

MODULE 4: BASIC CAPACITIES AND ROUTINGS

Module Overview

The capacity setup establishes a model of the production environment. In a bakery, this could consist of a pastry area, a filling area, different types of ovens, and so on. The tasks that are performed in each area differ, and so does the capacity to perform these tasks.

A routing specifies a sequence of steps (operations) that are required to manufacture a product.

If you are the production manager in charge of a bakery, it is obviously helpful to do the following:

- Identify the different areas inside your operation (your manufacturing facility).
- Determine the capacity of each area, such as how many pastry shells you can create in an hour.
- Define the steps that are required to make each product (a routing).
- Determine the time that is required for each step (also part of a routing).
- Identify the products and the quantity of each product that you want to make (the demand).
- Compare your product demand to your capacity, and then schedule accordingly.

You can plan the activities of your baking operation with these "ingredients."

"Basic Capacities and Routings" focuses on the creation, maintenance, and reporting for basic capacities and routings.

Before starting the lessons in this module, set your work date to January 23, 2014. Please perform all lessons, demonstrations, and labs in sequence.

Objectives

The objectives are:

- Explain how to set up capacity.
- Show how to create routings.
- Describe the advanced features for routings.
- Review the standard capacity and routing reports.

Capacity Setup

Capacity setup consists of the following elements:

- Capacity unit of measure
- Work shifts
- Shop calendars
- Types of capacities, such as work center groups, work centers, machine centers
- Standard tasks
- Stop codes
- Scrap codes
- Capacity constrained resources

Capacity Units of Measure

Capacity unit of measure codes define the unit of measure in which a machine or work center is managed. The choices are as follows:

- <blank>
- 100/hour
- Minutes
- Hours
- Days

 **Note:** Remember that the Days option equals 24 hours. It does not reflect a work day.

Demonstration: Create a Capacity Unit of Measure

Scenario: Oscar, the process engineer at CRONUS, decides to set up a new capacity unit of measure called SECONDS. Because no suitable type exists for this capacity unit of measure, he leaves the **Type** field blank.

Demonstration Steps

1. Create the capacity unit of measure.
 - a. In the **Search** box, type “capacity units of measure”, and then select the related setup link.
 - b. On the **Capacity Units of Measure** page, on the **Home** tab, click **New**.
 - c. In the **Code** field, type “SECONDS”.

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- d. Set the **Type** field to <blank>.
- e. In the **Description** field, type "Seconds".

Code	Type	Description
DAYS	Days	Days
HOURS	Hours	Hours
MINUTES	Minutes	Minutes
SECONDS		Seconds

FIGURE 4.1:CAPACITY UNITS OF MEASURE PAGE

- f. Click **OK** to close the page.

Work Shifts

You can set up one or more work shifts to group the working times. You must set up work shifts before you can create shop calendars. Use the calendars to enter the actual shift hours. Use work shifts to evaluate capacity availability and the efficiency of machine centers and work centers. You can use just one work shift even if your plant operates 24 hours each day.

For more information on work shifts, refer to "Advanced Capacity" in this training material.

Demonstration: Create a Work Shift

Scenario: Oscar, the process engineer at CRONUS, decides to set up a third work shift for the company.

Demonstration Steps

1. Create the new work shift.
 - a. In the **Search** box, type “work shifts”, and then select the related setup link.
 - b. On the **Work Shifts** page, on the **Home** tab, click **New**.
 - c. In the **Code** field, type “3”.
 - d. In the **Description** field, type “3rd shift”.

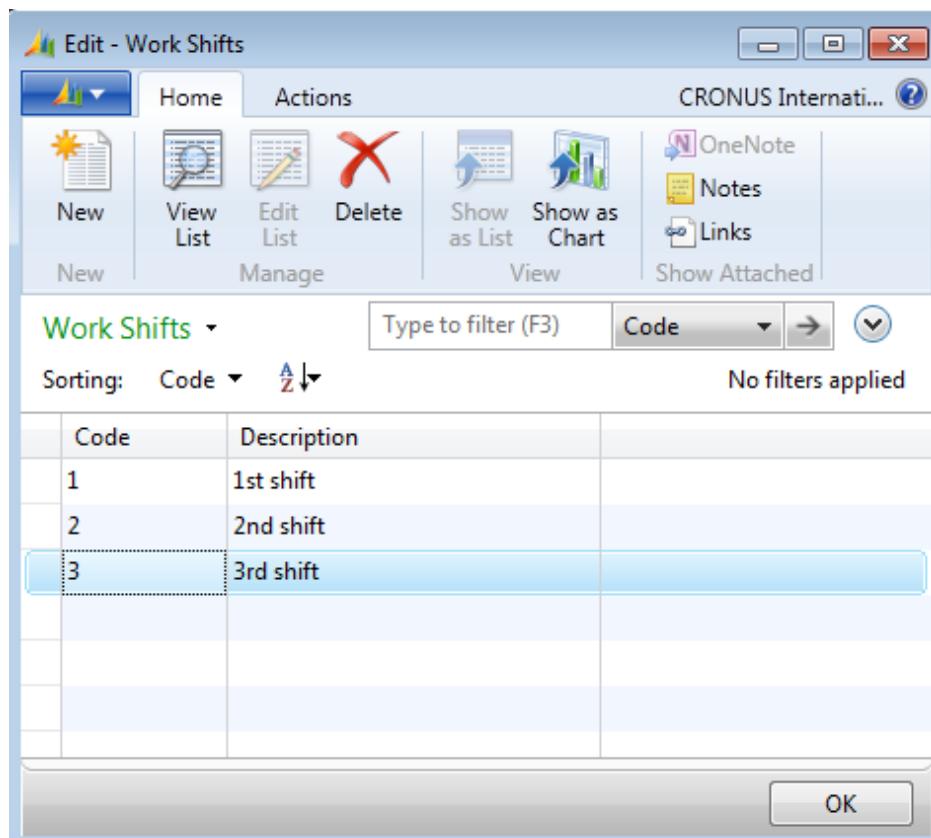


FIGURE 4.2:WORK SHIFTS PAGE

- e. Click **OK** to close the page.

Shop Calendars

Shop calendars are set up based on work shifts. For each shop calendar, enter the working hours for each day, and associate each day entry with a work shift.

The ending time must be after the starting time within the span of a day. If a work shift spans midnight, then users must enter two lines for each day, one ending at 11:59:59 P.M., and the next starting at 12:00:00 A.M.

If you want to enter a calendar to show a 24-hour period for each day operation, enter a starting time of 12:00:00 A.M., and an ending time of 11:59:59 P.M.

Enter shop calendars on work center cards to calculate the calendars for work and machine centers.

To view existing shop calendars, follow these steps.

1. In the **Search** box, type “shop calendars”, and then select the related setup link.
2. Expand the **Shop Calendars** page until the labels show under all the icons on the **Home** tab.

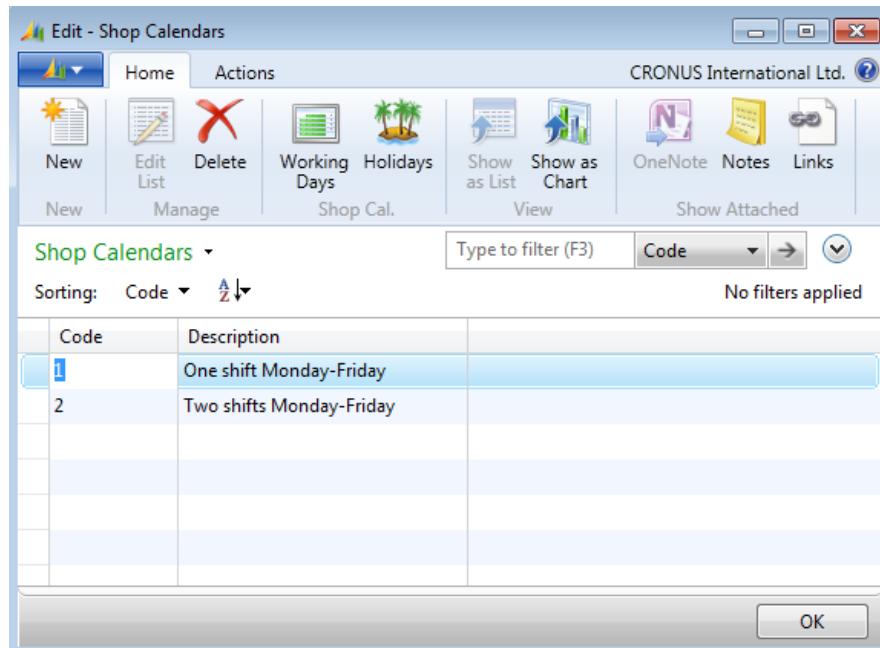


FIGURE 4.3:SHOP CALENDARS PAGE

3. Select the first line (One shift Monday-Friday).
4. On the **Home** tab, click **Working Days**. This opens the **Shop Calendar Working Days** page.

