CHAPTER 9

RESOURCE LEVELLING

INFOCUS

WPL_J408

In a perfect world you will always have enough resources to complete the tasks in your project. The problem is that the world isn't always perfect and you will not always have enough resources for the work you've scheduled. This is known as ***over-allocation***.

Resources become ***over allocated*** in a project when they are scheduled to do more work than can be accomplished in the specified time. Resource levelling resolves any over allocations which exist in your project.

Microsoft Project gives you two options when levelling – letting Microsoft Project level the schedule for you or resolving the resource over allocations yourself.

In this session you will:

- ✓ gain an understanding of resource over allocations
- ✓ learn how to create resource chaos in a project
- ✓ learn how to track down resource over allocations using the ***Resource Graph***
- ✓ learn how to check ***Resource Usage*** for over allocations
- ✓ learn how to create an over allocated resources report
- ✓ learn how to change work effort to fix over allocations
- ✓ gain an understanding of assigning overtime to resources
- ✓ learn how to assign overtime to fix over allocations
- ✓ learn how to assign contract labour to fix over allocations
- ✓ learn how to switch work assignments to fix over allocations
- ✓ learn how to reschedule tasks to fix over allocations.

UNDERSTANDING RESOURCE LEVELLING

Levelling refers to the even allocation of resources. When you assign more resources to a task than you have available the resource is said to be ***over-allocated*** and requires ***levelling***.

Sometimes over-allocation is also referred to as a ***resource conflict*** – you simply have too much work for a resource to do.

Resolving Resource Conflict Using Levelling

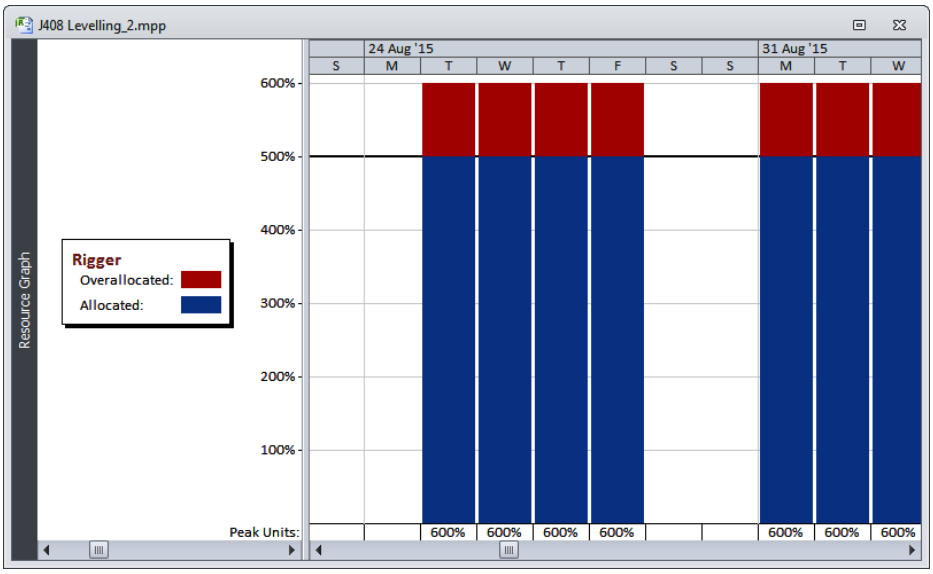
Resource conflicts occur normally when you are entering the resources against the tasks. You may not have noticed that the same resource is required in more than one place. However, because Microsoft Project is constantly recalculating the start and finish dates it is able to provide you with accurate details about these overlaps, or ***over-allocations***, in work commitments.

The process of resolving these over-allocations is called ***levelling*** (although Project spells it as *Leveling*). This term stems from the fact that in a perfect project all of your resources will be spread evenly, or flatly, across the scope of tasks. An over-allocation suggests that you have a bump or peak usage that needs to be ironed out.

Project has a special ***Resource Graph*** view as shown below which demonstrates this concept of over-allocation and levelling.

In the graph the thicker line at 500% indicates that this is the maximum units that we have in the resource pool. Any bar above this line indicates an over-allocation of resources. This peaking needs to be eliminated.

Microsoft Project provides you with the ability to ***automatically*** or ***manually*** level over-allocations.



If you choose ***automatic levelling*** Microsoft Project will attempt to resolve the conflict for you. Usually this is done by ***slipping*** the task dates out. It does this by adding delay to the tasks so that resources are not required at the same time. However, with automatic levelling you do forfeit control over your project. Most people prefer to resolve over-allocations manually.

This can be done by:

- ***moving a task*** that has an over-allocated resource within the project so that the task dates are changed to a date when the resource is free
- ***increasing the maximum units*** of the resource (usually by hiring or seconding additional staff)
- ***assigning a different resource*** that is currently free to the task
- ***assigning overtime***
- ***extending working days*** on the calendar used by the resource so that more time is available to work on the tasks.

Obviously not all of these options are practical. For example, if you have a deadline to meet, slipping the task dates by moving the task further down the timeframe is not good. In this circumstance you may be better off hiring more staff or allocating another resource to the task.

Similarly, if your project is constrained by costs then you may need to slip the dates out rather than hire or buy additional resources or allocate overtime to the task.

CREATING RESOURCE CHAOS

Our case study project is totally sanitised – we have ample resources to complete the required tasks. However, the project manager has just been advised that a second project is to begin elsewhere and some of the resources he has in the resource pool will be taken away to work on the new project. Having carefully assigned resources to the various tasks this will now wreak chaos.

