

Chapter 8

物料搬運與動畫模擬

- Advanced Transfer模組介紹
- 以Sequence模擬Entity移動
- 以Transporter與Distance模擬Entity被搬運
- 多載量的搬運車

Example 8-1 Simple Route

- 模擬產品根據設定的順序在各站之間自行移動，不須使用搬運設備。
- 模組：Station, Route, Sequence

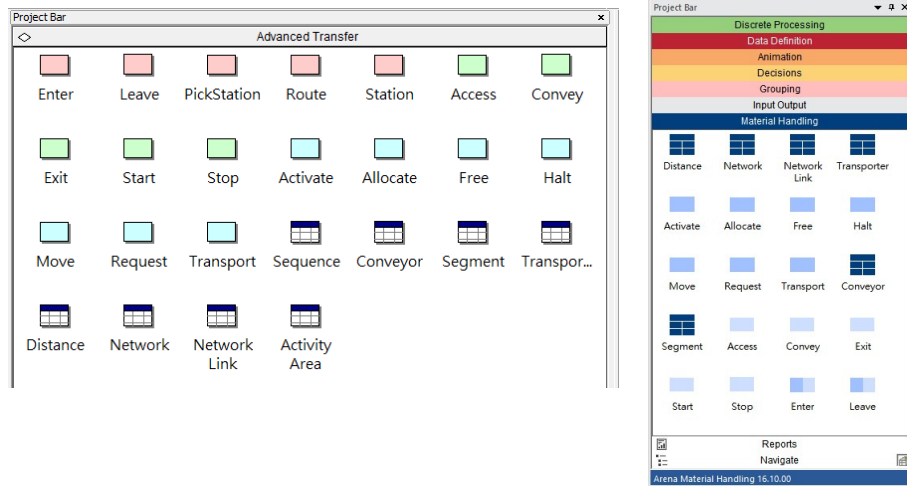
Example 8-2 Simple Transporter

- 類似Example 8-1，但是產品由車輛搬運，行駛時間由距離與車速決定。
- 模組：Station, Request, Transport, Free, Transporter, Distance, Sequence

Example 8-5 Pickup and Dropoff

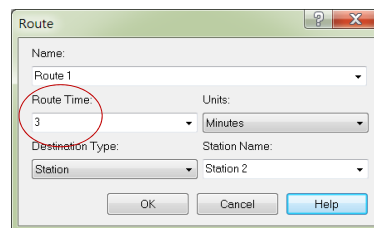
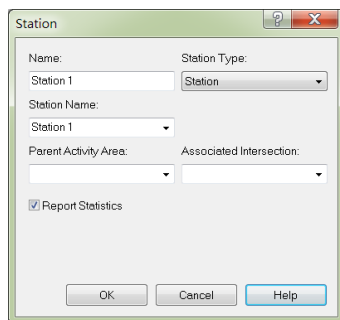
- 模擬多載量搬運車到不同地點將等候搬運的產品一起運送至目的地。
- 模組：Station, Route, Pickup, Dropoff

8.1 Advanced Transfer Panel

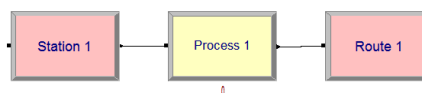


Station and Route Modules

Station為某個地理位置的站點入口，所有的物料移動都發生在站點之間



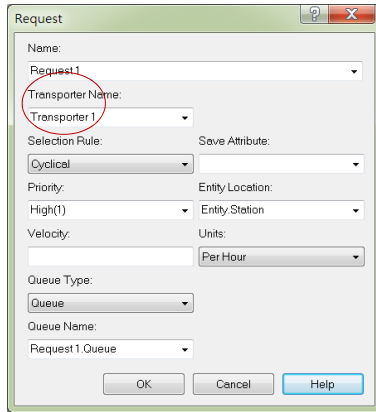
Route為站點出口，引導entity前往指定的下個站點



Entity由其他站點進入，經過處理後自行前往下一站點

使用運輸載具的搬運方式

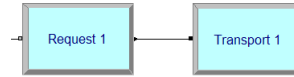
Request: 呼叫Transporter(載具)