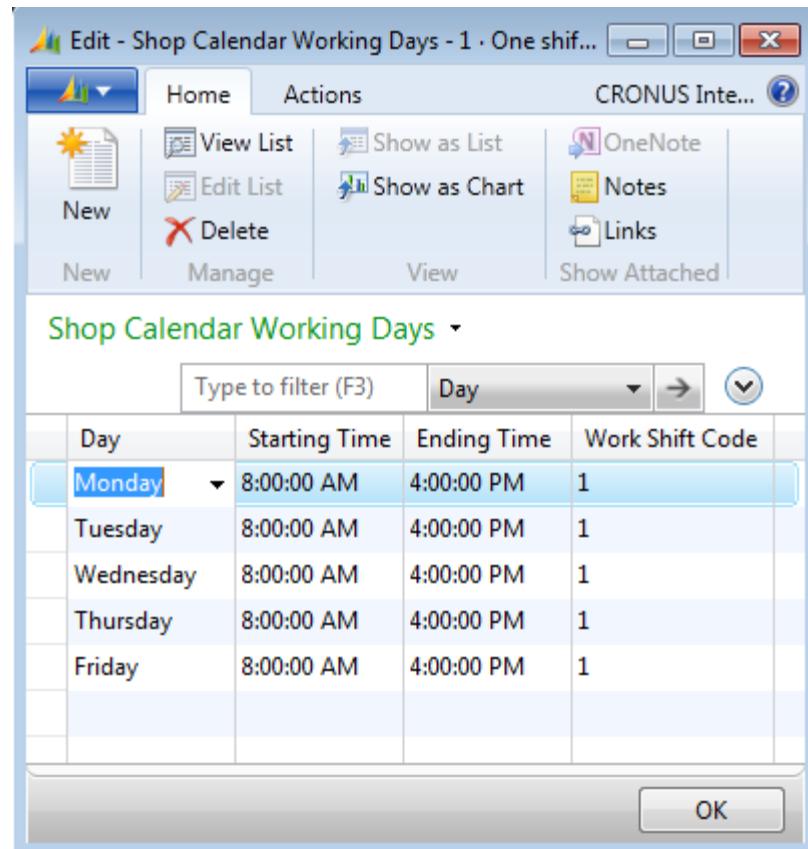


FIGURE 4.4:SHOP CALENDAR WORKING DAYS PAGE

Notice the association between the day/time entries and the work shift code. This is where the definition of a work shift becomes meaningful.

Working days represent the regular weekly schedule. Sometimes holidays fall on these regular working days. When they are defined in the program, holidays become exceptions to the regular schedule and reduce the planned working time. Holidays are not necessarily full days. They can be only a part of a regular workday, such as a company meeting in the afternoon.

To review holiday information, follow these steps.

1. Click **OK** to close **Shop Calendar Working Days** page. This returns you to the **Shop Calendars** page.
2. On the **Home** tab, click **Holidays**. This opens the **Shop Calendar Holidays** page.

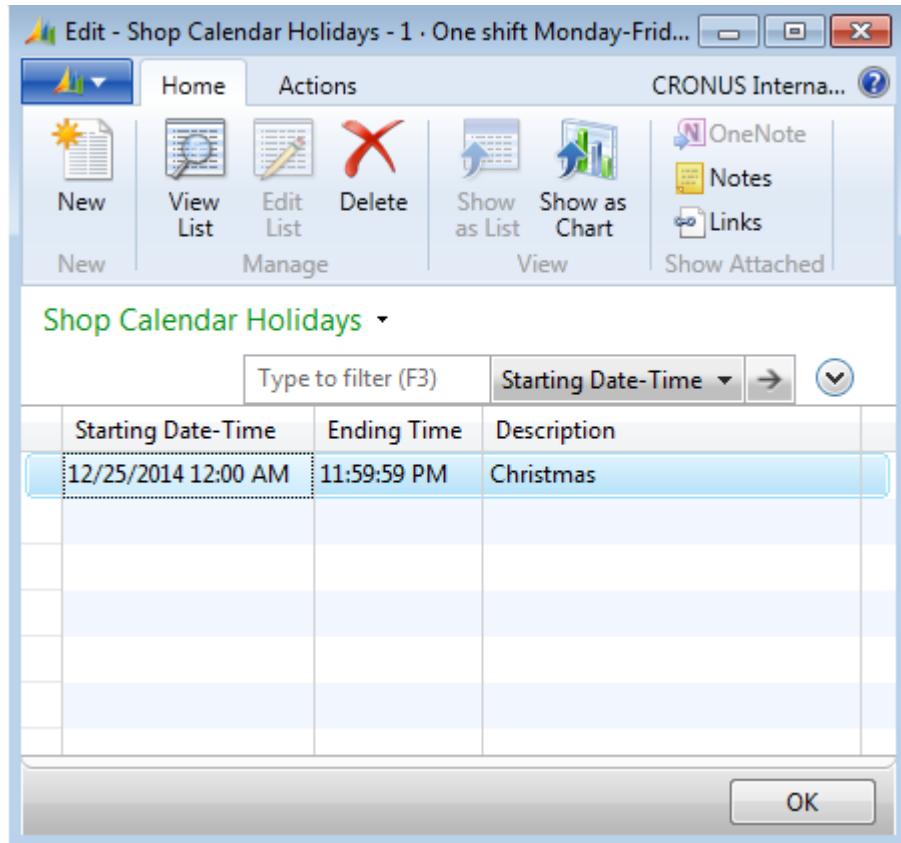


FIGURE 4.5:SHOP CALENDAR HOLIDAYS PAGE



Note: The Christmas holiday that is shown in the "Shop Calendar Holidays Page" image is not in the sample database. Do not create it. It is provided here only to show how a holiday entry appears.

3. Press **Esc** two times to close all open pages.

For more information on shop calendars, refer to "Advanced Capacity" in this training material.

Types of Capacities

Microsoft Dynamics® NAV lets users define the following three types of capacities, also known as *facilities*:

- Work center group
- Work center
- Machine center

These are arranged hierarchically, as shown in the "Capacity Hierarchy in Microsoft Dynamics NAV" diagram.

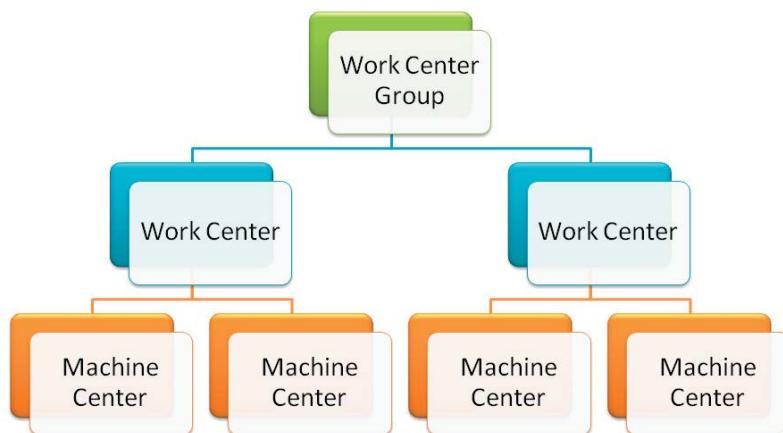


FIGURE 4.6:CAPACITY HIERARCHY IN MICROSOFT DYNAMICS NAV

Work Center Groups

The top level of the hierarchy is the *work center group*. Work center groups are broad departments within an organization. A work center group is a reporting unit, such as a production or inventory department, instead of a facility where work is scheduled. A company must set up at least one work center group, but can also use multiple groups.

