# D3.1 – Traceability Database and Software Application

Zhipeng Wu (UM), Lizong Zhang (UM) and John Gray (UM))

9/27/2013
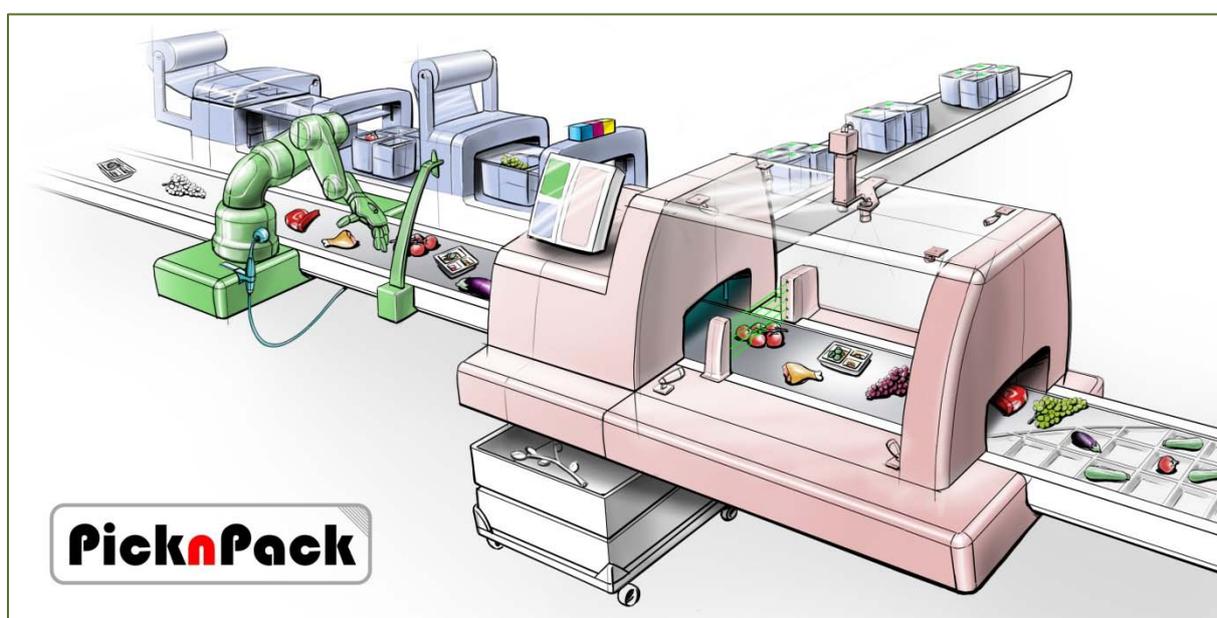
Flexible robotic systems for automated adaptive packaging of fresh and processed food products

Dissemination level		
PU	Public	X
PR	Restricted to other programme participants (including the EC Services)	
RE	Restricted to a group specified by the consortium (including the EC Services)	
CO	Confidential, only for members of the consortium (including the EC Services)	

Table of Contents

1   Introduction

This document outlines the operation of the traceability database and software, relating to the deliverable of:

- D3.1: Database and software for intelligent production

Two associated milestones are:

- M3.1: Database establishment (M6)
- M3.2: Software development (M12)

A database has been established with SQL Server 2008 as the outcome of M3.1. This database stores traceability information to support the functions of the traceability system. It contains logistical data, identification number, product, supplier, customer and other information. The information in the database could be retrieved from the traceability software written using Microsoft Visual Studio C#. Details of the database and traceability software design can be found in the deliverable report for D3.2.

This report illustrates how the software application is used with a series of screenshots. Further details of operation are given in the following sections.

2   The Traceability Database

The traceability system has a database used for recording the information of:

       (1) Suppliers
       (2) Goods supplied & ID codes
       (3) Production line processes: methods and procedures
       (4) Links to process databases
       (5) Product parameters: product type, weight, price, ID codes and others
       (6) Labelling details
       (7) Customers and delivery
       (8) Time stamp at various stages

The database is built using SQL server 2008, as it has an advantage of handling structured data. The implemented database structure is shown on Figure 1.
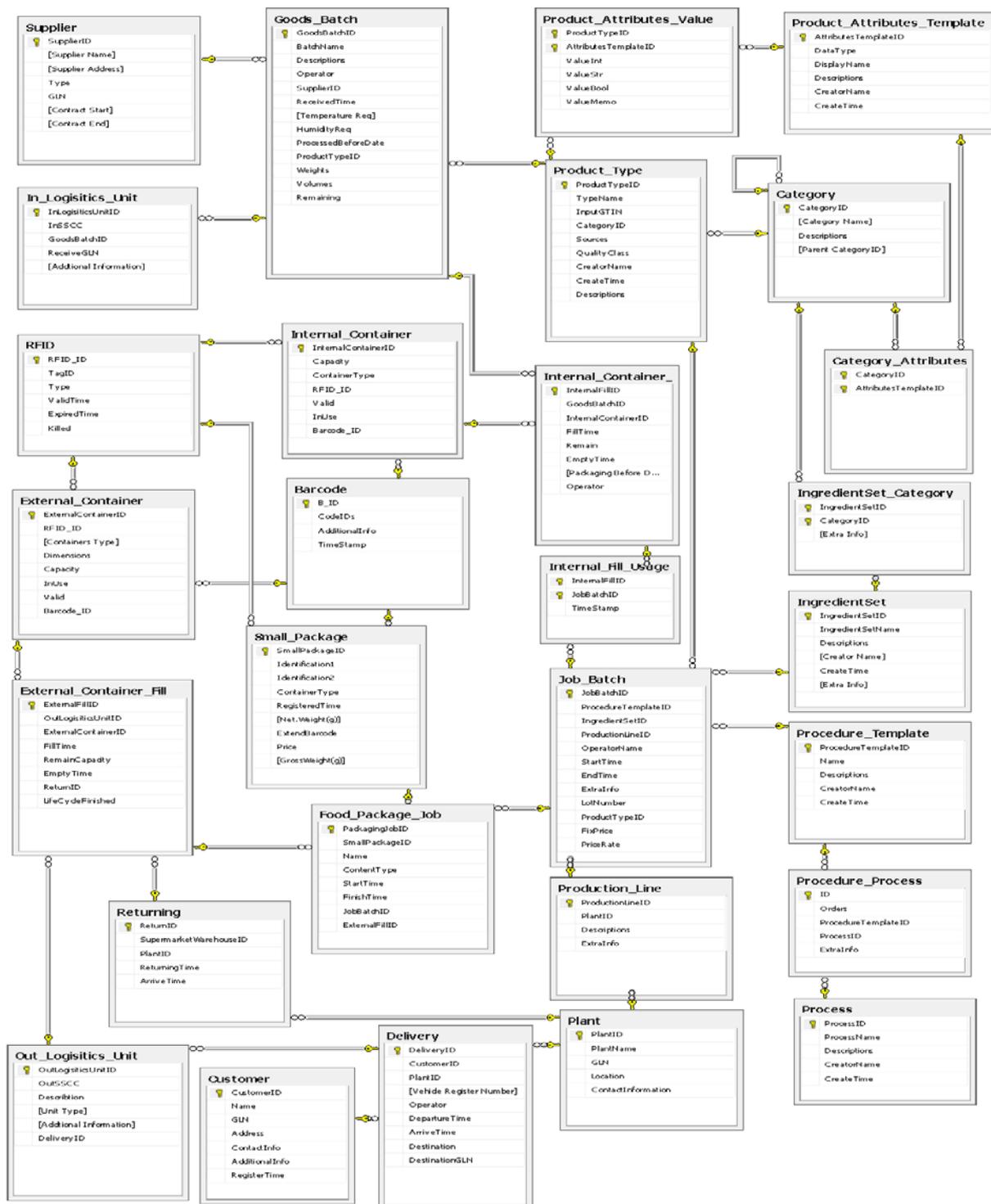
Figure 1 - Database structure

The current database can handle the traceability information. Its link to other distributed databases in WP2 is to be further developed when WP2 is ready for interfacing or integration.