Try This Yourself:

Open File *Before starting this exercise you MUST open the file J408 Levelling_1.mpp...*

1. Click on the ***Project*** tab on the ***Ribbon*** and click on ***Project Information*** in the ***Properties*** group

   The case study project is currently scheduled to finish on Wednesday April 27…

2. Click on **[OK]** to close the dialog box
3. Click on the ***View*** tab on the ***Ribbon*** and click on ***Resource Sheet*** in the ***Resource Views*** group
4. Click on ***200%*** in ***Max*** for ***Draftsperson***, type **100%** and press Enter
5. Hover over the warning icon and read the (less then helpful) message that appears
6. Repeat step ***4*** and change the number of resource units for the resources: **Rigger 500%**, **Carpenter 600%**, **Driver 200%**

	Resource Name	Type	Material	Initials	Group	Max.	Std. Rate
1	Architect	Work		Arc	Consultant	100%	$0.00/hr
2	Draftsperson	Work		Dft	Staff	100%	$0.00/hr
3	Building Clerk	Work		BC	Staff	100%	$0.00/hr
4	Supervisor	Work		Sup	Staff	100%	$0.00/hr
5	Rigger	Work		Rig	Wages	600%	$0.00/hr
6	Boilermaker	Work		BM	Wages	600%	$0.00/hr
7	Welder	Work		Weld	Wages	500%	$0.00/hr
8	Carpenter	Work		Car	Wages	800%	$0.00/hr

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This action has effectively halved the drafting resources in your project. Since there were more resources available when you did the initial assignments there are now times when the resource is over committed. Our committed (allocated) resources appear in red. A warning icon appears in the left column.

	Resource Name	Type	Material	Initials	Group	Max.	Std. Rate
1	Architect	Work		Arc	Consultant	100%	$0.00/hr
2	Draftsperson	Work		Dft	Staff	100%	$0.00/hr
3	Building Clerk	Work		BC	Staff	100%	$0.00/hr
4	Supervisor	Work		Sup	Staff	100%	$0.00/hr
5	Rigger	Work		Rig	Wages	500%	$0.00/hr
6	Boilermaker	Work		BM	Wages	600%	$0.00/hr
7	Welder	Work		Weld	Wages	500%	$0.00/hr
8	Carpenter	Work		Car	Wages	600%	$0.00/hr
9	Painter	Work		Ptr	Wages	500%	$0.00/hr
10	Labourer	Work		Lab	Wages	1,000%	$0.00/hr
11	Driver	Work		Drv	Wages	200%	$0.00/hr
12	No Barrier Fencing	Work		NBF	Contractor	100%	$0.00/hr
13	Rock Solid Concrete	Work		RSC	Contractor	100%	$0.00/hr
14	Listen Far Audio	Work		LFA	Contractor	100%	$0.00/hr

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For Your Reference…

To create ***resource chaos***:

1. Reduce the number of units of a resource(!)

Handy to Know…

- Over-allocations also occur when more resources are assigned to a task than there are units in the resource pool. For example, Microsoft Project will allow you to assign 10 carpenters to a task even though only 5 exist in the resource pool.

TRACKING DOWN OVER ALLOCATIONS

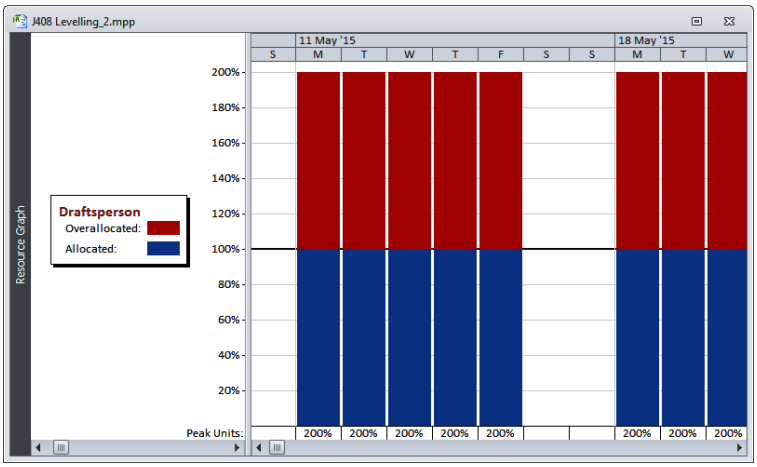
Over allocations aren't immediately apparent – unless they arise when you are changing data in the resource sheet as we have done. Over-allocations can be quite insidious and it is a good idea to check the resource pool on a regular basis to see whether there are over-allocations in your project. Remember, over-allocated resources appear bolded red in the resource pool.

Try This Yourself:

Same File *Continue using the previous file with this exercise, or open the file J408 Levelling_2.mpp...*

1. Click on the ***View*** tab on the ***Ribbon***, click on ***Other Views*** in the ***Resource Views*** group and click on ***Resource Graph***
2. Press Ctrl + Home , then Alt + Home
3. Press Pg Dn until the ***Draftsperson*** comes into view

   This resource is over allocated as indicated by the colouring of the name and in the chart…
4. Press Pg Dn until you can see the ***Rigger*** and press Alt + Home to return to the start of the project
5. Click on the ***Resource*** tab on the ***Ribbon*** and click on ***Next Overallocation*** in the ***Level*** group to see the over allocation for the ***Riggers***
6. Click on ***Next Overallocation*** again and you will be advised that there are no more over-allocations for this resource
7. Click on **[OK]**
8. Repeat steps ***4*** to ***7*** with the ***Carpenter*** resource



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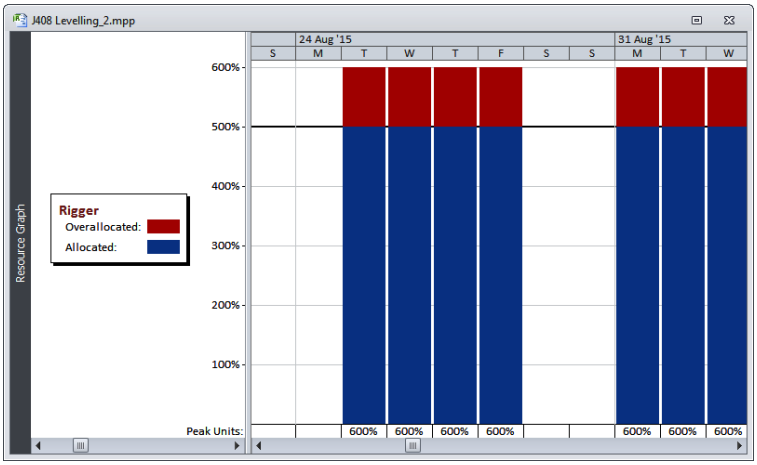