Work Centers

Work centers are specific locations where work is performed. You can set up work center cards for the following:

- Machines
- Groups of machines
- People

You schedule production order operations in work centers and machine centers through routings. Work centers can have machine centers on a discrete basis, or the machine centers can roll up to include the availability of the work centers by using the consolidated calendar.

Assign each work center to one work center group. The work center group calendar is the sum of all calendars of all work centers that are assigned to it. If you use machine centers, the total capacity of the work center is the sum of the capacity of the assigned machine centers.

Machine Centers

Machine centers are the lowest level of the capacity hierarchy and represent the following:

- A machine
- A group of machines with identical characteristics
- A person
- A group of people that perform the same tasks

A company can define the extent to which a machine center has to focus. Usually only those resources that have to be monitored, or are frequently bottlenecks, are designated as machine centers. When you schedule a production order in a machine center, it consumes *capacity* (reduces availability). A machine center has only its own capacity, since there are no other capacities that are defined below it in the hierarchy.

You must assign each machine center to a work center. Machine centers are an option and are not required for manufacturing.

Setting Up Capacity

It is important to set up the correct combination of work center groups, work centers, and machine centers to accurately define a company's manufacturing capacity. Typically, you do this in consultation with production planners and production managers.

The setup of capacity is described in greater detail in "Advanced Capacity" in this training material.

Demonstration: Create a Work Center Group

Scenario: Oscar, the process engineer at CRONUS, decides to set up a new work center group.

Demonstration Steps

1. Create the new work center group.
 - a. In the **Search** box, type "work center groups", and then select the related setup link.
 - b. Expand the **Work Center Groups** page until you can see the labels under all of the icons on the **Home** tab.
 - c. On the **Home** tab, click **New**.
 - d. In the **Code** field, type "3".
 - e. In the **Description** field, type "Inspection department".

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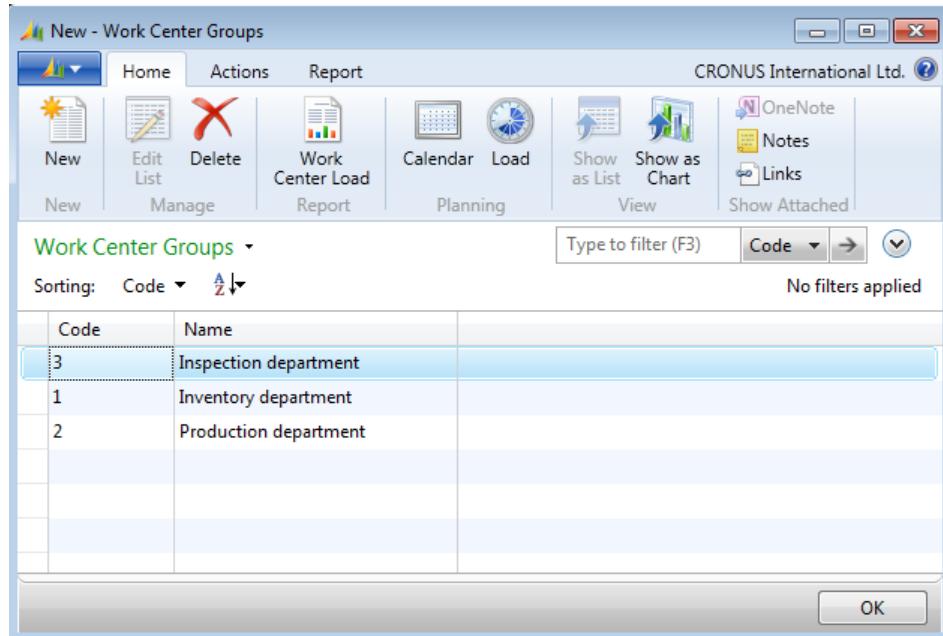


FIGURE 4.7:WORK CENTER GROUPS PAGE

2. Review the work center group calendar.
 - a. Make sure that the line for the Inspection department is still selected.
 - b. On the **Home** tab, click **Calendar**.
 - c. On the **Home** tab of the **Work Ctr. Group Calendar** page, click **Show Matrix**.

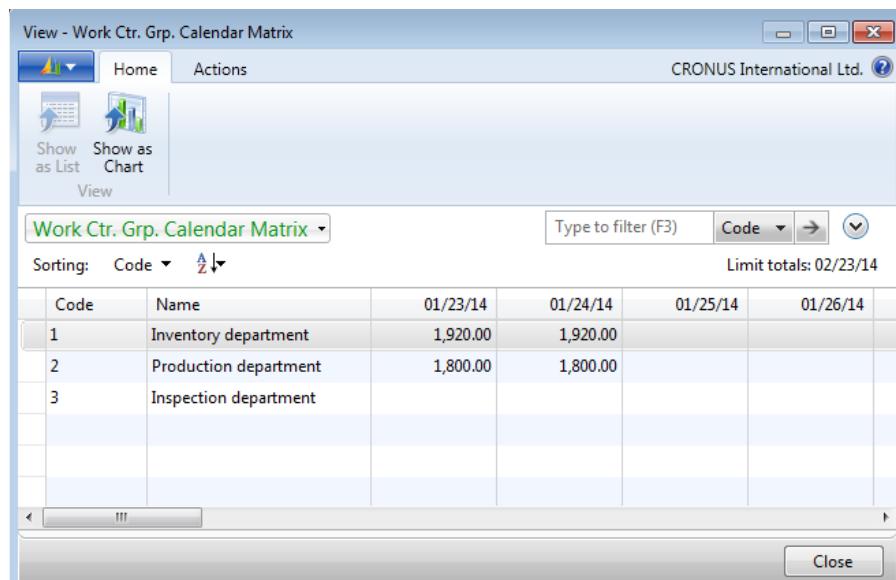


FIGURE 4.8:WORK CENTER GROUP CALENDAR MATRIX PAGE

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The **Work Ctr. Grp. Calendar Matrix** page shows the sum of the available time for all the work and machine centers that are assigned to each work center group. You can view the information by day, week, month, quarter, year, or fiscal period by selecting the appropriate matrix option prior to clicking **Show Matrix**. You can also view the capacity by any capacity units of measure that you have defined.

Notice that there are no calendar entries for the Inspection department. This is because it is a new work center group.

3. Review the calendar entries for the work centers and machine centers that belong to a work center group.
 - a. On the line for the Inventory department, in the first date column, drill down into the value of 1920.00. This opens the **Calendar Entries** page.

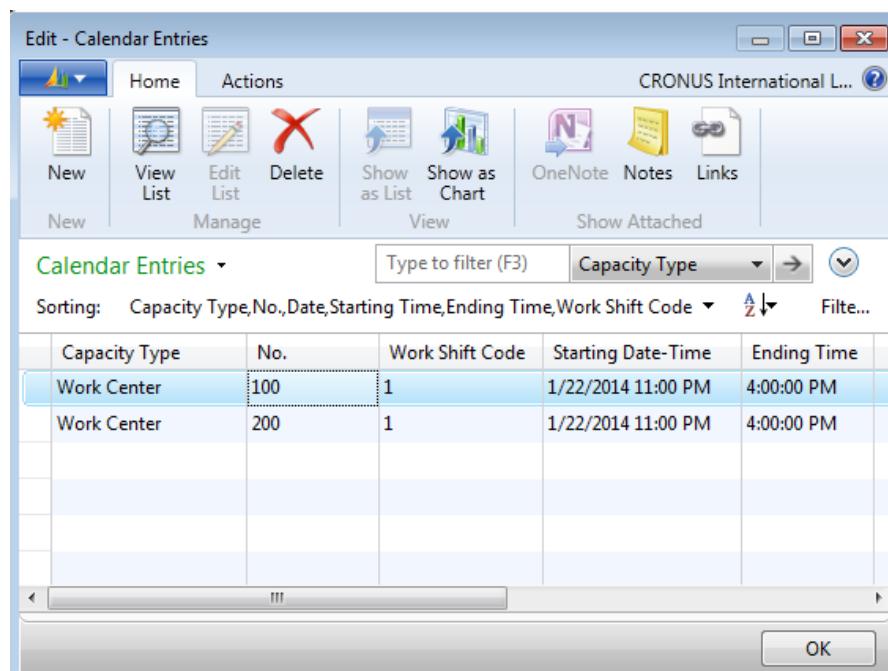


FIGURE 4.9:CALENDAR ENTRIES PAGE FOR WORK CENTERS AND MACHINE CENTERS THAT BELONG TO A WORK CENTER GROUP

Notice that only work centers are defined for the Inventory department, not machine centers.

