

# Reverse Engineering the Work Formula in Microsoft Project

1 Person can finish a job in 100 days.  
100 People can finish the same job in 1 day.  
10,000 People cannot finish the job before it starts!

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## 1.0 Introduction

This white paper was published in July 2009 as part of the Lockergnome technical posts. Thanks to Chris Pirillo and Bob Fogarty for all their help.

Review it and others here:

<http://www.lockergnome.com/akramnajjar/2009/08/05/reverse-engineering-the-work-formula/>

Please revert to me with your comments and feedback: [anajjar@infoconsult.com.lb](mailto:anajjar@infoconsult.com.lb)

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At the heart of planning a project using Microsoft Project is the daunting responsibility of assigning Resources to Tasks. Worse still, try adjusting those assignments (both during planning and monitoring) and see what happens.

A confusing facility in Microsoft Project is the way **Duration**, **Units of Resources** and **Work Loads** per Task are interact with one another.

The work formula is clear: **Work = Units x Duration**. But there are 2 major options that make Microsoft Project behave in diverse ways, some of them unintuitive. One is a field called the **Task Type** (Fixed Work, Unit or Duration) and the other is a field that defines whether a Task is **Effort Driven** or not.

Try as I might, I could not get books, blogs or training material that carried the Work Formula logic to the end.

The time was ripe for **Reverse Engineering**. We have a box called Microsoft Project and its Work Formula is programmed to work in ways more mysterious than a Project Manager's mind. The box has a lot of input and a fewer outputs. Which inputs do we use to which output?

To Reverse Engineer the Work Formula, we will:

1. Analyze the two Task fields (columns): Task Type and Effort Driven
2. Identify all possible combinations of input (scenarios)
3. Try each one to see how Microsoft Project behaves (output)
4. Arrive at a decision logic that allows us to know where to use which setting.

These are presented in the next 4 main Sections.

### Applicability

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All of the discussions apply to Microsoft 2003 and 2007. There is no difference in the Work Formula and Work Resources between the two versions.

### What is the Work Formula?

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The Work Formula measures the effort you put on a task over a specific period of time:

## **Work = Units of Resources x Duration**

**Work** is measured in units of time: hours, days, months, etc

**Units** are measured in fractions of a Full Time Employment (FTE). So if you are assigning a full time developer, the unit is 1.0 (some use %100). If you only need 2 hours per day of a supervisor, then the units for that Resource = 0.25 (assuming the default working hours are set to 8 hours per day).

**Duration** is measured in time and when calculating, it should be in the same units as Work. It is possible to display the Duration in different units.

Duration can be a business period OR a calendar period.

a) A business period skips over weekends and holidays or days when the Resource is not available. For example, if you specify the Duration of a Task to be 8 days, the Resource will work from Mon to Fri in Week 1 and then from Mon to Wed in Week 2.

b) Duration can also be in Calendar days where non-working days are not relevant. For example, waiting for paint to dry requires 3 consecutive days regardless of weekends or holidays.

**Good news:** the two different types of Duration do NOT affect our Work Formula. Microsoft Project will simply decide on which days to spread the work.

### **Examples of the Work Formula**

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A Task requires 40 hours of programming

- 2 developers are assigned for 5 days at 50% of their daily load
- $2 \text{ developers} \times 5 \text{ days} \times 8 \text{ hours} \times 50\% = 50\% \text{ of } 80 \text{ hours} = 40 \text{ Hours}$
- **Work** = 40 hours
- **Units** = 0.5 of developers
- **Duration** = 5 days

A Task needs 5 days of QA to complete but only 2 hours a day

- It requires 5 days at 25% of the load of a QA
- $1 \text{ QA} \times 5 \text{ days} \times 8 \text{ hours} \times 0.25 = 10 \text{ hours}$
- **Units** = 0.25 of QA
- **Duration** = 5 days

In the last example, whether the QA is scheduled to work across the weekend or during the weekend will not affect the total Work.

### **Three Tips**

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1. Starting with 2003, Microsoft provided **Smart Tags** that remove some of the confusion by thinking for you: which behavior did you really want?