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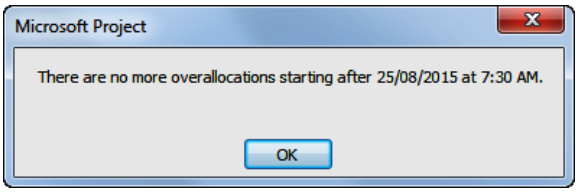

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For Your Reference…

To display over allocations as a chart:

1. Click on the ***View*** tab, click on ***Other Views*** in the ***Resource Views*** group and click on ***Resource Graph***
2. Click on the over allocated resource
3. Click on the ***Resource*** tab and click on the ***Next Overallocation*** command

Handy to Know…

- In earlier versions of Microsoft Project a message would appear on the status bar at the bottom of the screen to indicate that resources needed to be levelled. This no longer appears in Project.

CHECKING RESOURCE USAGE

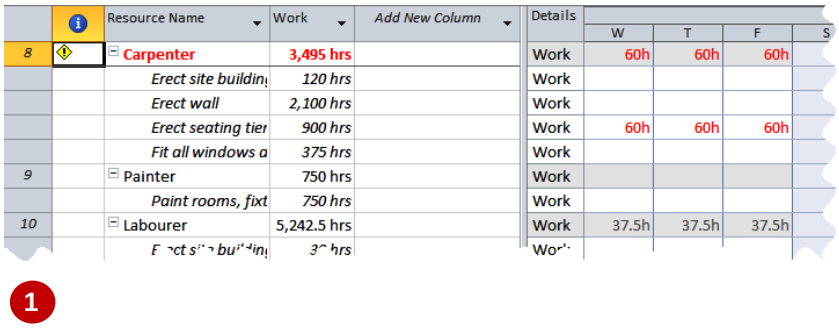
Another great way of tracking over allocations, and more importantly the extent of over allocation, is through the ***Resource Usage*** view. This view presents a sheet at the left which is organised in order of resources and the tasks that they are working on. At the right is a timeline view which shows the hours the resource works. Over allocated resources appear in red colouring.

Try This Yourself:

Same File

Continue using the previous file with this exercise, or open the file J408 Levelling_2.mpp...

1. Click on the ***View*** tab on the ***Ribbon*** and click on ***Resource Usage*** in ***Resource Views***
2. Press Ctrl + Home to move to the top of the resource list
3. Scroll to and click on ***Draftsperson***, click on the ***Task*** tab on the ***Ribbon*** and click on ***Scroll to Task*** in the ***Editing*** group
4. Scroll to and click on ***Rigger*** and click on ***Scroll to Task*** in the ***Editing*** group



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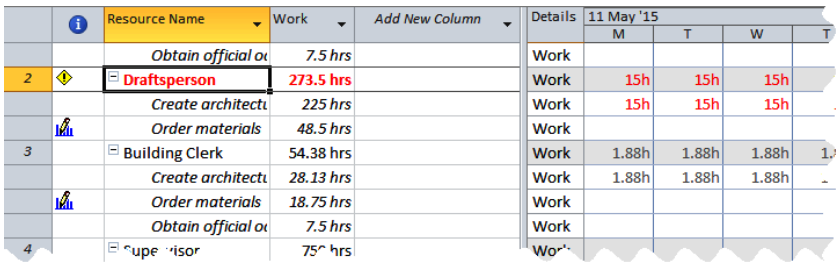

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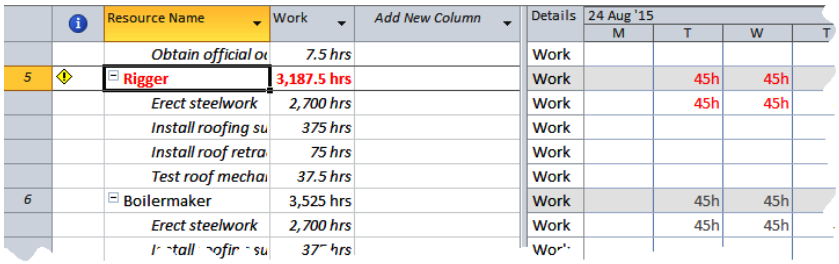

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For Your Reference…

To check ***resource usage*** for over allocations:

1. Click on the ***View*** tab on the ***Ribbon*** and click on ***Resource Usage*** in ***Resource Views***
2. Scroll to over allocated resources

Handy to Know…

- We didn't use the ***Next Overallocation*** command to move to the task in the timeline in the ***Resource Usage*** view because at the time of writing there was an erratic and inconsistent bug in this command – but only when used in ***Resource Usage*** view.

CREATING AN OVER ALLOCATION REPORT

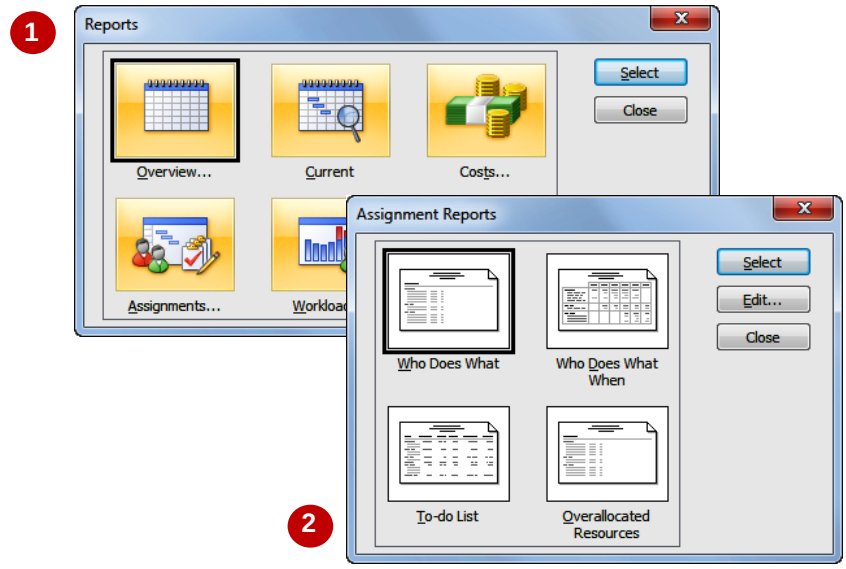
Microsoft Project contains a number of in-built and pre-defined reports which help you locate all sorts of information about, and problems in, your project. One such report, the ***Overallocated Resources*** report, lists all of the resources that are over allocated in your project and which tasks contain those over allocations. This is a handy report to use when levelling your project.