Here, for the first time, you can see the capacity hierarchy at work. The calendars that are defined for the work centers and machine centers that are assigned to a work center group determine the total time that is available for that group. Do not try to reconcile the available time that is shown for the Inventory department to the calendars that are shown for its work centers. The net capacities of work centers and machine centers involve other factors in addition to calendar entries. These and other advanced capacity subjects are described in "Advanced Capacity" in this training material.

 **Note:** To add calendar entries for the Inspection department work center group, return to the **Work Ctr. Grp. Calendar Matrix** page and drill down into any period for that group. This opens the **Calendar Entries** page for the group. You then can enter information for the work centers and machine centers for the group.

Standard Tasks

Use standard tasks to define the following:

- Task descriptions
- Tools
- Personnel
- Quality measures for informational purposes

Setting up standard tasks simplifies the creation of routings. To access the **Standard Tasks** page, type "standard tasks" in the **Search** box, and then select the related setup link.

The description that you provide for a standard task overwrites the description of the work or machine center on the routing line. By clicking the appropriate function in the **Home** tab of the **Standard Tasks** page, you can also assign tools, personnel, task descriptions, and quality measures.

When you select a standard task on a routing line, all of its assigned definitions copy to that line. For more information on standard tasks, refer to "Additional Manufacturing Topics" in this training material.

Stop Codes

Use stop codes to define the reason that a work center or machine center stopped during production. After setting up the stop codes, you can enter them in the posting lines of the output journal and the capacity journal. Use codes that are easy to remember, such as DOWN for a machine breakdown. You can set up as many codes as you want.

Scrap Codes

Scrap codes are used to define reasons for scrap or waste. Enter a code to identify the reason that an item was scrapped. After setting up the scrap codes, you can enter them in the posting lines of the output journal and the capacity journal. Use codes that are easy to remember, such as DEFECT for material defects. You can set up as many codes as you want.

Capacity Constrained Resources

When production planners foresee a risk of overloading a resource, they can select that resource as capacity-constrained. This makes sure that the machine center or work center in question is loaded only to a specific critical level – a *finite load*. Typically, a planner uses finite loading for a work center or machine center that is identified as a bottleneck. This feature makes sure that no more work is assigned to the resource than it can execute in a given time.

To assign finite loads to machine centers and work centers, you must set them up in the **Capacity Constrained Resources** page.

To view this page, type “capacity constrained resources” in the **Search** box, and then select the related setup link.

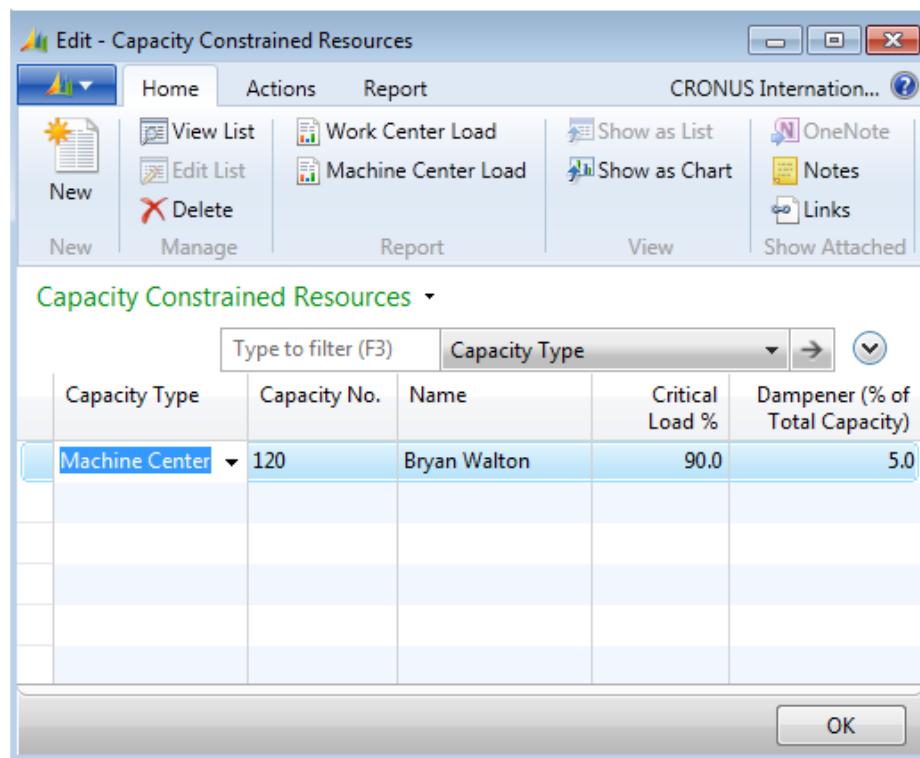


FIGURE 4.10:CAPACITY CONSTRAINED RESOURCES PAGE

The page contains the following fields that are specific to finite loading.

Field	Description
Critical Load %	Percentage of the available capacity of a work center or machine center to which the program can apply load. This lets users account for potential downtime.
Dampener (% of Total Capacity)	Allowable tolerance (as a percentage) by which the critical load can be exceeded. By slightly exceeding the critical load percentage, the program can schedule a load to a work center or machine center on the last possible day.

For more information on capacity constrained resources, refer to "Shop Loading" in this training material.

Routings

A routing specifies the sequence of operations that are required to manufacture a product. The operations are performed at a work center or at a machine center, also referred to as *capacities* or *facilities*. Manufacturing companies use routings to manage the production process. The routings are the basis for the following:

- Process scheduling
- Capacity planning
- Manufacturing documents

Routings are assigned to item cards in the same manner as production BOMs.

Routing Header

To create a routing, you must first define the routing header. This header information applies to the whole routing. To view the routing header for routing 1000, Bicycle, follow these steps.

1. In the **Search** box, type "routings", and then select the related link.
2. On the **Routings** list page, double-click the line for routing 1000, Bicycle. This opens the routing card for routing 1000. Notice that this routing has the same number as item 1000, Bicycle. This is frequently the case when there is a 1:1 relationship between items and routings. But it is not a requirement (routing numbers are independent of item numbers).

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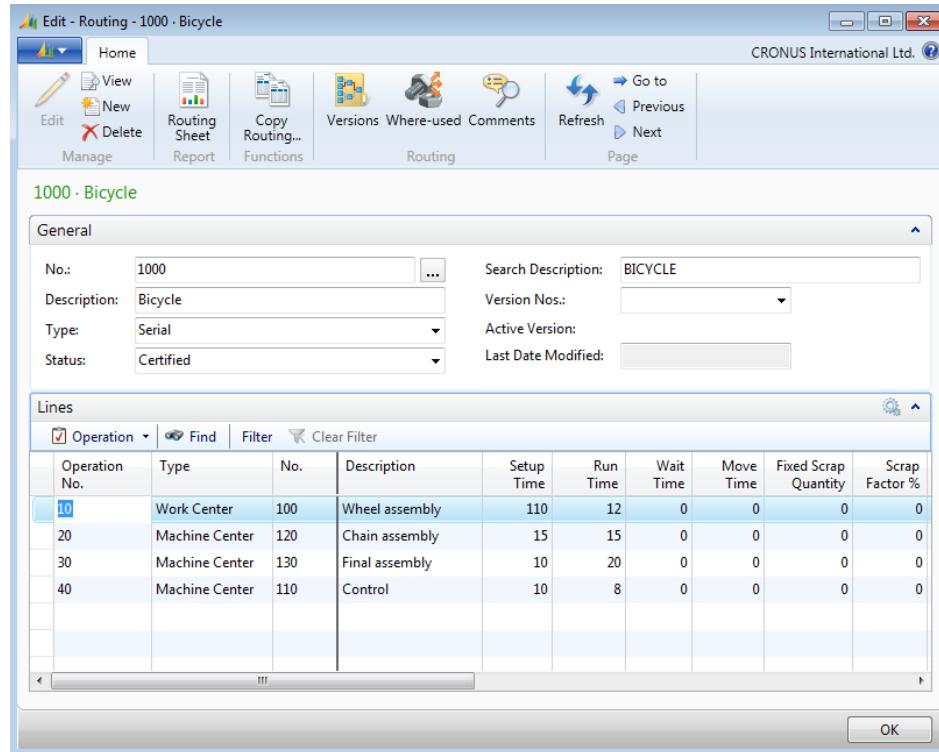


FIGURE 4.11:ROUTING CARD FOR ITEM 1000, BICYCLE

The routing header fields are shown on the **General** FastTab. These fields are described in the following table.