3 Application Interface
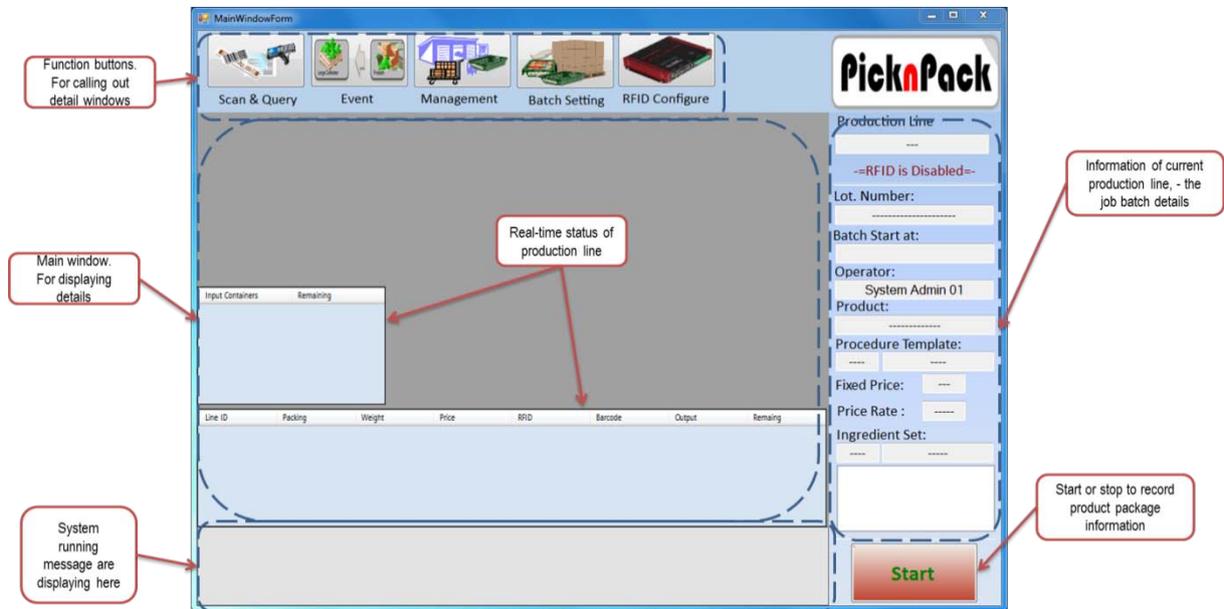
Figure 2 - The interface of the traceability software application
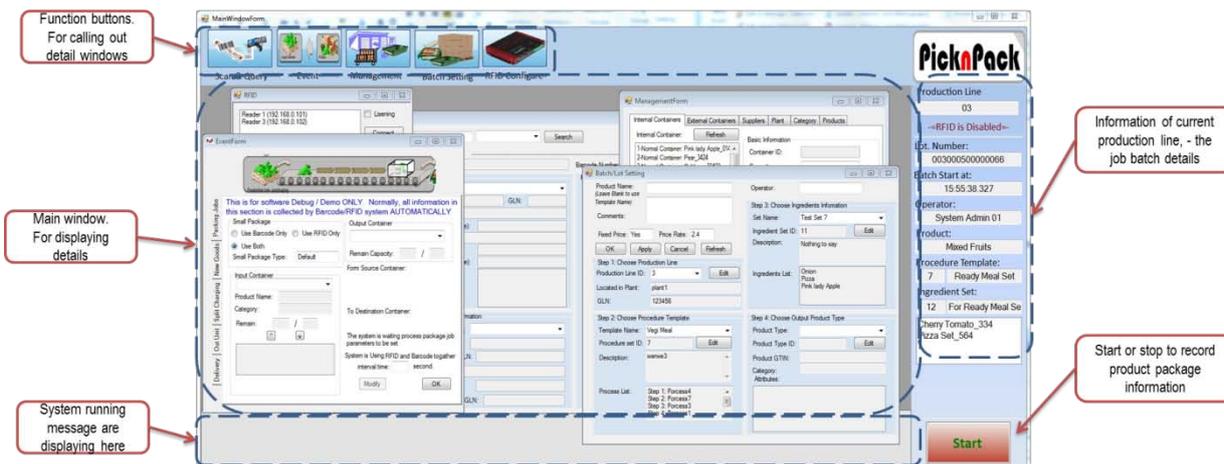
Figure 3 - Interface with functions displayed

The traceability software application developed for the WP3 takes up a simple one-screen design. Starting from the first screen shown in Figure 1, all functions can be called to display further on the screen, as shown in Figure 2. In total, there are five function areas:

- Function buttons: these are for calling out related windows/interfaces.
- Main window area: This is where the windows are displayed. It also shows real-time information on the production line, including input source material, output packed product, and current packaging information.
- System running message: This area shows system running messages. They include error messages, notifications, and reminders etc.
- Production line setting and parameters: This area shows the current 'Job Batch/Lot Setting' of a production line.
- Start/Stop Button: This is used to start or stop recording the traceability information of a production line.

The procedures of using the software are illustrated in Figure 3. Mainly, there are four steps: (1) Initial setup for entities, (2) Preparing ingredients (source material), (3) Job batch settings (for packaging job), and (4) Packing event settings.
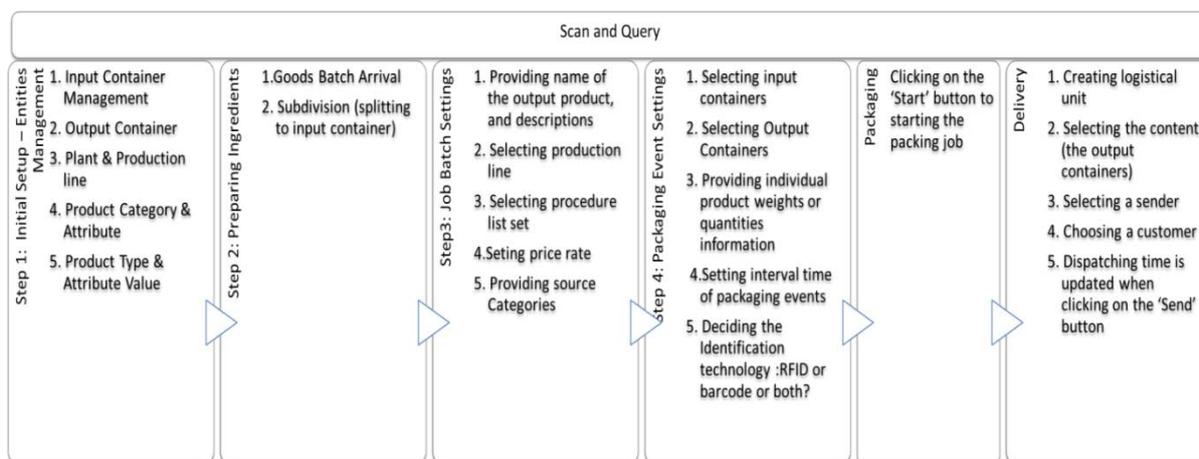
Figure 4 – Operation procedures in using the software

4   Application Operations – Step1: Initial Setup

Before operation, necessary entities need to be registered into the system. These include plant, production, supplier, customer, product type and category information, at least one record of each type of entity is required. The 'Management Function' is designed for creating new records or updating existing records of entities, and it can be called out by the 'Management' button as shown in Figure 4.
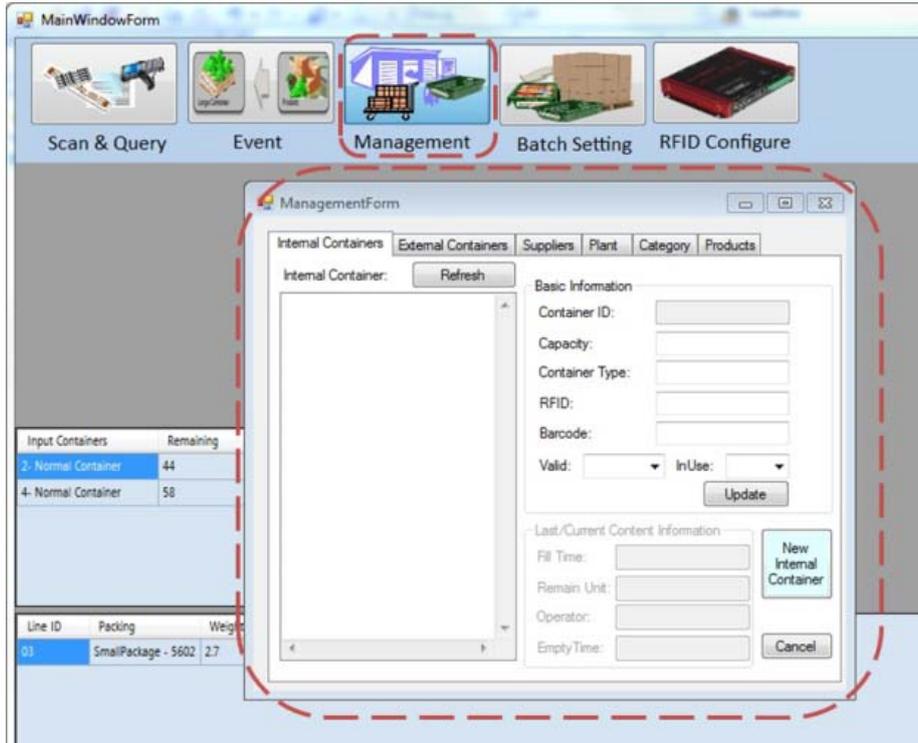
Figure 5- The interface of Management function

4.1 Suppliers Management

'Suppliers' can be registered/ modified in the third tab of the Management interface. Supplier information can be modified by clicking on the 'Update' button after changes are made. New suppliers can be added to the system by clicking on the 'New Suppliers' button, and the layout of the window is then changed for creating new suppliers (Figure 5a). The layout can be switched back to 'Modifying Supplier' (Figure 5b) by clicking on the 'Edit Supplier' button. Figure 5 illustrates the two layouts.