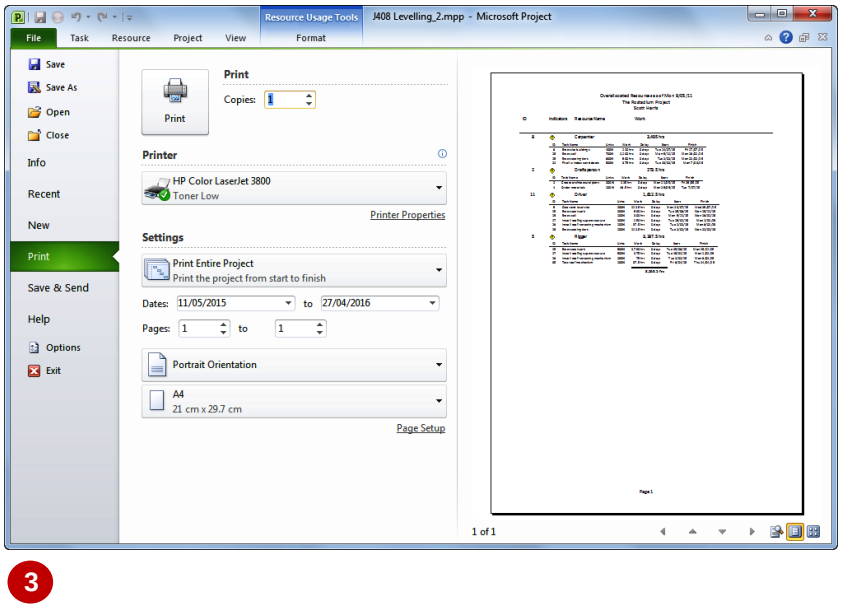
Try This Yourself:

Same File

Continue using the previous file with this exercise, or open the file J408 Levelling_2.mpp...

1. Click on the ***Project*** tab on the ***Ribbon*** and click on ***Reports*** to display the ***Reports*** dialog box
2. Click on ***Assignments*** and click on **[Select]** to see the ***Assignment Reports*** dialog box
3. Click on ***Overallocated Resources*** and click on **[Select]** to see the ***Overallocated Resources*** report in preview mode
4. Adjust the print settings as required and click on **[Print]** to print the report
5. Click on the ***Task*** tab on the ***Ribbon*** to return to the normal view of the project





For Your Reference…

To create an ***overallocated reources*** report:

1. Click on the ***Project*** tab and click on ***Reports***
2. Click on ***Assignments*** and click on **[Select]**
3. Click on ***Overallocated Resources*** and click on **[Select]**

Handy to Know…

- It is a good idea to print this report before you commence levelling operations so that you know the road and the task ahead of you.

FIX 1: CHANGING WORK EFFORT

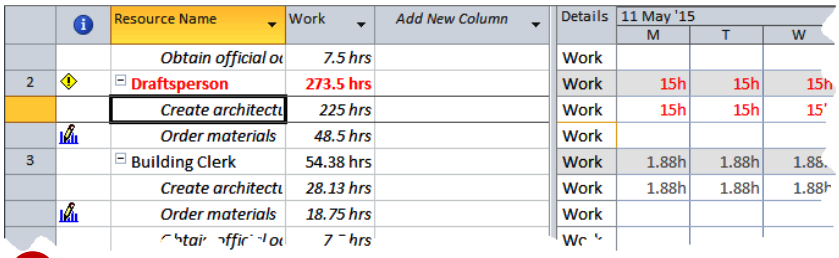
There is no right or wrong way to level over allocations – the methods that you choose are determined by the nature of your project. The best way to tackle over allocations is one at a time. We'll start with the ***Draftsperson***. We identified a work requirement for two draftspersons to create the architectural plans. It has been decided that there is only enough work for one.

Try This Yourself:

Same File *Continue using the previous file with this exercise, or open the file J408 Levelling_2.mpp...*

1. Click on the ***View*** tab on the ***Ribbon*** and click on ***Resource Usage***
2. Scroll to and click on ***Draftsperson***, click on the ***Task*** tab on the ***Ribbon*** and click on ***Scroll to Task***
3. Click on ***Gantt Chart*** to see a ***Gantt Chart*** view
4. Right click on the icon next to ***Create architectural plans*** and click on ***Fix in Task Inspector***
5. Click on **[Reduce Work]** to remove the over allocation
6. Click on ***Create architectural plans*** and click on ***Details*** to see a task form in the lower pane of the screen

   Notice that the hours for the draftsperson show 112.5h (3w x 37.5h)…
7. Click on the close button of the ***Task Inspector***



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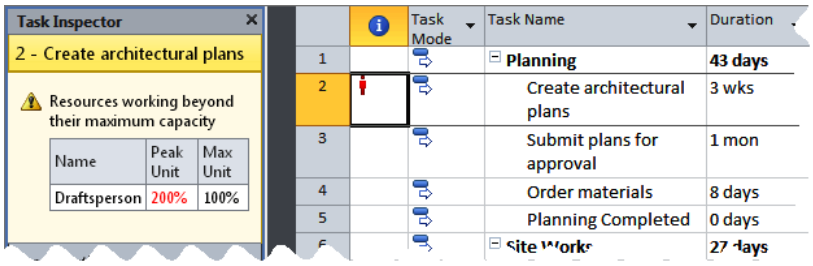

