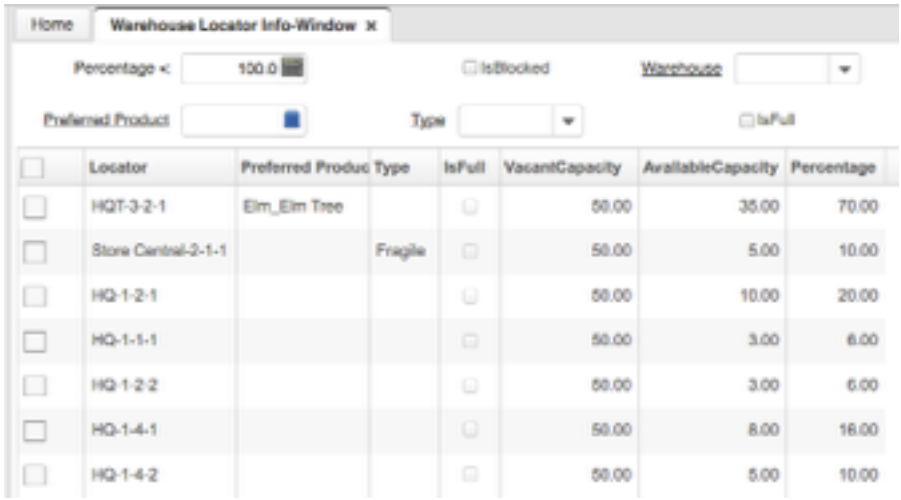


Figure pg 39-1 semi occupied locators

Now check the IsFull box and click on Refresh icon at the bottom so that we see those that have become full. There are two locators that fully used up its VacantCapacity of 50.

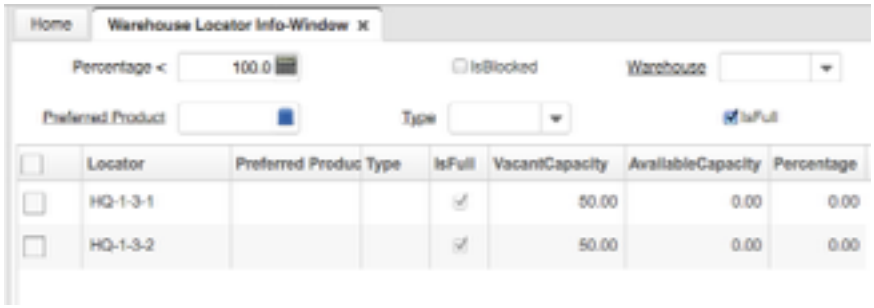
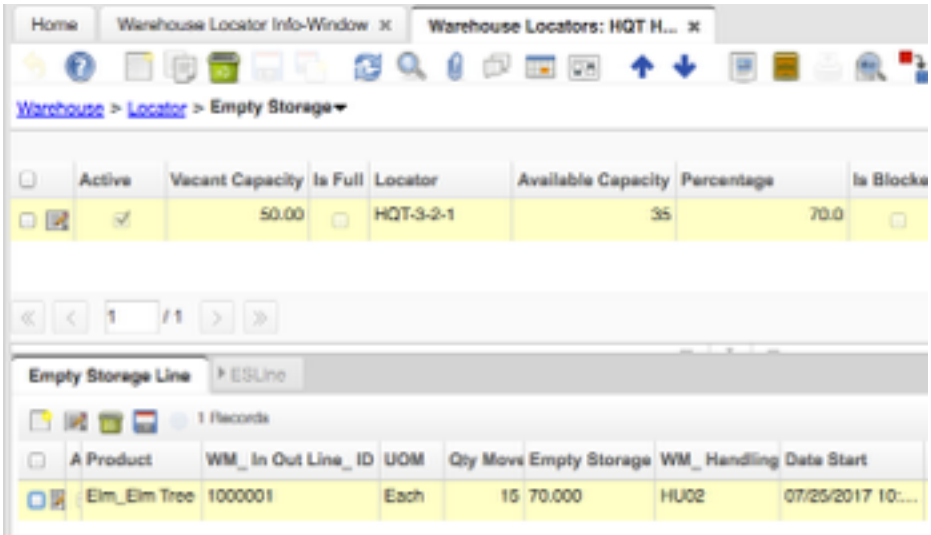


Figure pg 39-2 Full locators

Now click on any locator and press the Zoom icon at the bottom to go into its Warehouse model window. Let's check the 'Elm Tree' locator. Below is the zoomed window.