Field	Description
No.	Unique identifier for the routing. You can enter a maximum of 20 characters. This includes both numbers and letters.
Description	Description for the routing header that makes it easier to recognize its purpose. You can enter 30 characters. This includes both numbers and letters.

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Field	Description
Type	<p>Specification that defines the routing as serial or parallel.</p> <ul style="list-style-type: none">• Serial – Indicates that operations are performed consecutively.• Parallel – Indicates that two separate, unrelated operations can be performed at the same time. For more information, refer to the “Parallel Scheduling” topic in the “Routings Advanced Features” lesson in this training material.
Status	<p>Status of a routing. The following are valid statuses:</p> <ul style="list-style-type: none">• New –The status is set automatically to New when you create a new routing. With new routings, you can edit the contents of the routing fields.• Certified – You manually set the status of a routing to Certified when it is ready for production. Only certified routings are used for production orders and production planning. You cannot edit the fields of a routing if it is certified.• Under Development – You manually set the status of a routing to Under Development when you want to edit it. Changing a routing to this status makes it possible to edit the routing fields. After you finish your edits, you must change its status back to Certified if you want to use the routing for production and planning again.• Closed – You manually set the status of a routing to Closed when it is no longer used.
Search Description	Search criteria for a routing when you do not remember its number. The field derives from the description, but you can edit it to create a name that is easier to remember. This field can have a maximum of 30 characters.

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Field	Description
Version Nos	Specifies the number series to use to create a new version of this routing. The program automatically takes the next number from this number series to create a new version. If you leave this field blank, you must manually assign the version code.
Active Version	The current version that is used. The starting date determines the active version. Also, the status of the active version must be Certified.
Last Date Modified	This field updates to the current system date (not the work date) when a routing is initiated or changed.

You can also add comments to a routing header by clicking the **Comments** function on the **Home** tab of the routing card.

Routing Lines

The routing lines define the operations for the routing (the steps in the production process), and are shown on the **Lines** FastTab. The contents of each line define its associated operation. Except in the case of parallel processing, the values in the **Operation No.** field determine the sequence in which the operations are performed.

The routing line fields are described in the following table.

Field	Description
Operation No.	Operation number for the routing line. Every line of the routing has an operation number, which the program uses for various references. You can enter no more than 10 characters. This includes both numbers and letters. The program sorts operations in the order of the operation number. We recommend that you leave a gap between operation numbers, such as 10, 20, 30, and so on. This makes it easier to insert new operations between existing ones.

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Field	Description
Type	<p>The capacity type that is used for the operation. You can specify one of two types: Work Center and Machine Center. Both are described throughout this course.</p> <p>Certain information copies to the routing line that is based on the type that you select. If you select Work Center, the following field information copies to the routing line:</p> <ul style="list-style-type: none"> • Setup Time Unit of Meas. Code • Run Time Unit of Meas. Code • Wait Time Unit of Meas. Code • Move Time Unit of Meas. Code <p>Machine centers link to a work center. If you select Machine Center, the following field information copies to the routing line (if defined):</p> <ul style="list-style-type: none"> • Setup Time and Setup Time Unit of Meas. Code • Wait Time and Wait Time Unit of Meas. Code • Move Time and Move Time Unit of Meas. Code • Fixed Scrap • Scrap % • Send-Ahead Quantity • Minimum Process Time • Maximum Process Time • Concurrent Capacities
No.	Number of the machine center or work center based on the selection in the Type field.
Description	Name of the machine center or work center. Change this field to improve or enhance the operation definition. The description prints on the <i>job card</i> , sometimes called the <i>traveler</i> or <i>work order</i> .

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Field	Description
Standard Task Code	Standard task for the operation. When you select a standard task code, the description of the standard task is copied to the Description field. If you save tools, personnel, descriptions, and quality measures under the standard task, this information is copied to the routing line. For more information on standard tasks, refer to "Additional Manufacturing Topics" in this training material.
Routing Link Code	Routing link code that indicates the routing operation on which a production BOM component is used. Enter the routing link code on the routing operation before you enter it on the production BOM component, or an error message is displayed when you try to certify the BOM. For more information about routing link codes, refer to the "Routings Advanced Features" lesson, and "Production Order Processing" in this training material.
Fixed Scrap Quantity	Amount that reflects scrap that occurs at the start of an operation. For example, if the operation is printing, you might discard the first 100 pages during the setup of the machine. This increases gross requirements.

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Field	Description
Scrap Factor %	Percentage that is allowed for scrap at the end of the operation. During the actual running of the operation, you could encounter additional scrap, such as ten out of every 1000 sheets that print incorrectly. This can be estimated as a percentage of the total run, which increases gross requirements. By default, the scrap factor is placed on all components that are used in an operation. To place the scrap factor on a specific component only, you have to differentiate that component's operation from the other components by setting different routing link codes in the production BOM and routing lines.
Minimum Process Time	Minimum time that is required by the machine for processing. This is for information purposes only and does affect any processes.
Maximum Process Time	Maximum time that is required by the machine for processing. This is for information purposes only and does affect any processes.
Concurrent Capacities	Total quantity that is defined for concurrently available machines or persons. Use this at the machine center level only to reduce the production lead time of the order. For example, if processing normally requires four hours, the processing time is reduced significantly by using two machines. In the APICS dictionary this is called " <i>lot splitting</i> ."
Send-Ahead Quantity	Quantity of the current operation that must be finished before the next operation can start. This reduces the lead time of production orders.

Field	Description
Unit Cost Per	The task-related production cost to use if the unit cost of the operation is different from the unit cost on the work center card. If you decide to enter the cost on each routing operation line, you must select the Specific Unit Cost field on the work center card. This is available for work centers only. For machine center operation lines, you can specify the unit cost only on the machine center card.

For additional information on these and other routing line fields, refer to Help by selecting the field and pressing F1.

Throughput Time

There are two types of throughput time: productive and non-productive. Each type consists of other time components.

Productive Time

Productive time consists of the setup time and run time:

- **Setup Time** – The time that is required to set up the machine or work center to convert from production of the last good item in a lot to the first good item of the next lot.
- **Run Time** – The time that is required to process or manufacture an item for a specific operation. Run time does not include setup time.

Non-Productive Time

Non-productive time consists of wait time, move time, and queue time as follows:

- **Wait Time** – The time that is required between the processing steps, such as drying processes. APICS defines wait time as "the time a job remains at a work center after an operation is finished until it is moved to the next operation. It is often expressed as part of move time."
- **Move Time** – The time a production lot or batch spends in transit from one operation to the next.

- **Queue Time** – The time that production lots or batches wait at a work center or machine center before setup and processing. This occurs when a released production order arrives at a facility, but the facility is already busy processing another operation. In other words, queue time is used to represent work in front of a facility rather than behind it. This can indicate a production line that is not in balance or that has bottlenecks. If queue time is not used, the scheduled generated for a production order might be too optimistic. This is because the system schedules each order as if it is the only order in the factory. Therefore, you can use queue time to improve the accuracy of order scheduling based on real production times.