(a)   (b)
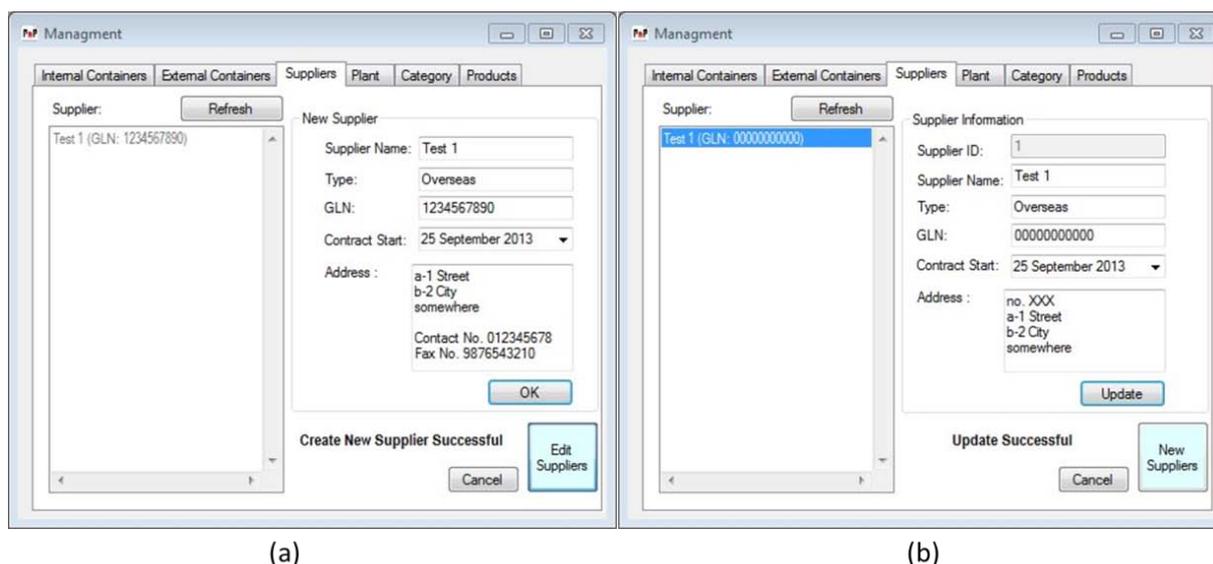
Figure 6 – Interface for supplier information inputs

Figure 6 shows a supplier 'Test 1' is successfully added to the system with GLN '1234567890' and then the GLN number is modified to '0000000000'.
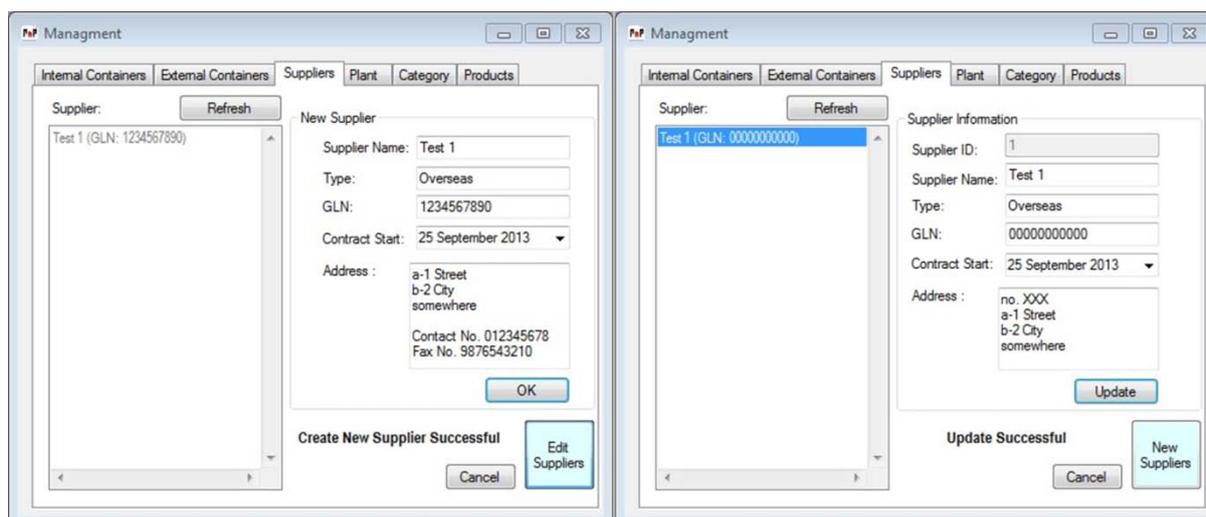
Figure 7 – Illustration of a supplier being added into the system

4.2 Factory and Production Lines

The fourth tab of the management window is for adding or modifying the information of factory/plant and production lines. The 'Add New' and 'Modify' layouts can be switched between them by clicking on 'New Plant' or 'Modify Plant' button in these two layouts. Production line information can be changed in a separated window (Figure 7c) that is called out by clicking on the 'Edit Production Line' button. This button is only shown in 'Modify Plant' layout (Figure 7a).
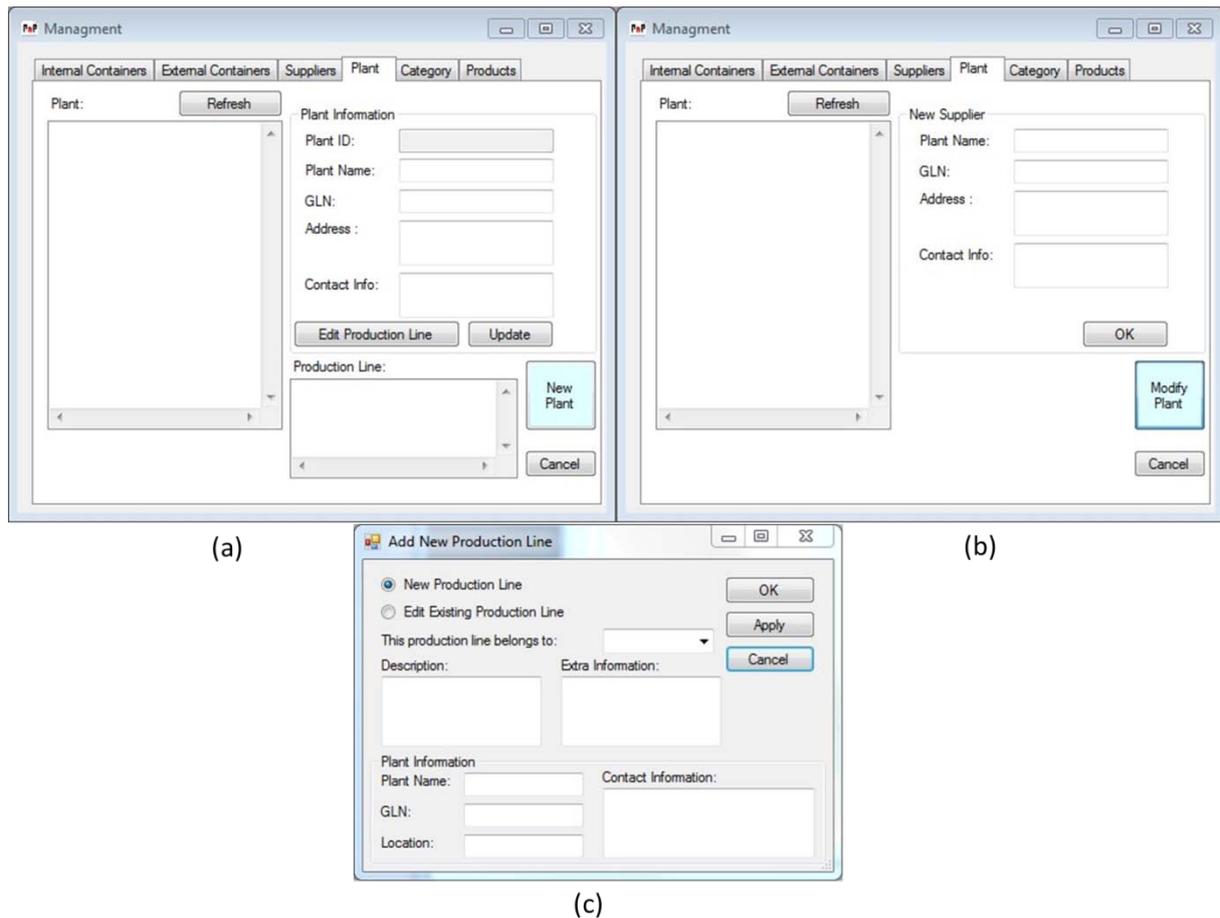
Figure 8 - Plant and production line settings

At least one plant needs to be created before creating production lines. Figure 7 (b) shows an interface for creating new plant record, and the created plant information is confirmed by clicking on 'OK' button in 'Create New Plant' layout (Figure 7b). Once a desired plant is successfully created (Figure 8a), production line information can then be added to the system by clicking on the 'Edit Production Line' button in 'Modify' layout (Figure 8b).

The information for a new production line can be confirmed by clicking on the 'OK' button, and the added production line information is also displayed in the 'Plant' tab (Figure 8c).The existing production line information can be changed by the 'Edit Existing Product Line' options (Figure 8e), and the changes can also be confirmed by clicking on the 'OK' button.
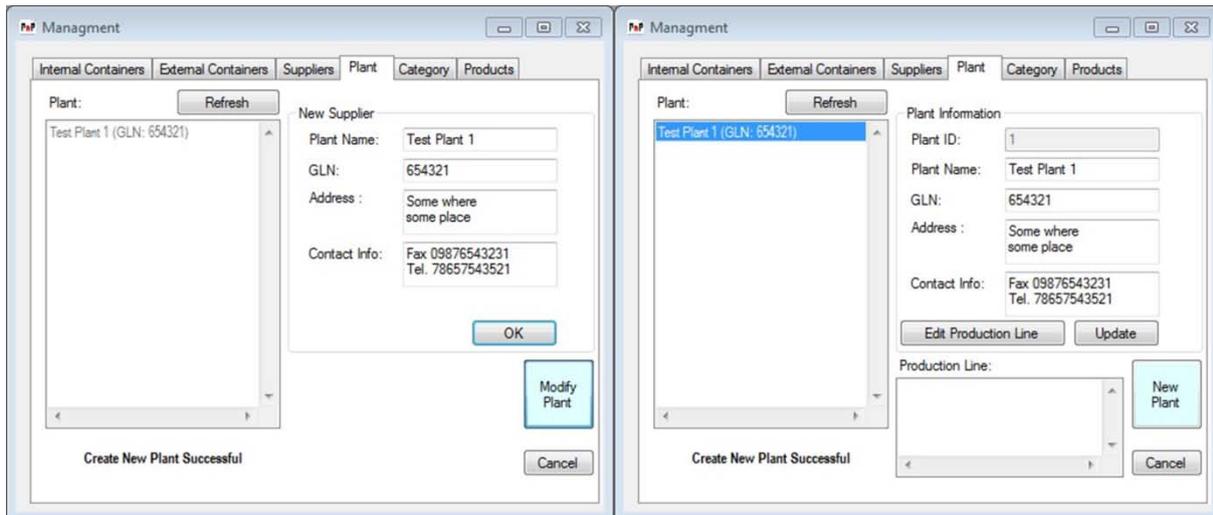
(a)