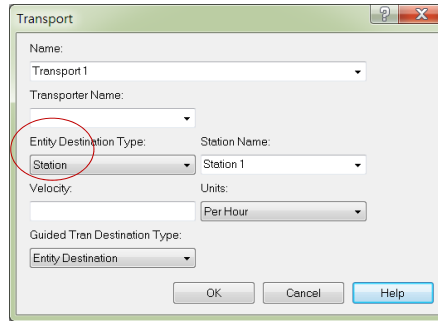
The Request dialog box contains the following fields and options:

- Name: Request 1
- Transporter Name: Transporter 1
- Selection Rule: Cyclical
- Save Attribute: (empty)
- Priority: High(1)
- Entity Location: Entity: Station
- Velocity: (empty)
- Units: Per Hour
- Queue Type: Queue
- Queue Name: Request 1 Queue

Buttons: OK, Cancel, Help



Transport: 搭乘載具前往目的地



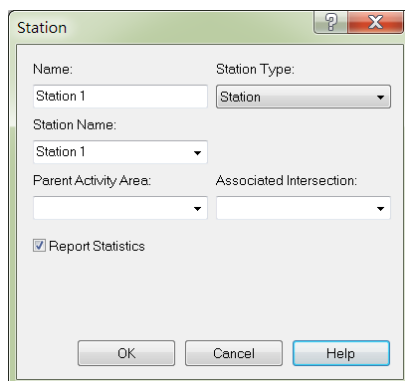
The Transport dialog box contains the following fields and options:

- Name: Transport 1
- Transporter Name: (empty)
- Entity Destination Type: Station
- Station Name: Station 1
- Velocity: (empty)
- Units: Per Hour
- Guided Tran Destination Type: Entity Destination

Buttons: OK, Cancel, Help

到達目的地後釋出載具

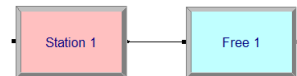
Station: 進入目的地



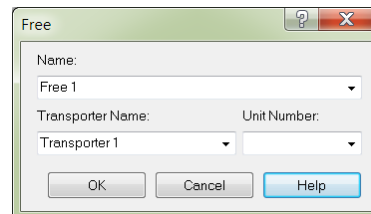
The Station dialog box contains the following fields and options:

- Name: Station 1
- Station Type: Station
- Station Name: Station 1
- Parent Activity Area: (empty)
- Associated Intersection: (empty)
- Report Statistics

Buttons: OK, Cancel, Help



Free: 釋放載具



The Free dialog box contains the following fields and options:

- Name: Free 1
- Transporter Name: Transporter 1
- Unit Number: (empty)

Buttons: OK, Cancel, Help

Advance Transfer 資料模組

- (1) **Sequence**(路線順序): 設定Entity或者是Transporter移動站點的次序。第一個站點並非流程起點，而是第一個目的站點；可以重複前往相同站點，沒有限制；最後的站點通常連結到流程結束的Dispose模組。

The screenshot shows the 'Sequence - Advanced Transfer' window. On the left, there is a sidebar with icons for 'Sequence', 'Transporter...', and 'Network Link'. The main window contains a table with the following data:

Name	Steps
Sequence A	3 rows
Sequence B	6 rows

Below this table is a 'Double-click here to add a new row.' prompt. To the right, a 'Steps' dialog box is open, showing a detailed table:

	Station Name	Step Name	Next Step	Assignments
1	Station 3			0 rows
2	Station 4			0 rows
3	Station 1			0 rows
4	Station 3			0 rows
5	Station 2			0 rows
6	EXIT Station			0 rows

Below the 'Steps' table is a 'Double-click here to add a new row.' prompt.

Advance Transfer 資料模組

- (2) **Transporter**(載具): 主要用途為設定載具的數量與規格，包括行駛路線與速度。

移動時間所參照的距離表

The screenshot shows the 'Transporter - Advanced Transfer' window. On the left, there is a sidebar with an icon for 'Transporter'. The main window contains a table with the following data:

Name	Number of Units	Type	Distance Set	Velocity	Units	Initial Position Status	Report Statistics
Cart	2	Free Path	Cart.Distanc	30	Per Minute	0 rows	<input checked="" type="checkbox"/>

Below the table is a 'Double-click here to add a new row.' prompt.

Free Path or Guided

Advance Transfer資料模組

(3) **Distance**(距離): 設定站與站之間的距離，例如高鐵沿途各站的間隔距離，與載具速度共同決定移動時間。

	Name	Stations
1	Cart Distance	25 rows

Double-click here to add a new row.