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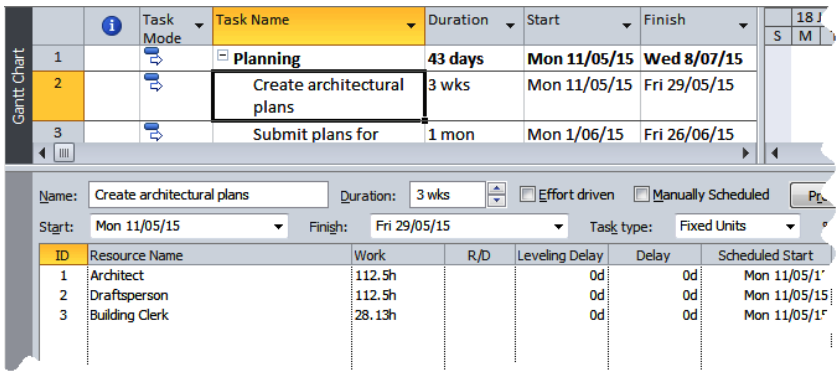
The problem here is that the task Create architectural plans requires/shows 15 hours of draftsperson work on most days – since a day is 7.5 hours this means that there is a requirement for 2 draftspeople.



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For Your Reference…

To change the work effort:

1. Right click on the icon next to the task with the over allocation and click on ***Fix in Task Inspector***
2. Click on **[Reduce Work]** to remove the over allocation

Handy to Know…

- You could have done this manually yourself by typing the ***112.5h*** hours in the Work field for ***Draftsperson***. But, hey, why not use the ***Task Inspector*** to do the leg work!

UNDERSTANDING OVERTIME

You can reduce the overall duration of a resource assignment in a task by assigning ***overtime*** to the resource. The total work for the assigned resources remains the same, but the task duration is reduced. In Microsoft Project overtime is defined as the work scheduled to take place beyond the regular working hours of the resource.

The Effect of Overtime On Task Duration

We have an over-allocation with the riggers. As you'll soon see this is only in one task – erecting the steelwork. In our case study there is a specific amount of work to be done on this. The riggers prepare and assemble some of the steelwork units that are then lifted into place.

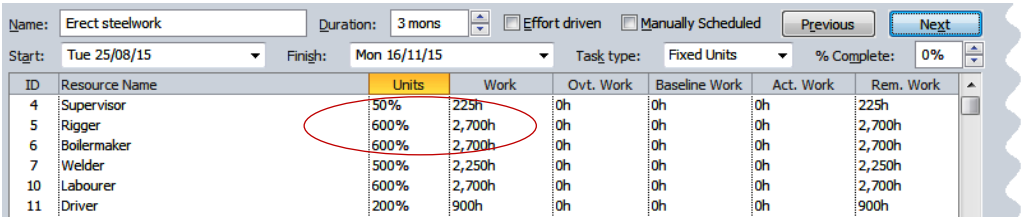
We are actually short one rigger. Scott Harris has decided to overcome this shortfall by ***assigning overtime*** to the other riggers – they'll work enough overtime to cover the shortfall of one rigger.

In Microsoft Project assigning overtime can shorten the duration of a task. A task requires a specific amount of work effort by the resources to complete the task within the required duration. The duration of the task is calculated on the basis that the work effort will be done in regular work time.

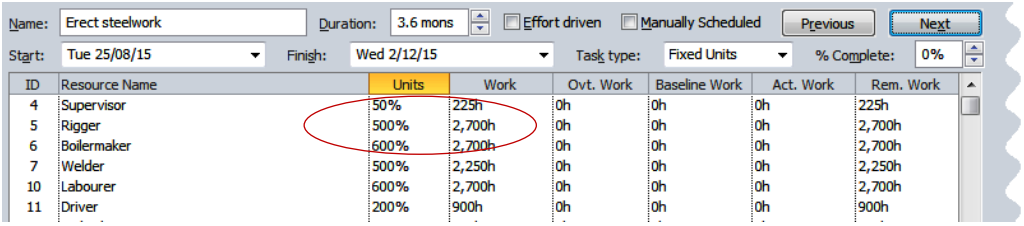
However, if some of that ***work effort*** is done in overtime (that is, outside of ***regular work time***) then the duration of the task will shorten – providing effort from other resources doesn't come into play. Consider the table below:

Total Work	Ovt Hours	Reg Work Time	Duration
15h	0h	15h	2 days
15h	3.75h	11.25h	1.5 days

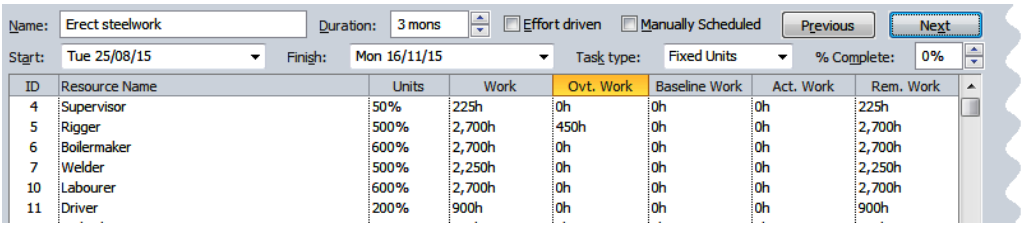
So how does this help us? Well, our task is ***effort driven***. At the moment it requires 6 riggers per day to complete.



Take one rigger away and the duration will be longer – assuming that the same amount of work needs to be done by the five remaining riggers.



However, by assigning overtime we should be able to pull the duration back to its original amount. This is presented numerically in the form below.