(b)
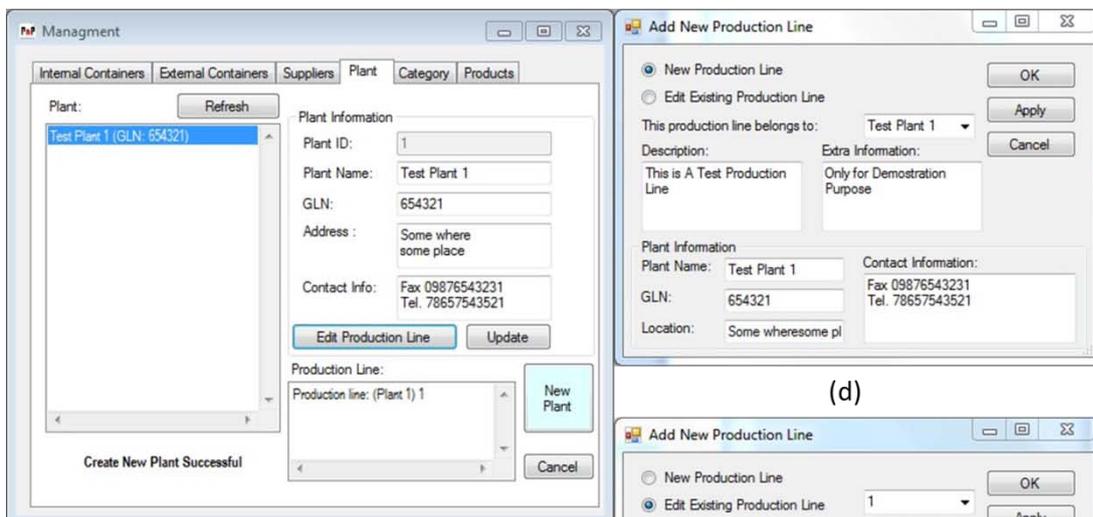
(c)

(d)
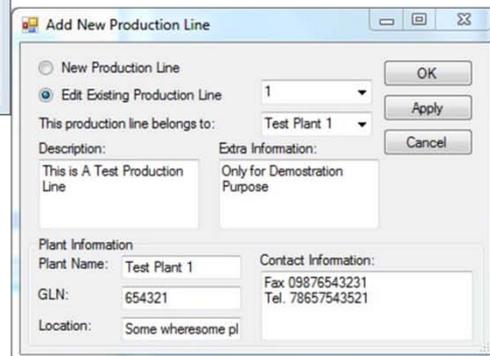
(e)

Figure 9 – Illustration of a plant and a production line being added into the system

4.3 Input Containers

The first tab of the 'Management' window is for 'Input Container' management. An 'Input Container' contains a group of products with assigned ID codes.

Figure 9 shows the 'Input Containers' management interface: the left layout is for modifying existing containers, and the right is for adding new containers. The layouts can be switched between them by clicking on the 'Modify Internal Container' button or the 'New Internal Container'.
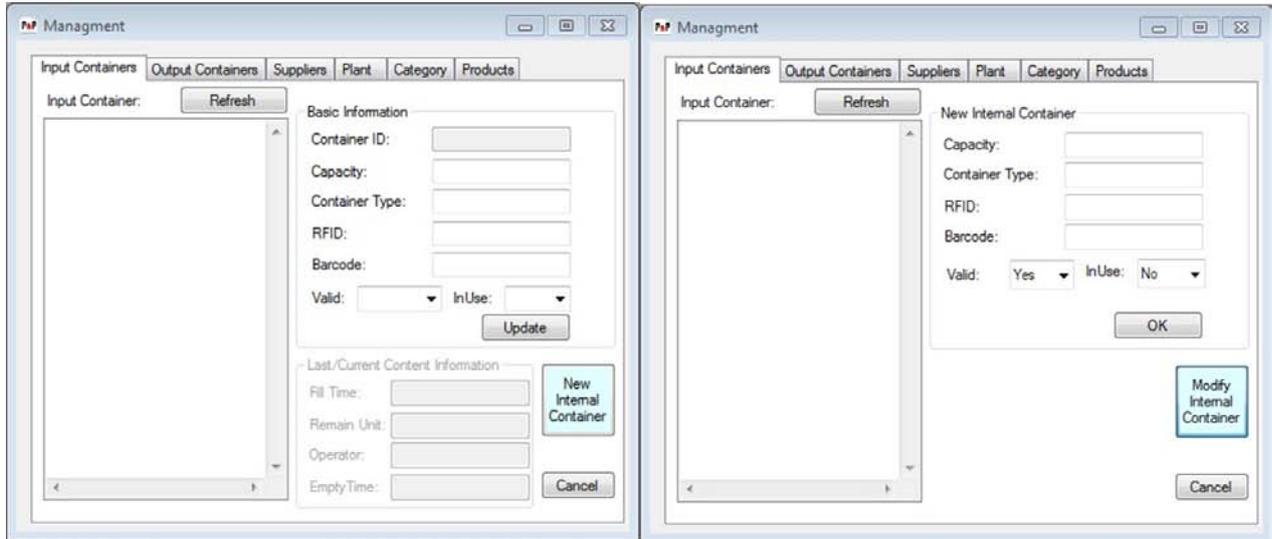
Figure 10 - Input container settings

Figure 10 shows that an 'Input Container' is successfully added into the system with '100' capacity and then its capacity is modified to 200.
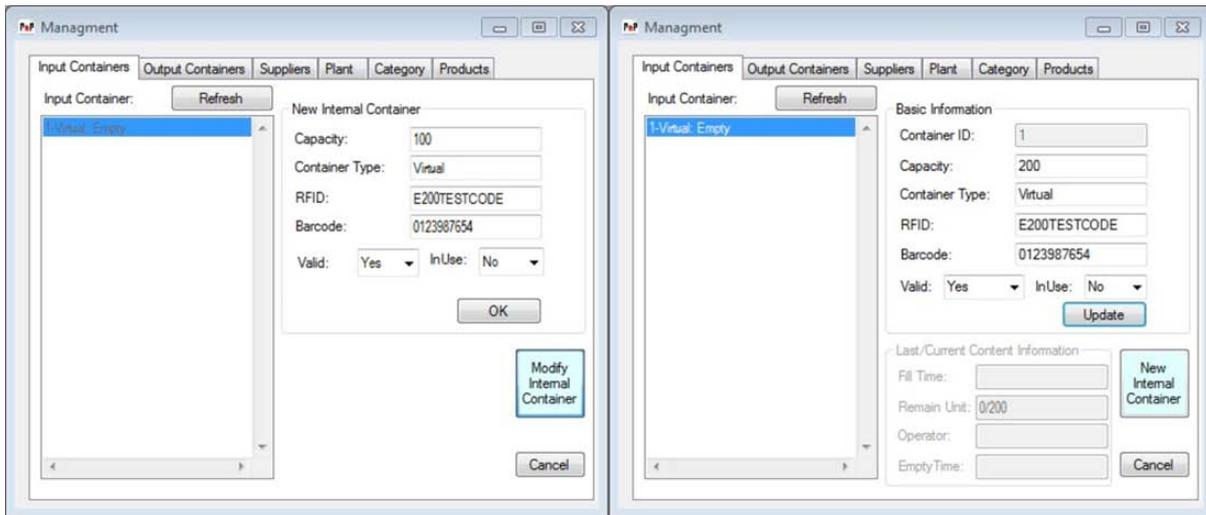
Figure 11 – Illustration of an input container being added into the system.

4.4 Output Containers

The second tab of 'Management' window is for 'Output Container' management. Figure 11 shows the layouts of 'Output Containers' management: the left layout is for modifying existing containers, and the right is for adding new containers. The operations of adding or modifying 'Output Container' are the same as that for the 'Input Containers'.
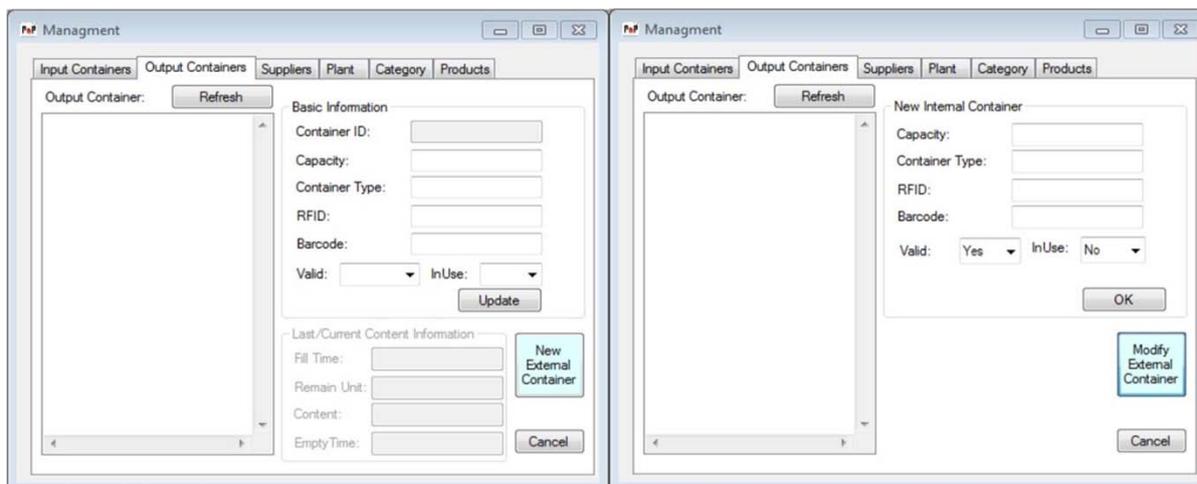
Figure 12 – Two layouts of output container settings