	Beginning Station	Ending	Distance
1	Order Release	Cell 1	37
2	Order Release	Cell 2	74
3	Cell 1	Cell 2	45
4	Cell 1	Cell 3	92
5	Cell 2	Cell 1	139
6	Cell 2	Cell 3	55
7	Cell 2	Cell 4	147
8	Cell 3	Cell 4	45
9	Cell 3	Exit System	155

8.2 Simple Route

- Example 8-1: 兩站組成的生產系統，各站均有一台機器，產品Part隨機進入系統，作業順序為1-2-1，完成後離開。

Part到達時間間隔	Random (Expo) 1
第一站第一次作業	tria(0.3,0.4,0.6)
第二站作業	tria(0.5,1,1.2)
第一站第二次作業	unif(0.2,0.9)
站間移動時間	0.5 minutes

定義Station與Sequence

以Station模組建立站點：代表入口的Entrance，代表出口的Exit Station，以及代表工作站的Cell 1與Cell 2。

Name	Steps
1	Sequence 1 4 rows

Station Name	Step Name	Next Step	Assignments
Cell 1			1 rows
Cell 2			0 rows
Cell 1			1 rows
Exit Station			0 rows

Assignment Type	Attribute Name	Value
1	process time	tria(0.3, 0.4, 0.6)

- Part依照 Cell 1, Cell 2, Cell 1, Exit Station的順序移動。
- Step 1設定process time $\sim \text{tria}(0.3, 0.4, 0.6)$
- Step 3重新設定process time $\sim \text{unif}(0.2, 0.9)$

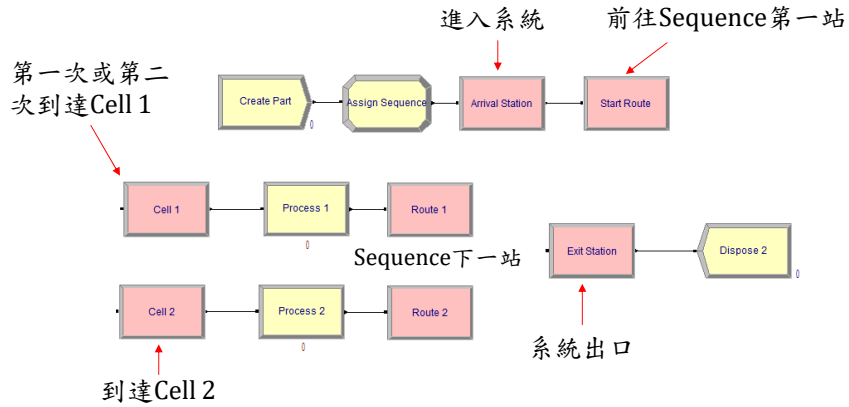
Sequence的後續設定

Part內建的屬性Entity.Sequence設為剛剛定義的Sequence 1

Destination Type設定為By Sequence，因此Part會被送往Sequence 1的第一站，也就是Cell 1。

Example 8-1 流程模組

Cell 1→Cell 2→Cell 1→Exit Station



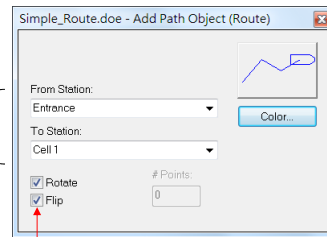
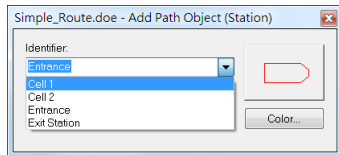
設定動畫的站點與路網