Note: You can define the various types of throughput time in different units of measure. For example, run time can be defined in hours while setup time is in minutes. However, setting different units of measure for the various throughput times has costing implications.

Demonstration: Create a New Routing and Assign It to an Item

Scenario: Oscar, the process engineer at CRONUS, decides to create a routing for the company's Touring Bicycle. Because the Touring Bicycle is item 1001, Oscar decides to assign routing number 1001 to the new routing. Because the Touring Bicycle resembles item 1000, Bicycle, he decides to create the initial routing operations for the Touring Bicycle routing by copying the routing operations from routing 1000, Bicycle.

Demonstration Steps

1. Create new routing and populate routing header fields.
 - a. Close all open pages.
 - b. In the **Search** box, type "routings", and then select the related link.
 - c. On the **Home** tab of the **Routings** list page, click **New**.
 - d. On the **General** FastTab of the routing card, in the **No.** field, type "1001".
 - e. In the **Description** field, type "Touring Bicycle".
2. Copy the routing lines from routing 1000, Bicycle.
 - a. On the **Home** tab, click **Copy Routing**.
 - b. On the **Routing List** page, select 1000, Bicycle, and then click **OK**. The **Lines** FastTab on the routing card populates with a copy of the routing lines from routing 1000. At this point, you can change the operations as required.

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3. Certify the routing.
 - a. On the **General** FastTab, in the **Status** field, select Certified.
 - b. Click **OK** to close the routing card.

4. Assign the new routing to item 1001, Touring Bicycle.
 - a. In the **Search** box, type "items", and then select the related link.
 - b. On the **Items** list page, double-click the line for item 1001, Touring Bicycle, to open the item card.
 - c. Expand the **Replenishment** FastTab.
 - d. In the **Routing No.** field, type "1001".
 - e. Click **OK** to close the item card.

Routing Versions

You can have several versions of the same routing. The structure of a routing version corresponds to the structure of a routing. The *routing version* consists of a routing version header and routing lines.

A version code identifies each routing version. You can define versions by their starting date. A routing version automatically becomes active on its starting date. All versions with a starting date older than this date become invalid. To become *active* means that the program uses the version automatically in place of the routing as of that date.

The advantages of using routing versions include the following:

- The ability to schedule the implementation of a new version by setting its starting date. Because the program automatically uses the new version when the starting date is reached, the process engineer does not have to remember when to switch from one version to the next.
- Because the program automatically uses the correct version of a routing for any given date, there is no need to change the product structure by changing the routing that is associated with items.
- The old version of the routing is retained in the database. The engineer can use this historical information, such as the date when a routing was changed, to determine if routing changes achieve their desired effect.

Copy Routing Version

To make the creation of routing versions more efficient, you can use the following functions on the **Actions** tab of the routing version card:

- **Copy Routing Header** – Copies the base routing lines to the current routing version.
- **Copy Routing Version** – Copies the routing lines from another routing version that you select to the current routing version.

After the operations are copied to the new routing version, you can make any necessary changes.

Demonstration: Create New Routing Version and Add a Step

Scenario: Oscar, the process engineer at CRONUS, decides to create a new routing version of routing 1001, Touring Bicycle. He decides to call the new version "Touring Bicycle w/Inspection", and to change the routing version by adding a new step for inspection.

Demonstration Steps

1. Create the routing version header.
 - a. In the **Search** box, type "routings", and then select the related link.
 - b. On the **Routings** list page, select the line for routing 1001, Touring Bicycle.
 - c. On the **Home** tab of the routing card, click **Versions**.
 - d. On the **Home** tab of **Routing Version List** page, click **New**.
 - e. On the **General** FastTab of the routing version card, in the **Version Code** field, type "1".
 - f. In the **Description** field, type "Touring Bicycle w/Inspection".
 - g. Set the **Starting Date** field to November 01, 2014.
2. Copy the standard routing lines to the new routing version.
 - a. On the **Actions** tab, click **Copy Routing Header**.
 - b. On the request message, click **Yes** to copy the routing lines from the base routing.

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3. Add a new step to the version.
 - a. On the first blank line on the **Lines** FastTab, in the **Operation No.** field, type "50". The typical approach is to follow the existing sequencing, and to leave a gap in the numbers between each successive operation. For example, 50 is used here because the previous steps are numbered 10 through 40.
 - b. In the **Type** field, select Machine Center.
 - c. In the **No.** field, select 440 (Machine inspection).
 - d. In the **Run Time** field, type "30".

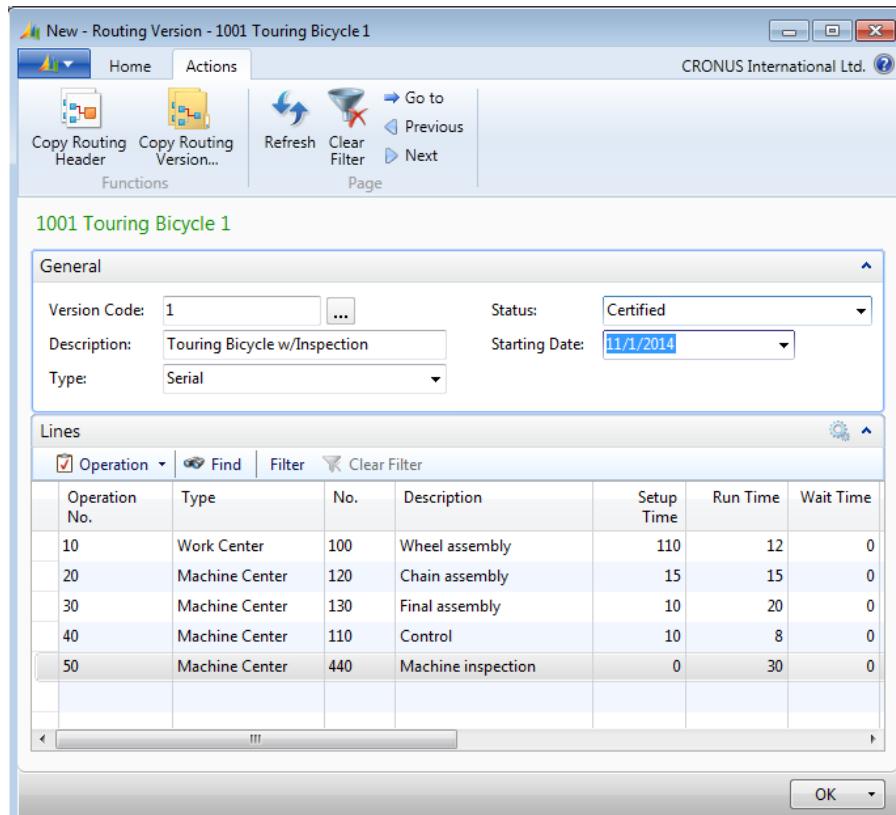


FIGURE 4.12:NEW ROUTING VERSION FOR TOURING BICYCLE ROUTING

4. Certify the routing version.
 - a. On the **General** FastTab, in the **Status** field, select Certified.
 - b. Press **Esc** three times to close all open pages.

Where-Used Feature

To assist in maintenance and troubleshooting, use the **Where-used** function to display where a routing is used throughout the product structure.

To access the **Where-used** function, follow these steps.

1. In the **Search** box, type "routings", and then select the related link.
2. On the **Routings** list page, select the line for routing 1150, Hub.
3. On the **Home** tab, click **Where-used** to open the **Where-Used** page. This page shows all items that use this routing. If the page shows no items, then the routing is not assigned to any item card.

The screenshot shows a Microsoft Dynamics NAV application window titled "View - Where-Used - 1150 · Hub". The window has a standard Windows-style title bar with minimize, maximize, and close buttons. Below the title bar is a ribbon bar with tabs: "Home" (selected), "Actions", and "CRONUS Internat...". The "Actions" tab contains icons for "Show as List" (selected), "Show as Chart", "OneNote", "Notes", and "Links". The "Links" icon is highlighted with a yellow box. The main area is titled "Where-Used" and contains a table with the following data:

No.	Description	Production BOM No.	Inventory Posting Group
1150	Front Hub	1150	FINISHED
1250	Back Hub	1250	FINISHED

At the bottom right of the table is a "Close" button.