4.5 Category

The fifth tab is for product category management. Figure 12 shows the interface with two layouts. The right one is for creating new category, and the left is for modifying existing categories with an option for creating, modifying and assigning attributes. These two layouts can be switched between them by using 'New Category' or 'Edit Category' button. The feature of product attribute assignment is only available in the 'Creating New Category' layout.
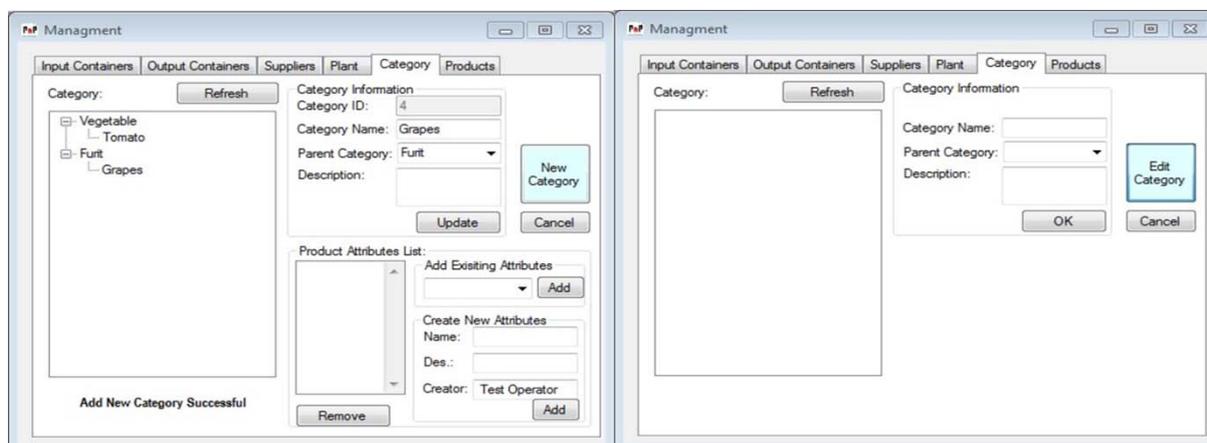
Figure 13 - Category management interface with two layouts

The category management is designed with a multiple-level structure, which is shown in Figure 13a. Four categories 'Vegetable', 'Tomato', 'Fruit', and 'Grapes' are added as an example to illustrate the multiple level structure.
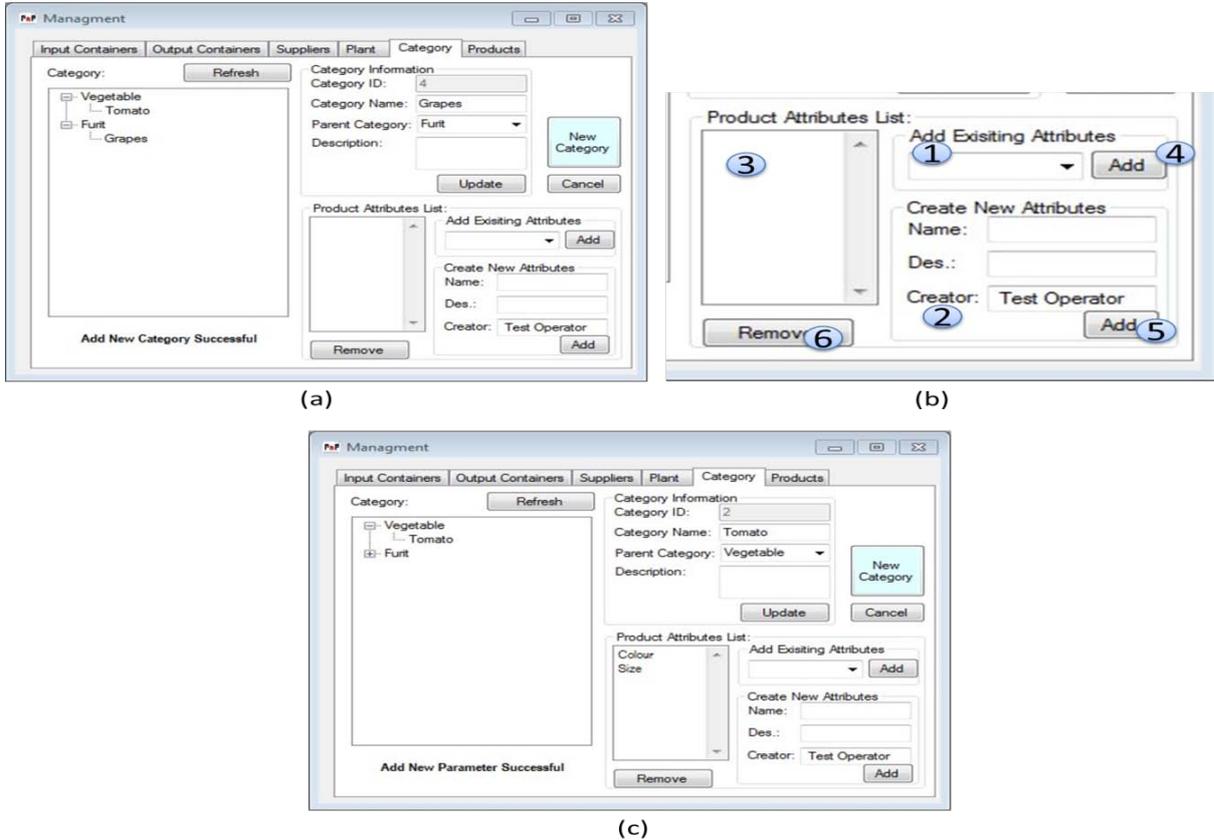
Figure 14- Example categories created with product attribute assignments

Figure 13b shows the interface of attribute assignment. The attributes can be inherited from the upper category level. For example, 'Vegetable' is already assigned an attribute 'Colour'. When a new attribute 'Size' is assigned to 'Tomato', 'Tomato' has then two attributes: the 'Colour' and the 'Size'.

Attributes can be assigned to a category in two ways, as illustrated in Figure 13b. If the attributes are already in the system, the user is able to choose it from location (1), and then clicking on the button (4) to add. If the desired attribute is not registered in the system, it can be created by filling the information in location (2) and clicking on the button (5) to add. Figure 13c shows the 'Tomato' category with its two attributes.

4.6 Product Type and Product Attribute Value

The sixth tab is for product type management and also for product attribute value assignment. Figure 14a shows that a product type named 'Tomato_0154' under the 'Tomato' category which has already been added into the system. The bottom left box on the window is a list of product types belonging to the selected category. Product type information is displayed on the top right of the window.

The attributes of the selected product type are then listed in the bottom right box. Brackets are used to indicate attributes without assigned values. Users can assign a value to the selected attribute by filling the value box and click on the 'Change' button. Figure 14b shows that colour 'Green' and size '10' are assigned to the product type 'Tomato_0154' as an example.
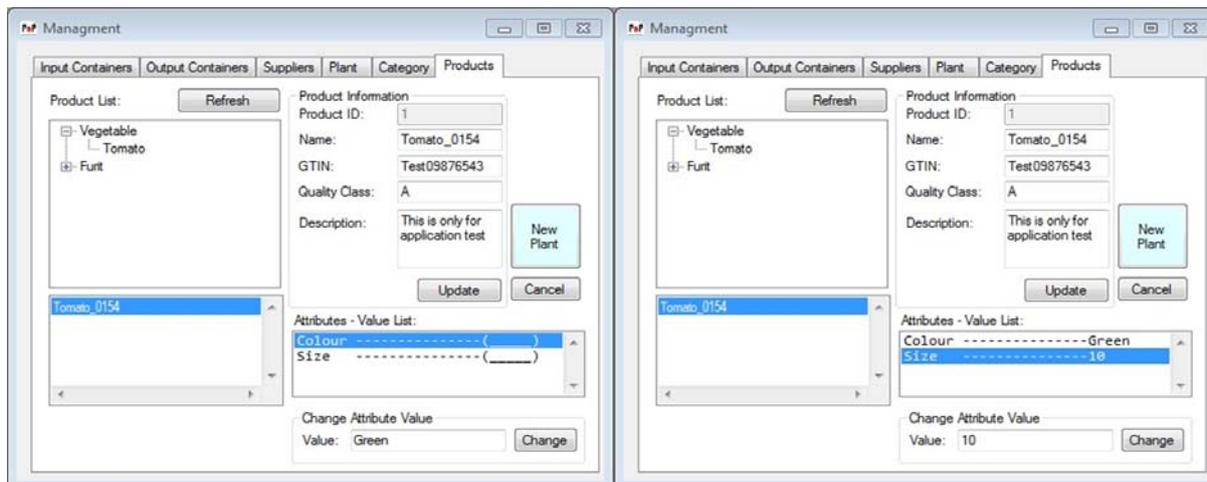
Figure 15-Product type management windows