FIX 2: ASSIGNING OVERTIME

To resolve a resource over allocation, you may need to assign ***overtime***. By definition, overtime is something that happens outside of the normal working hours. The value in ***Work*** represents total hours for a resource. Any value in overtime is subtracted from the total ***Work*** and this in turn may impact on the task ***duration***. Generally, more overtime results in a shorter task duration.

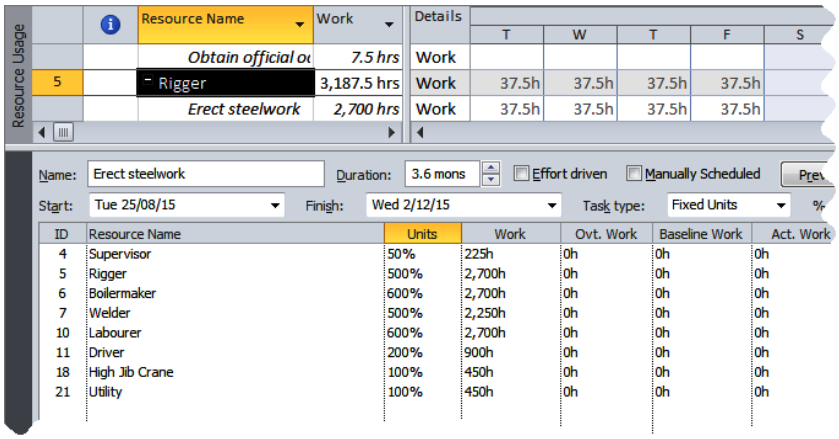
Try This Yourself:

Same File

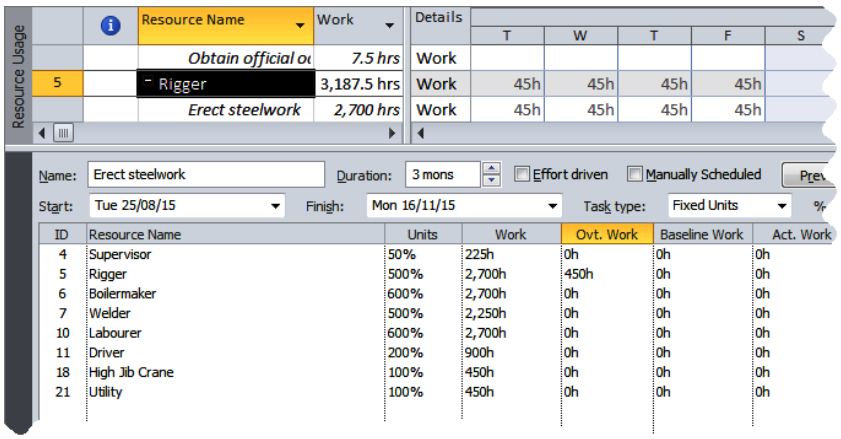
Continue using the previous file with this exercise, or open the file J408 Levelling_3.mpp...

1. Ensure you have a split screen view, click in the top pane, click on the ***View*** tab on the ***Ribbon*** and click on ***Resource Usage*** in ***Resource Views***
2. Scroll down, click on ***Rigger***, click on the ***Task*** tab on the ***Ribbon*** and click on ***Scroll to Task***
3. Click in the lower pane, click on the ***Format*** tab on the ***Ribbon*** and click on ***Work*** in the ***Details*** group
4. Click on ***600%*** in ***Units*** for ***Riggers***, type **500** and click on **[OK]**
5. Click on ***0h*** in ***Ovt. Work*** for ***Riggers***, type **450h** and click on **[OK]**

   Fixed! The task is back to 3 months and the Rigger is no longer over allocated



4 *The duration has pushed out to 3.6 months because the Work for the Riggers (2,700h) is now divided by 5 riggers to derive total work of 540 hours for each rigger. Since there are 150 hours of work per week (37.5 x 5) when you divide the total hours (540h) for a rigger by 150 you get 3.6 months.*



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For Your Reference…

To ***assign overtime*** to a resource:

1. Ensure a ***Task Form*** appears with the Work format
2. Type the appropriate overtime in the ***Ovt. Work*** field and click on **[OK]**

Handy to Know…

- Microsoft Project subtracts overtime from total ***Work*** (*2,700 – 450 = 2,250*), then divides this by the number of riggers (*2,250 / 5 = 450*). This in turn is then divided by the number of hours per week (*450 / 150 = 3*) to determine how many weeks of work are required by this resource.

FIX 3: HIRING CONTRACT LABOUR

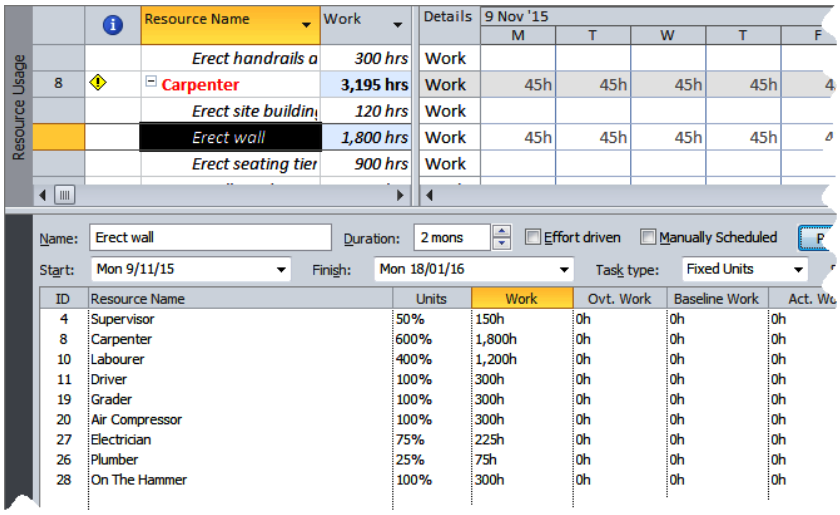
Scott Harris doesn't have enough carpenters to complete some of the work that needs to be done. In times of dire emergency he does have permission to bring in additional contract tradespeople. We will have to add a new resource to the pool, then assign the resource to the task, being careful that we don't accidentally change the duration due to the effort-driven nature of the task.