Animate Transfer工具列

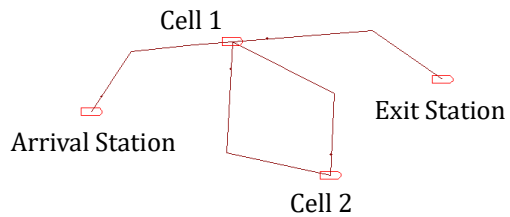


Station的
動畫位置

Route 移動路徑

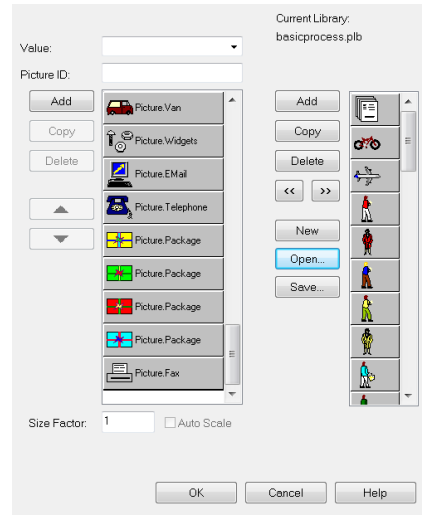


圖形是否自動轉向



設定Entity的動畫圖形

- entity的預設圖形是Picture.Report，從Entity資料模組的Initial Picture欄位改為Picture.Package。
- 從上方選單的Edit > Entity Pictures打開動畫圖形的設定視窗。
- 左側有四個顏色不同的禮盒圖形，名稱都是Picture.Package，動畫進行時，進入系統的每個產品會隨機使用不同顏色。

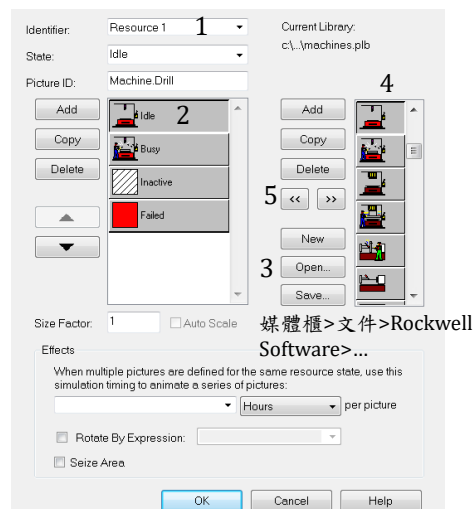


設定Resource的動畫圖形

Animate 工具列

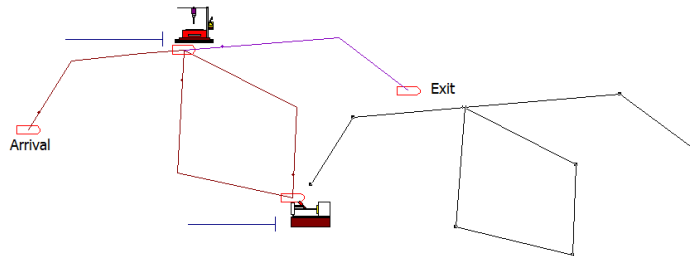


Resource按鈕



按OK後以滑鼠游標選擇機器在畫面上的位置

Example 8-1的動畫設計



8.1

- 模擬開始後，產品的圖形沿著隱形的路徑方向前進。
- 可使用Draw工具列上的polygon按鈕自行劃線，再將自行畫的線與路徑重疊。

8.3 Simple Transporter

- 產品在任何站點之間須等候由車輛搬運，行駛時間由距離與車速決定。
- 在Transporter資料模組裡定義搬運車的名稱為AGV，數量為兩部，移動方式為不會阻擋或塞車的Free Path，移動時間參照車速與AGV.Distance的距離。

Name	Number of Units	Type	Distance Set	Velocity	Units	Initial Position...	Report Statistics
1	AGV	2	Free Path	AGV Distance	1.0	Per Second	0 rows

Name	Stations
1	AGV Distance

	Beginning Station	Ending Station	Distance
1	Entrance	Cell 1	30
2	Cell 1	Cell 2	30
3	Cell 2	Cell 1	30
4	Cell 1	Exit Station	30
5	Cell 1	Entrance	30
6	Cell 2	Entrance	55
7	Exit Station	Entrance	65
8	Exit Station	Cell 1	30
9	Exit Station	Cell 2	50

雙向都要設定

使用 Request 模組呼叫搬運車

呼叫名稱為AGV
的搬運車

選擇距離最近
的閒置車輛

Request

Name: Request AGV

Transporter Name: AGV

Selection Rule: Smallest Distance

Queue Name: Request AGV Queue

到達下一站後釋出搬運車

Free

Name: Free 3

Transporter Name:

以 Transport 模組前往下一站

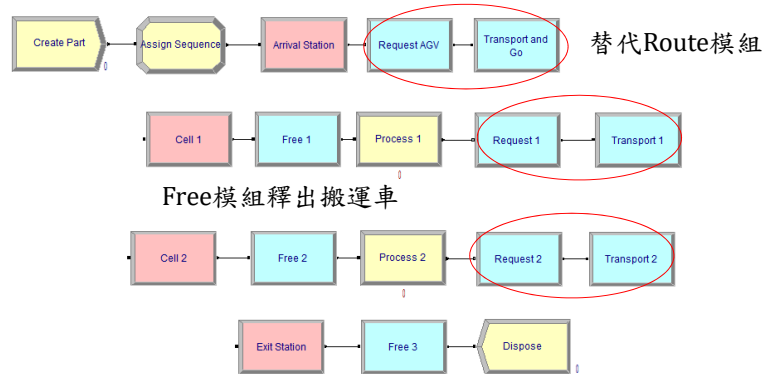
Transport

Name: Transport and Go

Transporter Name: AGV

Entity Destination Type: By Sequence

Example 8-2 流程模組



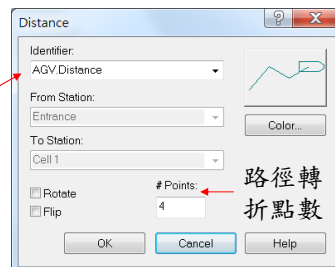
設定搬運車的動畫路線

Animate Transfer 工具列



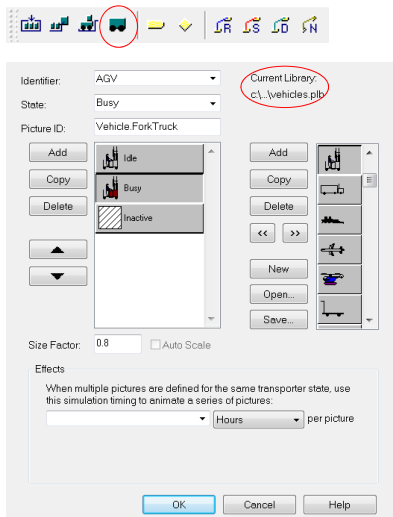
Distance 路徑

設定這條路徑屬於
AGV.Distance

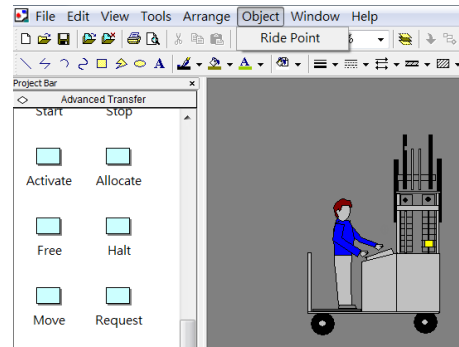


逐一建立AGV.Distance所定義的9條路徑

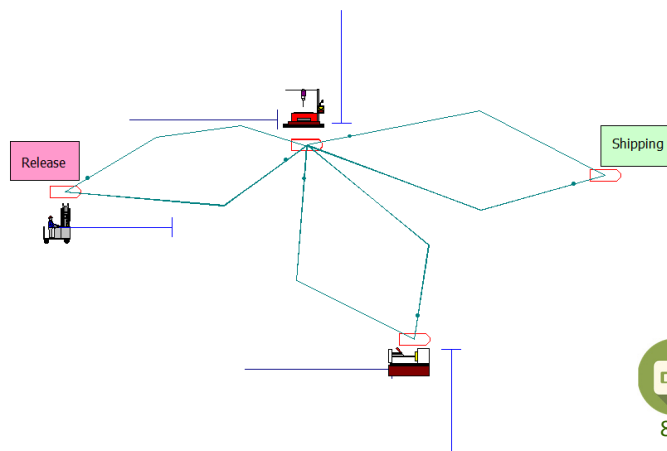
設定搬運車的動畫圖形



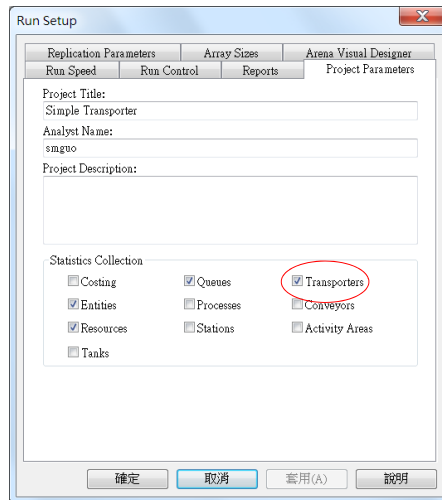
可按滑鼠兩次進入搬運車圖形的編輯畫面，從上面的選單Object > Ride Point可設定車輛載運時的產品位置。