5   Application Operations – Step2: Prepare Ingredients

The functions for preparing ingredients include two major events: recording 'Goods Arrival' event and recording 'Subdivision' event. These two events are located in the 'Event' window, which can be called out by clicking on the 'Event' button, as shown in Figure 15.
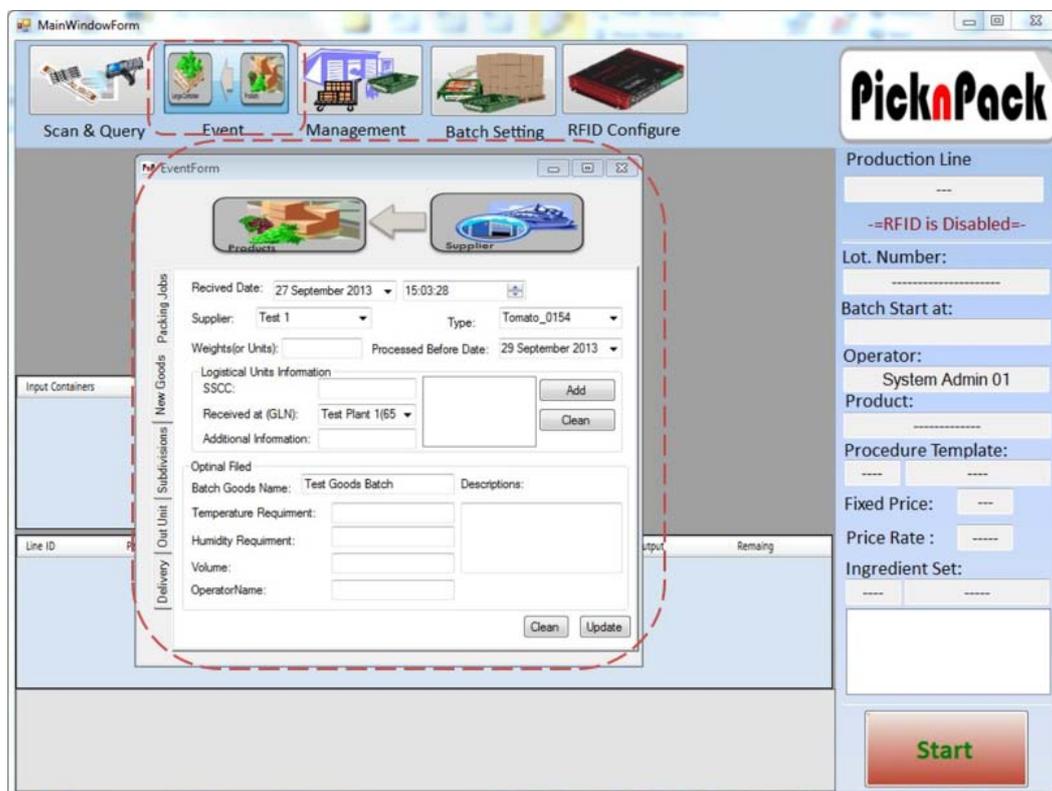
Figure 16 - Event window

5.1 Goods Arrival

The event of raw materials arriving at a plant needs to be recorded by the user. Figure 16 shows the 'New Goods Arrival' window for the user to record incoming goods.

In order to create a complete record of incoming goods batch, the following information is required:

- The logistical unit information of the batch needs to be provided by clicking on the 'Add' button (3) with the SSCC code (1) and the GLN of the receiving place (2). A new logistical unit record is then displayed in the box (4).
- Supplier Information (5) and product type (6) need to be selected from the drop down list.
- Weight or quantity information (7) of the incoming goods batch needs to be added, which will be used to calculate the consumption amount /rate of input source material during the packaging.
- Information listed in (8) is optional.

Once all necessary information is provided, clicking on the update button is to create a record for incoming goods batch.

Figure 17 – Illustration of creating a record for an incoming good batch

5.2   Subdivisions

Before the source material (i.e. the incoming goods batch) can be used for packaging, it is put into containers. This activity is referred to as 'Subdivisions'. The subdivision function is located in the 'Subdivisions' tab of the 'Event' window (Figure 17a).

The first step is to locate an incoming goods batch is split into containers. A feature is provided in this screen to display the last 10 incoming goods (by clicking on the button 1) or to display goods batches by date (clicking on the button 2).

The result is shown in box (3), and valid input containers are listed in box (4) after a goods batch is selected. Buttons (5) and (6) are for adding or removing a selected container in box (7). The selection can be confirmed by clicking on the 'OK' button. The containers used for the selected batch are listed in box (8) (Figure 17b).

(a)   (b)
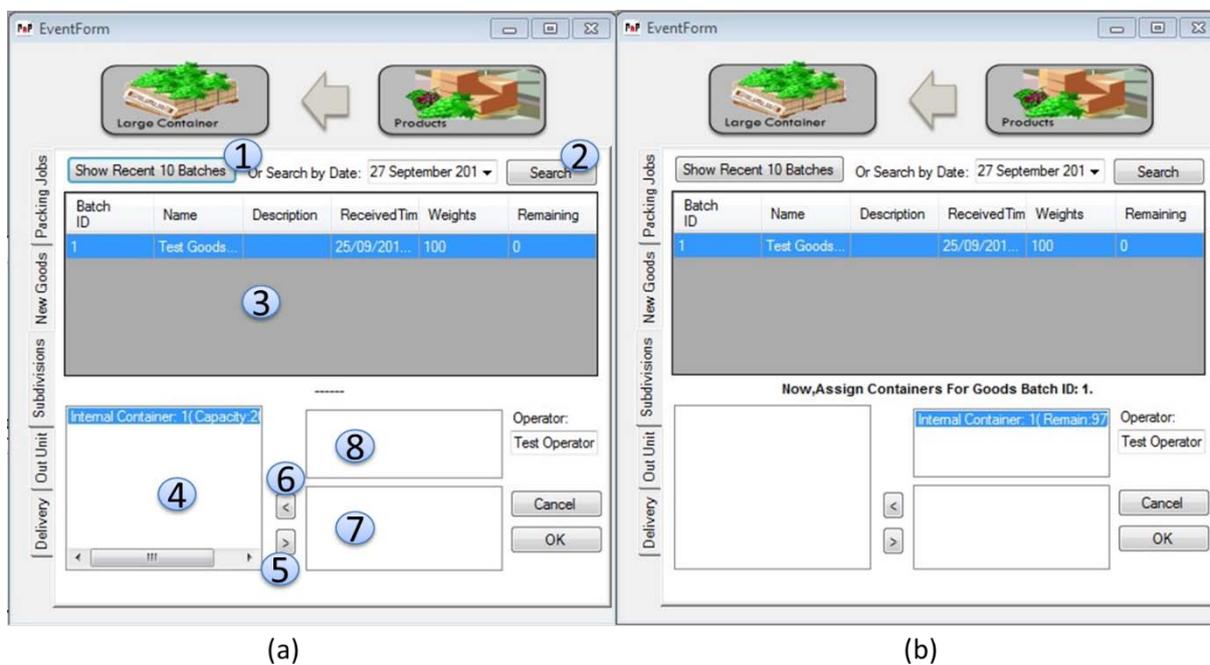
Figure 18 – Splitting a goods batch into containers

6   Application Operations – Step3: Setting UP the Job Batch

This step is for setting up job batch parameters. The related window can be called out by clicking on the 'Batch Setting' button, which is shown in Figure 18.
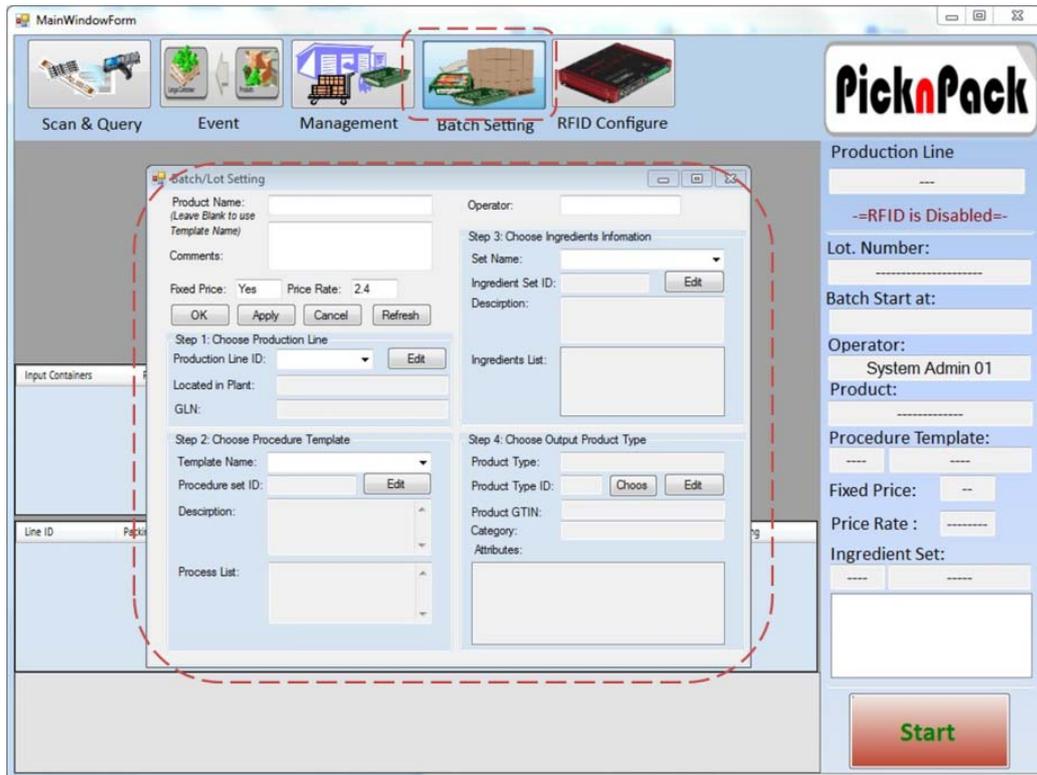
Figure 19 - Job batch setting window

There are four types of information that are required to complete the setup:

- Name of the product, descriptions, and product pricing method – fixed or by weight.
- Production line information (the 'Step 1' area).
- Procedure set (the 'Step 2' area).
- Categories of Ingredients used in the job batch (the 'step 3' area) for checking against input containers.
- Output product type and its GTIN number.