Try This Yourself:

Same File *Continue using the previous file with this exercise, or open the file J408 Levelling_4.mpp...*

1. Scroll the top pane until the ***Carpenter*** resource can be seen, click on ***Erect wall***, click on the ***Task*** tab on the ***Ribbon*** and click on ***Scroll to Task***
2. Click in ***Resource Name*** below ***Plumber***, type **On The Hammer** and click on **[OK]**

   Now we can adjust the carpenters down…
3. Click on ***700%*** in ***Units*** for ***Carpenter***, and type **600%**, then click on ***2,100h*** in ***Work***, type **1800** and click on **[OK]**
4. Double click on ***On The Hammer*** to display the ***Resource Information*** dialog box
5. Change the ***Units*** to ***1000%***, type **OTH** in ***Initials***, and type **Contract Labour** in ***Group***
6. Click on **[OK]**



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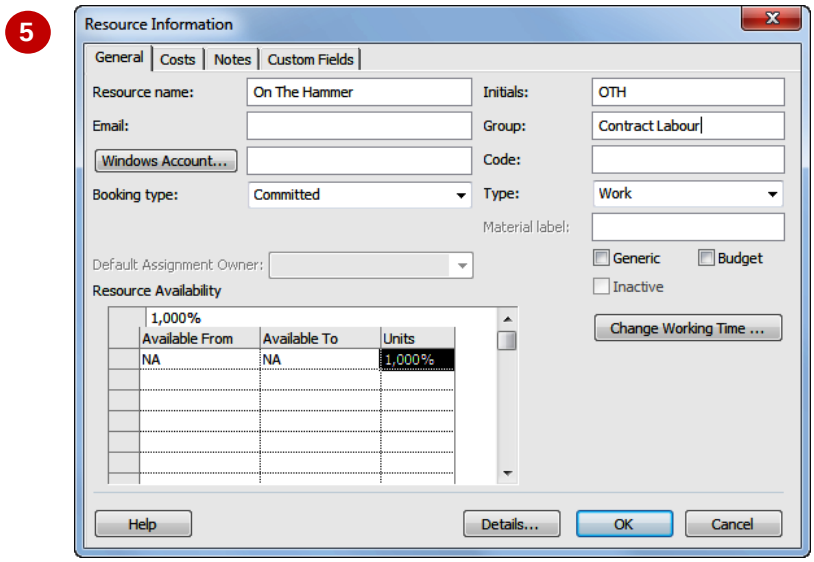


For Your Reference…

To add a new resource to cover over allocations:

1. Click in ***Resource Name***, type the name of the resource and click on **[OK]**
2. Enter the appropriate Work for this new resource, then deduct the same amount from the over allocated resource

Handy to Know…

- In our case study Scott Harris has access to an endless supply of contract carpenters – that is why we entered a large sum of 1000% units.

FIX 4: SWITCHING WORK ASSIGNMENTS

The task of erecting the seating tiers requires 8 carpenters, but there are only six in the pool. Scott could use the contact labour – but these folks are pricey. So, industrial relations issues aside, he has decided to give some of the more menial carpentry tasks to the labourers.

Try This Yourself:

Same File *Continue using the previous file with this exercise, or open the file J408 Levelling_5.mpp...*

1. Click on ***Erect seating tiers*** in the upper pane, click on the ***Task*** tab on the ***Ribbon***, and click on ***Scroll to Task***

2. Type **600%** in ***Units*** for ***Carpenter*** and type **675h** in ***Work***

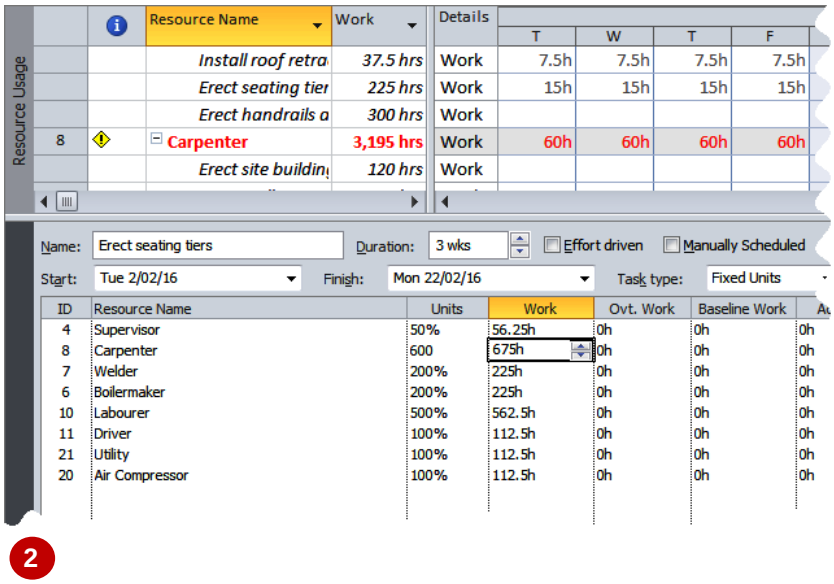
   This represents 3 weeks work for 6 carpenters (6 x 3 x 37.5 = 675)...