FIGURE 4.13:WHERE-US ED PAGE FOR ROUTING 1150, HUB

4. Click **Close** to close the page.

Lab: Manually Create a New Routing

Scenario

Oscar, the process engineer, at CRONUS, decides to create a new routing named New Path. Because this routing is unlike any other routing at CRONUS, he must manually enter all of the information for the routing.

High Level Steps

1. Create the routing header.
2. Create the routing lines.
3. Certify the routing.

Detailed Steps

1. Create the routing header.
 - a. In the **Search** box, type "routings", and then select the related link.
 - b. On the **Home** tab of the **Routings** list page, click **New**.
 - c. On the **General** FastTab of the routing card, in the **No.** field, type "1099".
 - d. In the **Description** field, type "New Path".
2. Create the routing lines.
 - a. On the **Lines** FastTab, in the **Operation No.** field, type "10".
 - b. In the **Type** field, select Machine Center.
 - c. In the **No.** field, type "410".
 - d. In the **Setup Time** field, type "20".
 - e. In the **Run Time** field type "1.5".
 - f. Move to the next row and type "20" in the **Operation No.** field.
 - g. In the **Type** field, select Machine Center.
 - h. In the **No.** field, type "420".
 - i. In the **Setup Time** field, type "30".
 - j. In the **Run Time** field, type "2.0".
 - k. Move to the next row, and then type "30" in the **Operation No.** field.

- i. In the **Type** field, select Machine Center.
 - m. In the **No.** field, type "440".
 - n. Do not enter anything in the **Setup Time** field.
 - o. In the **Run Time** field, type "1.0".
3. Certify the routing.
- a. On the **General** FastTab, in the **Status** field, select Certified.
 - b. Click **OK** to close the routing card.

Routings Advanced Features

Microsoft Dynamics NAV provides a number of advanced routing features. These include the following:

- Routing link codes
- Parallel scheduling
- Send-ahead quantity

Routing Link Codes

Use routing link codes to link a component that is defined on an item's bill of material (BOM) to an operation on the item's routing. This lets you specify at which step (operation) in the manufacturing process the components are flushed or removed from inventory. If you do not specify this, all components are removed at the start or the end of the production order. Routing link codes support greater just-in-time (JIT) functionality and frequently are used in long processes.

You must establish routing link codes on the routing lines prior to their entry on production BOM lines. MRP uses the routing link codes to schedule components that are based on the start date of the operation that requires them. The flushing method that you select on the component item cards affects when the components are removed from inventory.

Component Flushing Method	Removal From Inventory
Manual	Only when the user posts through the consumption or production journals.
Forward	When the routing step is started.
Backward	When the routing step is finished.

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Routing links are described in greater detail in "Production Order Processing" in this training material.

Demonstration: Set Up Routing Link Codes

Scenario: Oscar, the process engineer at CRONUS, decides to link the consumption of component 1300, Chain Assy, in the production BOM 1000, to operation number 20, Chain Assembly, in routing 1000. BOM 1000 and routing 1000 are both linked to item 1000, Bicycle.

Demonstration Steps

1. Add the routing link code to the routing operation.
 - a. In the **Search** box, type "routings", and then select the related link.
 - b. On the **Routings** list page, double-click the line for routing 1000, Bicycle, to open the routing card.
 - c. On the **General** FastTab, in the **Status** field, select Under Development.
 - d. On the **Lines** FastTab, on the line for operation number 20, Chain assembly, in the **Routing Link Code** field, select 100 (routing link code 100, Assembling).
 - e. Delete the values in the **Routing Link Code** field for all other operations.
 - f. On the **General** FastTab, in the **Status** field, select Certified.
 - g. Click **OK** to close the routing card.

 **Note:** At this point, the new routing link code that you have assigned to operation number 20 is nothing more than a code and a description. It could be any code and description that you create in the **Routing Links** table. The link does not become meaningful until the same link code is used in one or more production BOMs.

2. Add the routing link code to the BOM component line.
 - a. In the **Search** box, type "production BOM", and then select the related link.
 - b. On the **Production BOM** list page, double-click the line for BOM 1000, Bicycle, to open the **Production BOM** page.
 - c. On the **General** FastTab, in the **Status** field, select Under Development.
 - d. On the **Lines** FastTab, on the line for component item 1300, Chain Assy, in the **Routing Link Code** field, select 100.
 - e. On the **General** FastTab, in the **Status** field, select Certified.
 - f. Click **OK** to close the **Production BOM** page.

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The BOM operation and the routing operation are now linked. As a result, the program now knows that component item 1300 is consumed in operation number 20 during the manufacture of item 1000, Bicycle. In this instance, item 1000 specifies routing 1000 as its routing and production BOM 1000 as its BOM.

Parallel Scheduling

Parallel scheduling means that two separate, unrelated operations are performed at the same time.

Parallel operations reduce throughput time, increase efficiency, and help reduce the complexity in the BOM structure.

 **Note:** *In Microsoft Dynamics NAV, the definition of parallel processing or parallel scheduling differs from APICS. APICS defines it as "The use of two or more machines or job centers to perform identical operations on a lot of material. Duplicate tooling and setup are required." Microsoft Dynamics NAV parallel processing is used for two or more non-identical operations on different lots of material. The Microsoft Dynamics NAV definition of concurrent capacity is closer to the APICS definition of parallel scheduling.*

For more information, refer to the "Methods to Reduce Lead Time" lesson in "Additional Manufacturing Topics" in this training material.

Send-Ahead Quantity

The send-ahead quantity feature lets users specify for each routing operation, a portion of the lot or batch that is sent to the next operation. The next operation starts when the send-ahead quantity is produced.

For more information, refer to the "Methods to Reduce Lead Time" lesson in the "Additional Manufacturing Topics" in this training material.

Reports

Microsoft Dynamics NAV provides a number of reports to support users who work with capacities and routings. These include the following:

- Routing Sheet
- Work Center List
- Machine Center List
- Capacity Task List

Routing Sheet

The **Routing Sheet** report shows basic information for routings. This includes the following:

- Operation number
- Capacity type (machine center or work center)
- Machine center or work center number
- Send-ahead quantity
- Scrap factor %
- Setup time
- Wait time
- Move time
- Run time

Optional information can include the following:

- Tools
- Personnel
- Quality Measures
- Comments

Use this report to review routings or as a basis for new routings or versions.

To view a routing sheet, type “routing sheet” in the **Search** box, and then select the related link.