Next we go after another locator. Let's look at the first HQ Warehouse locator HQ-1-1-1 to see what is inside. (Reason been it is the first that be filled up by any products that are not defined under Bushes Product Category which is Fragile Storage Type or Preferred product.)

Note that its available space is only 3 units. In the detail tab is the list of lines packed into the same Locator, with their own handling units.

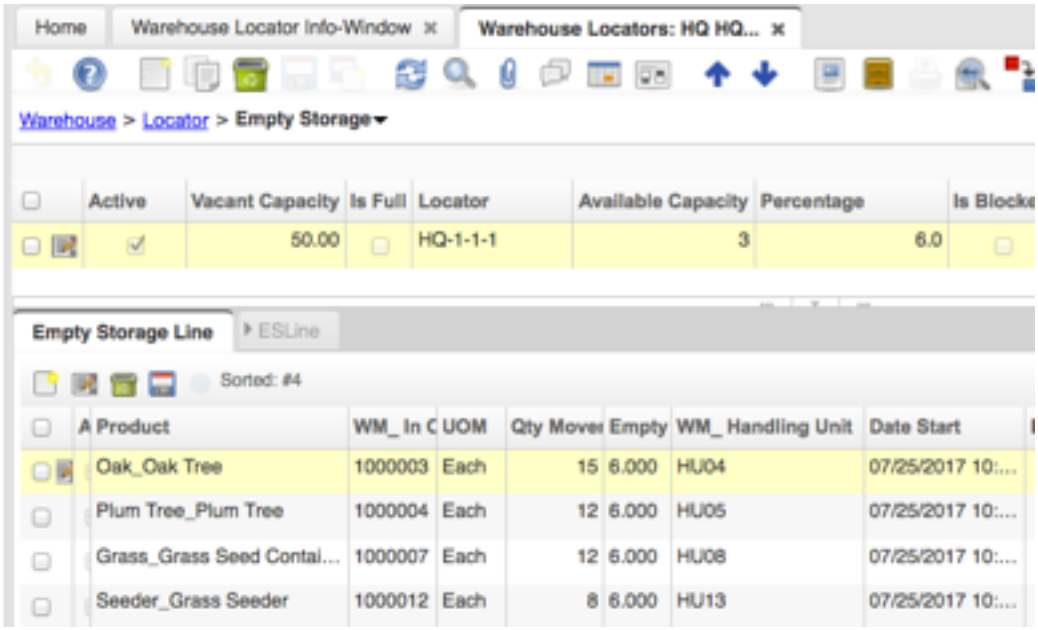


Figure pg 40 - Locator Storage Lines

Note that none of the items listed are in other preferred setting or type. Note also that the total quantity is within the unit capacity of 50 per locator. User can set individual locator space in denominator units and using Pack Factor to get a right relative fit.

You can go on to test through each configurable process to see if the putaway programmed logic is accurate. If not, send me an email describing in full so i can rectify it promptly.

Now, next, we can go and have a look at the interim movements and finally the picking process.

Intra Interim Operations

There are a few intra model or interim operations between putaway and picking that are tremendously useful to the user. There maybe a need and most certainly common need to change things here and there. There maybe a locator that is wrongly given. Or the user doing the putaway refused or find it difficult to reach a certain locator bin and wish to change the target locator. Or there are some items that need to be reorganised to another better location.

There can also be handling units that were not assigned by omission or necessity at first and now need to be assigned. Or those handlers were not operational and need to be replaced.

Let us first look at the Add Handling Unit process. You can do that by going to the Putaway/ Picking Info-Window, select the items concerned. Then press the button at the bottom.

In the dialog box the user has the choice to put all the items under the same handling unit, preserve its line row quantity integrity, or break them up according to locator capacity.

Add HandlingUnit / Change Locator / Stock Movement]

Completing Document Actions [Delivery Schedule / WM_InOut]

Executive Management

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