There are four areas marked with 'Step' on the interface. 'Step 1' is for choosing a valid production line from a drop down list. If the user would add or edit the production line records, the button 'Edit' in this area could be used to call out an edit window in the same way as that in Section 3.2.

(a)   (b)
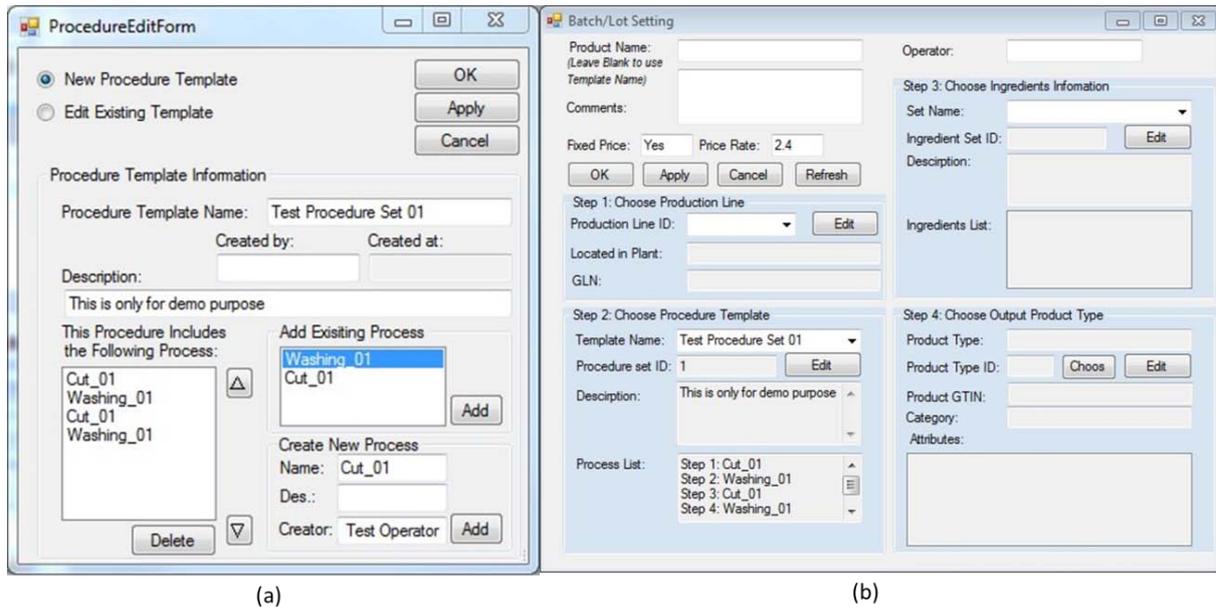
Figure 20 - Creating/modifying procedure set and job batch setting

'Step 2' is for selecting a procedure set. The 'procedure set' is a list of processes of packaging jobs, and it is pre-assigned by the operator. The details of each process could be retrieved from other elements of PicknPack system in later stage of the project, and the 'procedure set' information describes where to retrieve the details. If there is no valid procedure sets available, the 'Edit' button can be used to call out a window (Figure 19a) to modify or create a procedure set. The changes can be confirmed by clicking on the 'OK' button, which are then shown in the main job batch setting window (Figure 19b).

(a)   (b)
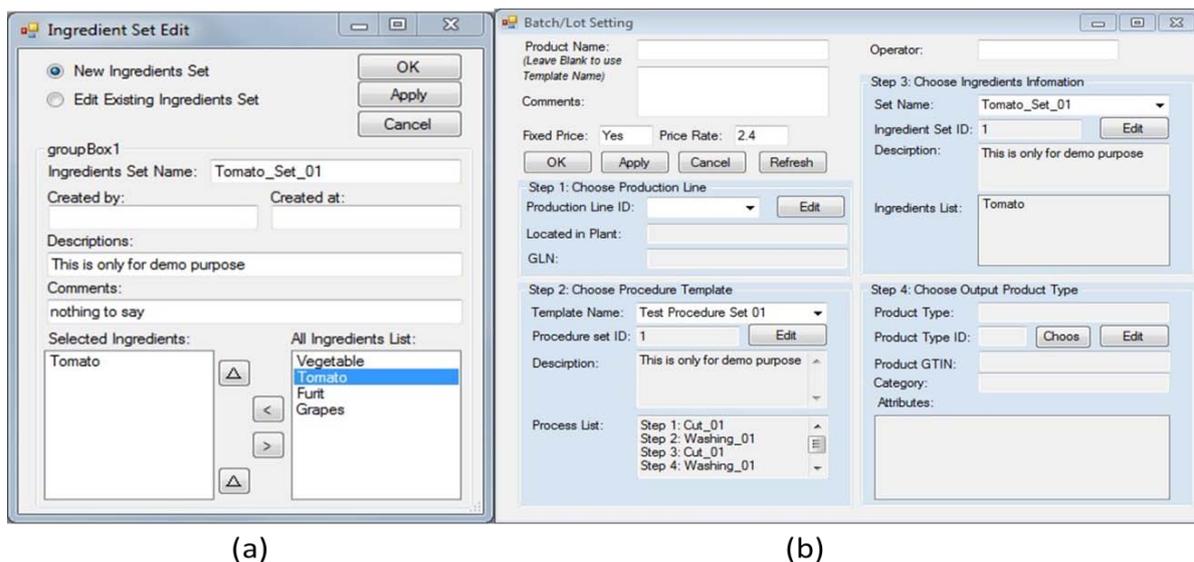
Figure 21 - Creating/modifying ingredients settings and job batch setting window

'Step 3' is for selecting an 'ingredients set' for the packaging job. The information is used to check against the input material in the packaging stage. The ingredients information provided here is only

the 'Categories'. The actual ingredients information (i.e. the Input Containers) is assigned during the packaging process; a 'Edit' button can be used to call out an 'Ingredients Sets' interface (Figure 20a). The confirmed changes are shown in the main job batch setting window (Figure 20b).

(a)   (b)
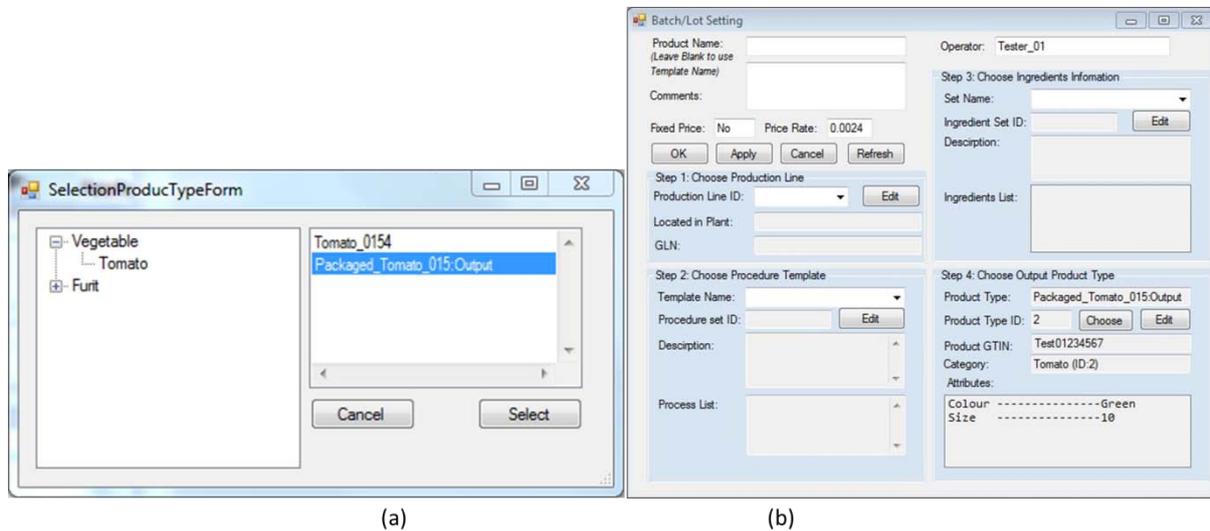
Figure 22 - Output product type settings

'Step 4' is for selecting an output product type of a job batch. The product types are managed by the 'Management' window that discussed in Section 3.6. The window can be called out by the 'Edit' button.

In order to set an output product type, the user needs to click on the 'Choose' button, which calls out a window (Figure 21a) for product type selection. Once the product type is decided by clicking on the 'Select' button, the information is displayed in the job setting interface (Figure 21b).

The last step is to set the price, operator, comments and product name information. The price information is used for pricing individual packs of the output product. It can be a fixed price or dynamic price. If the fixed price option is set to 'Yes', the price rate is the total price of each package. Otherwise, the price rate is used to calculate the actually price with the quantity or weight information of each individual package.

The operator, comments and product name are optional. If these three types of information are not provided, default values are used. The complete setting of a job batch is shown in Figure 22.

Figure 23- A completed setting for a job batch.

The information of packaging job setting is confirmed by clicking on the 'OK' button, and the settings are displayed in the right bar of the main window (Figure 23).