Example 8-2 動畫畫面



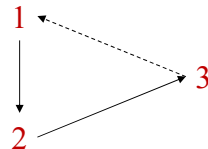
Run Setup設定收集搬運車的數據



- 勾選Project Parameters 頁籤 Statistics Collection的 Transporters選項
- 搬運車數量不足將造成大量產品等待搬運，造成瓶頸，影響生產效率。
- 必須到Transporter資料模組將搬運車數量改為4。

8-5 Pickup and Dropoff

- Pickup與Dropoff模組，可以模擬搬運車到不同地點把多個產品一起運送至目的地，並由使用者設定搬運車的載運容量
- 假設接駁車負責將兩處的乘客載運到同一目的地，接駁車的路線是Station 1 - Station 2 - Station 3，最多可載4人。乘客都在Station 3下車，接駁車會在原地等候，確認Station 1有乘客到達等候，才會回程前往載運。
- 各站之間的Route Time都設為unif(1.8, 2.2)分鐘。



接駁車流程(1)



Assign

Name: Assign 1

Assignments:

- Attribute: Capacity, 4
- Attribute: Load, min(NQ(Hold 1.Queue), capacity)
- Attribute: Capacity, Capacity - load
- <End of list>

Buttons: Add..., Edit..., Delete

1. 設定接駁車的載容量Capacity
2. 計算在第一站的上車人數Load
3. 計算剩餘容量。

Assignments

Type: Attribute Attribute Name: Load

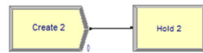
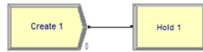
New Value: min(NQ(Hold 1.Queue), capacity)

Buttons: OK, Cancel, Help

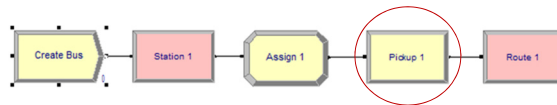
上車人數不超過等候人數，
不超過Capacity

接駁車流程(2)

Station 1候車乘客



Station 2候車乘客



Pickup

Name: Pickup 1 Quantity: load

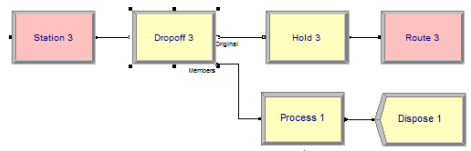
Queue Name: Hold 1.Queue Starting Rank: 1

Buttons: OK, Cancel, Help

Station 1候車隊伍

Pickup功能相當於將搭車乘客加入
接駁車所帶領的群體(group)

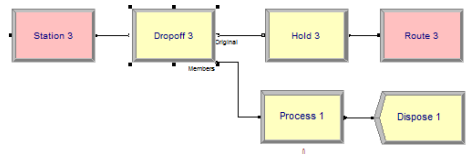
Dropoff模組分離接駁車與乘客



The screenshot shows the 'Dropoff' configuration dialog box. The 'Name' field is 'Dropoff 3'. The 'Quantity' field is 'NG-1', which is circled in red. The 'Starting Rank' is '2'. The 'Member Attributes' dropdown is set to 'Retain Original Entity Values'. Below the fields, there is a text box that reads: 'Dropoff功能相當於將接駁車帶領的搭車乘客(members)分離出去'. At the bottom are 'OK', 'Cancel', and 'Help' buttons.

NG是與群體內的entity總數，包含接駁車在內

Hold模組控制接駁車回程



接駁車在原地等候，確定Hold 1.Queue有乘客到達等候(scan for condition)，才會回程到第一站。

The screenshot shows the 'Hold' configuration dialog box. The 'Name' field is 'Hold 3'. The 'Type' dropdown is 'Scan for Condition'. The 'Condition' field contains the expression 'NG(Hold 1.Queue) >= 1'. The 'Queue Type' dropdown is 'Queue'. The 'Queue Name' dropdown is 'Hold 3.Queue'. At the bottom are 'OK', 'Cancel', and 'Help' buttons.

Example 8-5 模擬畫面