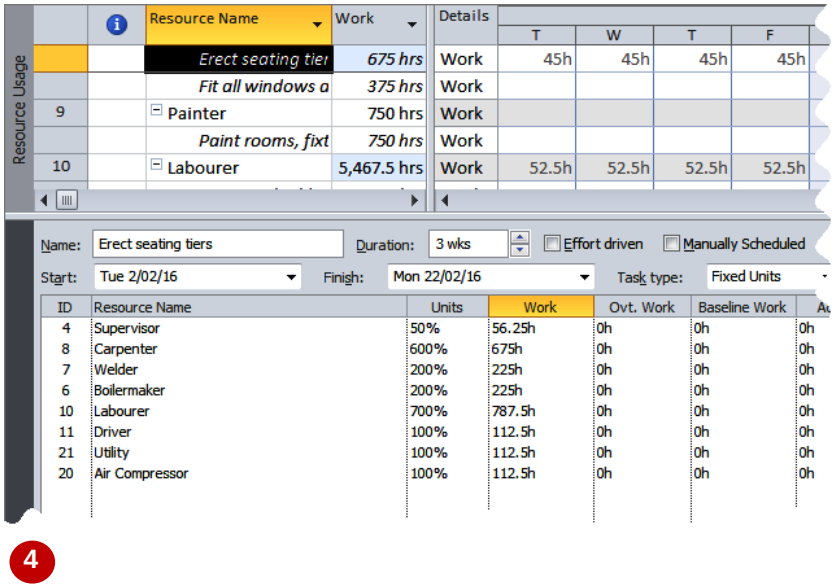
3. Type **700%** in ***Units*** for ***Labourer*** and type **787.5h** in ***Work***

   This represents 3 weeks work for 7 labourers (7 x 3 x 37.5 = 787.5)...

4. Click on **[OK]** to record the revised assignments

   The carpenter resource should no longer appear over allocated





For Your Reference…

To ***switch*** work assignments:

1. Select the task
2. Adjust the units and/or work effort for the over allocated resource
3. Click on **[OK]**

Handy to Know…

- Switching assignments in Microsoft Project is relatively easy to do providing you take into consideration the effort-driven nature of your tasks.

FIX 5: RESCHEDULING TASKS

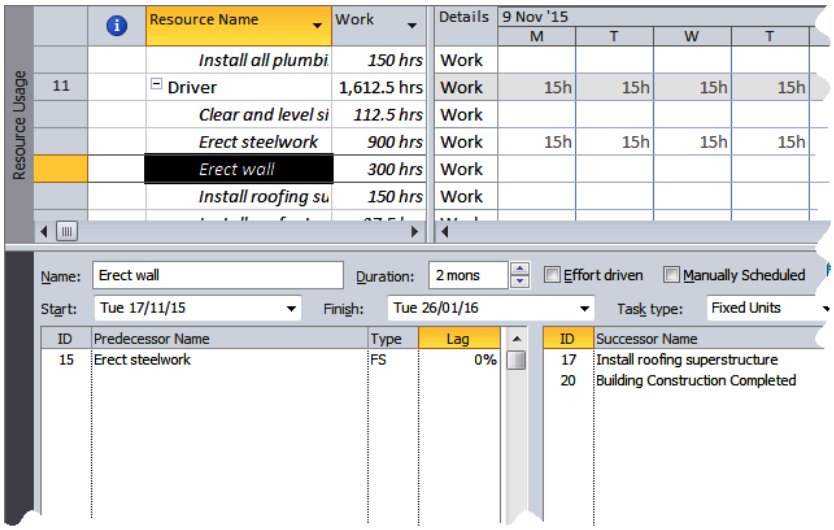
We have an over-allocation of drivers. This over-allocation has arisen because the resource is required on two different tasks at the same time. Scott doesn't want to use additional resources, and overtime isn't practical as the work of the driver is required in normal working time. Scott has to ***reschedule the tasks*** – but can this be done and still meet the project deadlines and timeframes?

Try This Yourself:

Same File *Continue using the previous file with this exercise, or open the file J408 Levelling_6.mpp...*

1. Scroll down in the top pane and click on the ***Driver*** resource, click on the ***Task*** tab on the ***Ribbon*** and click on ***Scroll to Task***
2. Use the scroll bar below the timeline until red values appear in the ***Driver*** row
3. Click on ***Erect wall*** in the upper pane, then click on the active pane bar in the ***Task Form*** (lower pane)
4. Click on the ***Format*** tab on the ***Ribbon*** and click on the ***Predecessor and Successors*** command
5. Click on ***-10%*** in ***Lag***, type **0** and click on **[OK]** to remove the over allocation
6. Click on the ***Project*** tab on the ***Ribbon*** and click on ***Project Information***

   The finish date is now Thursday May 5…
7. Click on **[OK]**
8. Double click on the divider line between the panes, click on the ***Task*** tab and click on ***Gantt Chart***



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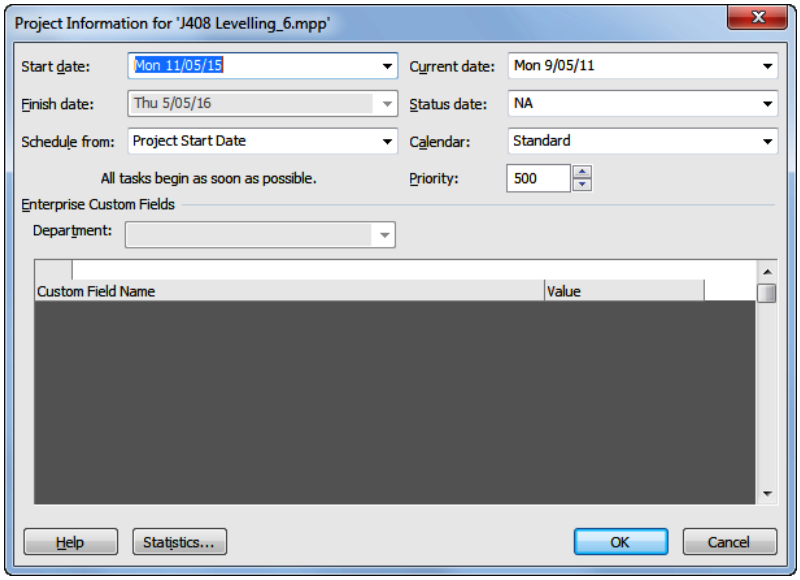

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For Your Reference…

To reschedule an over allocated task:

1. Display the predecessors in a task form
2. Adjust for lag or predecessor relationships

Handy to Know…

- When you want to switch to another view from a combination view, remember to remove the split in the window. For example, double click on the line between the two panes, then select ***Resource Sheet*** view to check that all over allocations have gone.