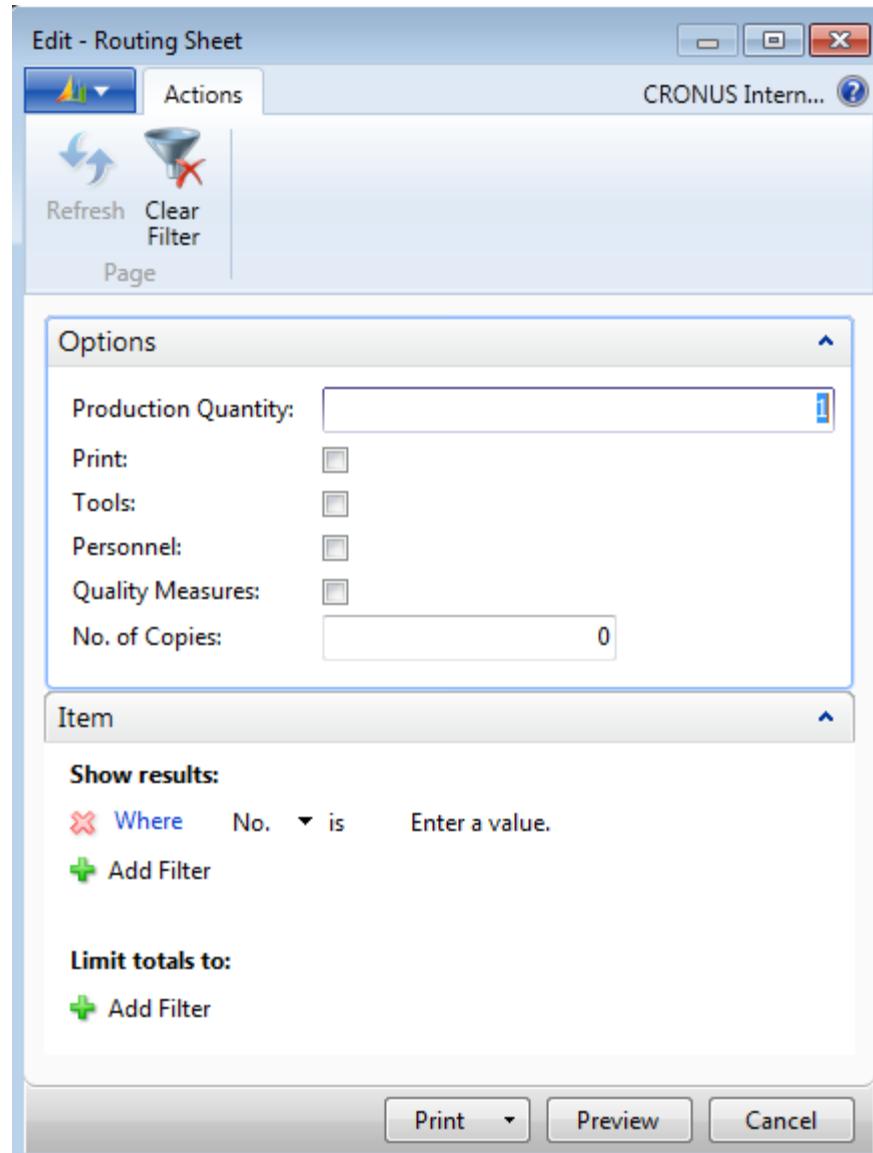


FIGURE 4.14:ROUTING SHEET REQUEST PAGE

The **Production Quantity** field lets you specify the quantity of items that you plan to manufacture. This lets the program calculate the total time that is required for the routing.

The **Print (comments)**, **Tools**, **Personnel**, and **Quality Measures** fields let you specify whether you want these fields included in the report.

The **Item** FastTab lets you specify filter fields to narrow the report results.

The "Routing Sheet Report" image shows an example of the report.

Routing Sheet
CRONUS International Ltd.

1000 Bicycle Routing No. 1000			Production Quantity 1							
Operation No.	Type	No.	Send-Ahead Quantity	Scrap Factor %	Setup Time	Wait Time	Move Time	Run Time	Total Time	Time Unit
10	Work Center	100	0	0	110	0	0	12	122	MINUTE
20	Machine Center	120	0	0	15	0	0	15	30	MINUTE
30	Machine Center	130	0	0	10	0	0	20	30	MINUTE
40	Machine Center	110	0	0	10	0	0	8	18	MINUTE

FIGURE 4.15:ROUTING SHEET REPORT



Note: Quality measures, such as minimum value, maximum value, and mean tolerance, do not print on the **Routing Sheet** report, but can be added by using a simple modification.

Work Center List

The **Work Center List** report shows basic information about work centers, including the following:

- Number
- Name
- Alternate work center
- Work center group
- Unit costs
- Unit of measure
- Capacity
- Efficiency
- Shop calendar code

To view a work center list, type “work center list” in the **Search** box, and then select the related link.

The request page for the report lets you specify filters for work center numbers, work center group codes, shop calendar codes, and any other fields in the **Work Center** table.

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The “Work Center List Report” image shows an example of the report.

No.	Name	Alternate Work Center	Work Center Group Code	Unit Cost	Unit of Measure Code	Capacity	Efficiency	Shop Calendar Code
100	Assembly department		1	1.20	MINUTES	3	100	1
200	Packing department		1	1.50	MINUTES	1	100	1
300	Painting department		2	1.70	MINUTES	1	100	2
400	Machine department		2	2.50	MINUTES	1	100	2

FIGURE 4.16:WORK CENTER LIST REPORT

Machine Center List

The **Machine Center List** report shows basic information about machine centers. This includes the following:

- Machine center number
- Name
- Work center number
- Capacity
- Efficiency

To view a machine center list, type “machine center list” in the **Search** box, and then select the related link.

The request page for the report lets you specify filters for machine center numbers, work center numbers, and any other field in the **Machine Center** table.

The “Machine Center List Report” image shows an example of the report.

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No.	Name	Work Center No.	Capacity	Efficiency
110	Mike Seamans	100	1	100
120	Bryan Walton	100	1	100
130	Linda Mitchell	100	1	100
210	Packing table 1	200	1	100
220	Packing table 2	200	1	100
230	Packing Machine	200	1	100
310	Painting Cabin	300	1	100
320	Painting Robot	300	1	100
330	Drying Cabin	300	1	100
340	Painting inspection	300	1	100
410	Drilling machine	400	1	100
420	CNC machine	400	1	100
430	Machine deburr	400	1	100
440	Machine inspection	400	1	100

FIGURE 4.17: MACHINE CENTER LIST REPORT

Capacity Task List

The **Capacity Task List** report shows the production orders that are waiting at the work centers and machine centers. The report includes the following:

- Production order number
- Routing number
- Operation number
- Description
- Input quantity
- Starting date and time
- Ending date and time

To view a capacity task list, type “capacity task list” in the **Search** box, and then select the related link.

The request page for the report lets you specify filters for capacity type, production order status, starting and ending dates, and any other fields in the **Prod. Order Routing Line** table.

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The "Capacity Task List Report" image shows an example of the report.

Prod. Order No.	Routing No.	Operation No.	Description	Input Quantity	Starting Time	Starting Date	Ending Time	Ending Date
Work Center	100							
1010005	1000	10	Wheel assembly	16	10:04:0 0 AM	01/27/1	3:06:00 4 PM	01/27/14
1011003	1000	10	Wheel assembly	16	2:55:00 PM	01/28/1	11:57:00 4 AM	01/29/14
1011004	1000	10	Wheel assembly	10	12:25:0 0 PM	01/29/1	8:15:00 4 AM	01/30/14
109001	1000	10	Wheel assembly	2	11:45:0 0 AM	01/30/1	1:59:00 4 PM	01/30/14
1010006	1000	10	Wheel assembly	3	10:50:0 0 AM	09/23/1	1:16:00 4 PM	09/23/14

FIGURE 4.18:CAPACITY TASK LIST REPORT

Module Review

This module describes how to set up, maintain, and report on basic capacities and routings in Microsoft Dynamics NAV.

This setup is important not only for the day-to-day processing of production orders in manufacturing, but also for more advanced program features such as planning, shop floor loading, automatic flushing of raw materials, and so on.

For more information on capacity, refer to "Advanced Capacity" in this training material.

Test Your Knowledge

Test your knowledge with the following questions.

1. What are the three types of capacities?

2. What are stop codes?

- Codes that you put into a routing to instruct plant operators to stop processing a production order.
- Codes that identify why a machine center has stopped during production.
- Codes that tell plant operators how long to stop their machines between operations.
- Codes that define the quality conditions under which a machine must be stopped.

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3. What is a routing?

4. What are the two categories of throughput time?

5. What is a routing link?

- A way of associating recurring tasks with a routing operation.
- A way to tie a shop calendar to a routing operation.
- A link between two routing operations.
- A way to link a routing operation to a production BOM component.

Test Your Knowledge Solutions

Test Your Knowledge

1. What are the three types of capacities?

MODEL ANSWER:

Work center group, work center, and machine center.

2. What are stop codes?

- () Codes that you put into a routing to instruct plant operators to stop processing a production order.
- (✓) Codes that identify why a machine center has stopped during production.
- () Codes that tell plant operators how long to stop their machines between operations.
- () Codes that define the quality conditions under which a machine must be stopped.

3. What is a routing?

MODEL ANSWER:

A routing specifies the sequence of operations required to manufacture a product. The operations are performed at a work center or at a machine center.

4. What are the two categories of throughput time?

MODEL ANSWER:

Productive time and non-productive time.

5. What is a routing link?

- () A way of associating recurring tasks with a routing operation.
- () A way to tie a shop calendar to a routing operation.
- () A link between two routing operations.
- (✓) A way to link a routing operation to a production BOM component.