Figure 24- Completed job batch setting and that shown on the right bar of the main window

7   Application Operations – Step4: Setting the Packaging Event

The packaging job events are currently generated by an internal module as the RFID/ barcode system has not been implanted. The setting is made from the first tab of Event window. Figure 24 shows the interface of setting packaging events.
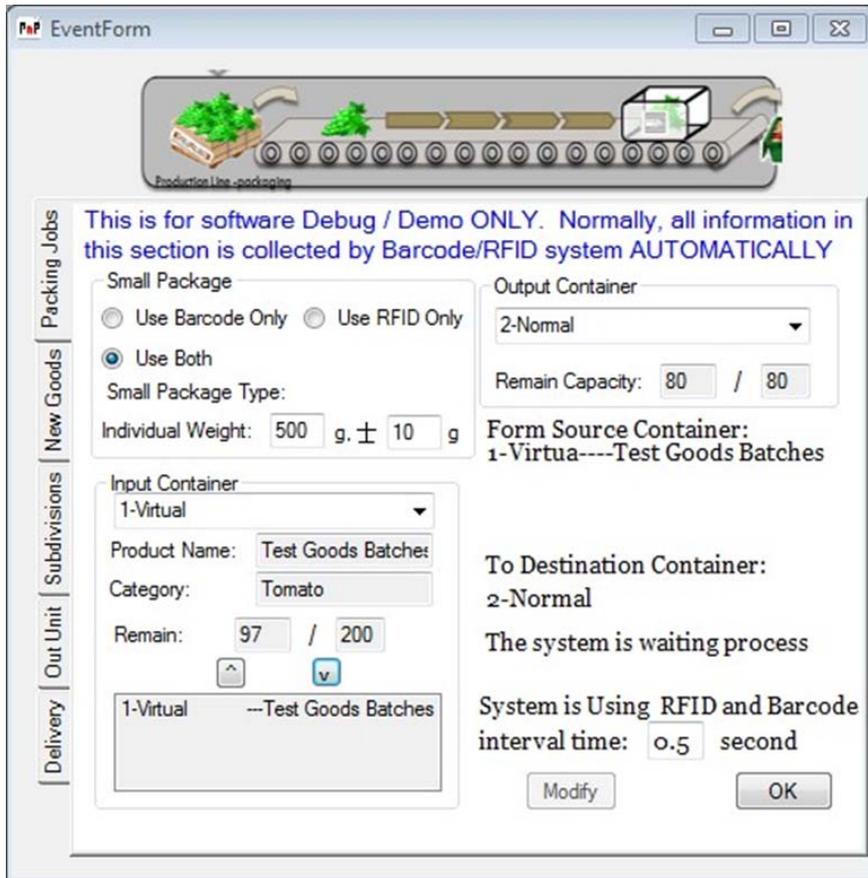
Figure 25- Packaging event setting interface

There are four types of information required to generate a packaging event: input container, output container, interval time of packaging events, and weight/quantity of each individual package. The settings are confirmed by clicking on the 'OK' button. A message may be displayed on the main window, if a 'Job Batch' has not been started (Figure 25).
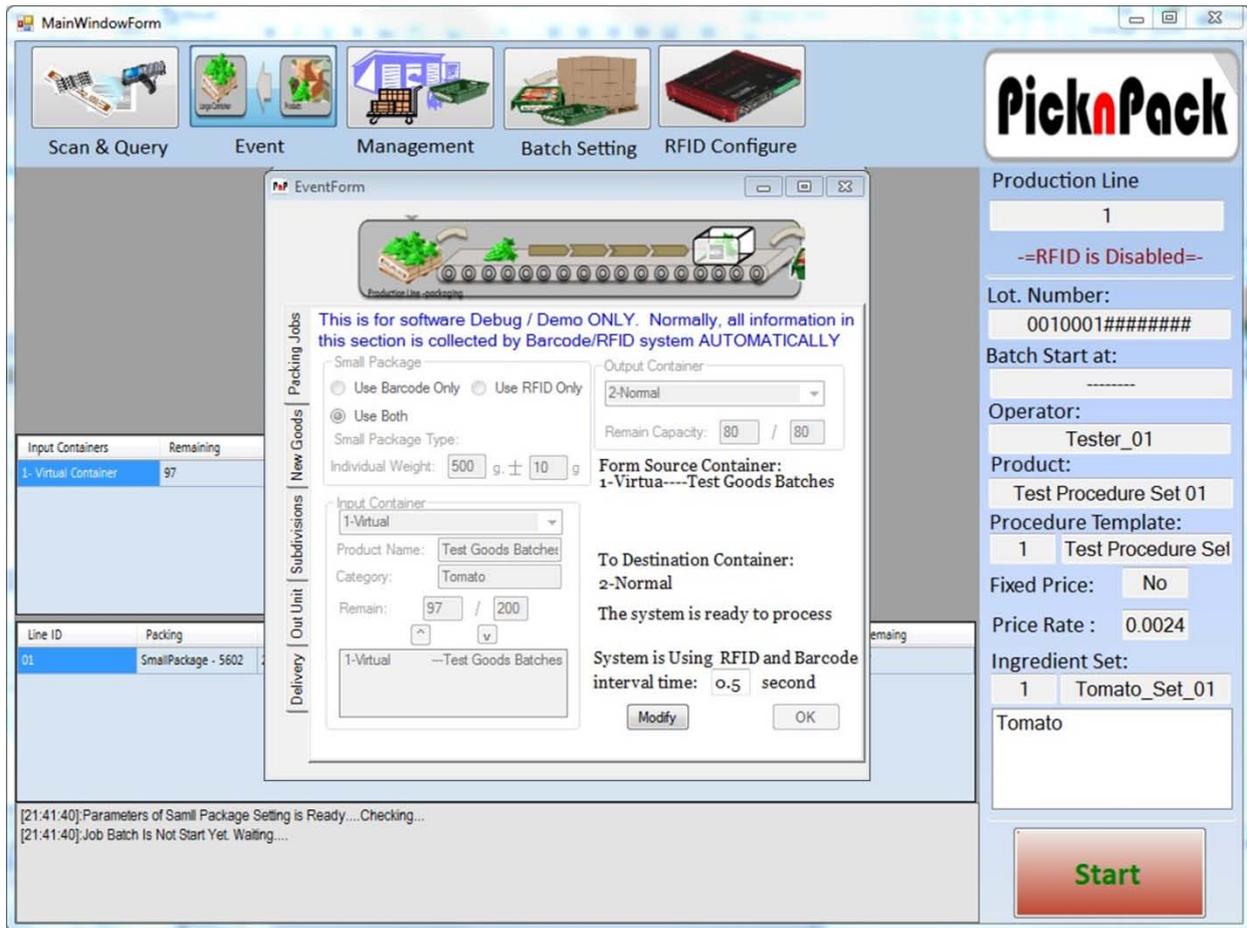
Figure 26 - A message displayed in the main window if the 'Job Batch' has not been started

A packaging job batch can be started by clicking on the 'Start' button on the main screen. Real time messages are displayed in the message box(Figure 26) and the status monitoring bar (Figure 27) shows the current status of the production line.
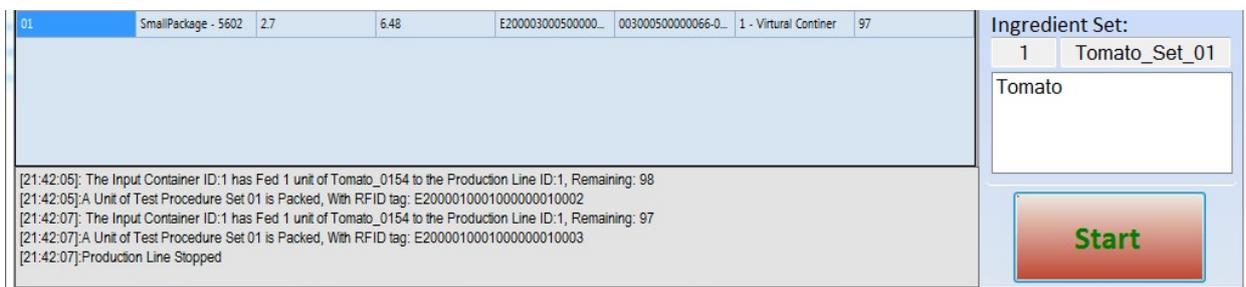
Figure 27 - Message box showing packaging information

Figure 28 – Production line status monitoring bar

8   Scan and Query

This function is a major feature of the traceability system. It allows the user to retrieve related information by providing an ID number, which can be a batch/lot number, RFID/barcode of the packaged product, or container number.

An interface of this function can be called out by clicking on the 'Scan & Query' button on the main window of the application. The interface is shown in Figure 28.

Figure 29 – Interface of 'Scan & Query' function

The user can key in an ID number for searching the information on the 'Number/ID/codes' box of the window. Once click on the button 'Search', all found information is displayed in the left list box in two formats: object name and the RFID/barcode number.

Details of a selection in the left list box are displayed on the right part of the interface. It includes source information, production information and delivery information. Some of the sections may have multiple records that can be shown by selecting from the drop-down lists.

9   Delivery

The delivery event is currently generated by simulation from an internal module located in 'Delivery' tab of Event window (Figure 29). This will be replaced by that generated by RFID/barcode inputs in the next step of development.

Figure 30 – Interface for simulating delivery events

Four types of information are required to generate a delivery event:

1) Logistical unit's information – a unit is created with a given SSCC number, a dispatch location GLN, and optional additional information. The unit can then be created by clicking on 'Add' button.

2) The content – i.e. the output container. It can be selected from the drop down list and confirmed by clicking on the 'Add' button in 'Output Containers' window.

3) Customer information- it can be done either by selecting from the drop-down list (existing customers) or by creating a new one from the 'New Customer' window.

4) The dispatching time – it is automatically updated by clicking on the 'Send' button.