Use them but note that when entering Resources through the split screen of the Task View, Smart Tags do not show. They only show after entering Resources using the Task Information Box.

2. If you enter wrong Resources or if you are in double, it is best not to attempt to correct or fix the assignments. Wipe out all the assignments and correct the Duration and Work (if changed). Then you can re-assign the Resources. The reason will become clear when we discuss how Microsoft Project freezes an assignment and consider later adjustments as help to the existing resources.

## **The Files to Download**

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Along with this document, the posts have a link for downloading files. The files are found in zipped format and contain:

1. **[Work Formula - Scenarios TEMPLATE.mpt](#)**

This is an Microsoft Project template that contains 30 scenarios of the Work Formula grouped under 6 combinations. They are color coded to correspond to the Excel file below.

2. **[Work Formula - Combinations.xls](#)**

This is an Excel Workbook that analyzes the results of the 30 scenarios and compares different settings with one another.

3. **[3T1R Not Assigned.mpt](#)**

This is a preset template that has 3 Tasks and 1 Resource still unassigned to the Tasks. Using it in some of the examples will save you time.

Download them and use them at your ease.

## 2.0 What are Task Types?

The **Task Type** is a field (a column) in the Task View in Microsoft Project.

The **Task Type** is NOT a characteristic of the Task such as its Location or its Cost Account. It is only used to dictate the behavior of the Work Formula for that Task.

**Definition:** the Task Type tells the Work Formula which factor to keep constant when either of the other two changes.

For example, if you set the Task Type to **Fixed Duration**, then if you change Work, the Units will change and vice versa, keeping the Duration constant or fixed.

There are 3 settings to the Task Type corresponding to the 3 factors in the Work Formula:

1. Fixed Units (default setting)
2. Fixed Duration
3. Fixed Work

### A) Accessing the Task Type Field

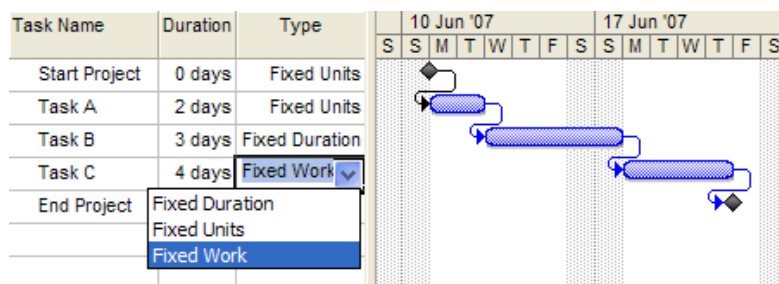
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The Task Type field can be **accessed** . . .

- As a column you insert in Task tables which provides you with a drop down list
- As an entry drop down list in the Task Information Box (in the Advanced Tab)
- As an entry drop down list in the Split Form in the Task view

Here is a capture of the Task Table showing the Type column with its option:

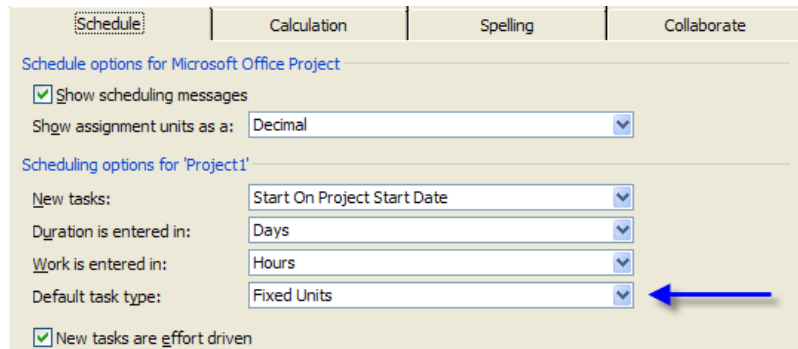
Task Name	Duration	Type	10 Jun '07							17 Jun '07						
			S	S	M	T	W	T	F	S	S	M	T	W	T	F
Start Project	0 days	Fixed Units														
Task A	2 days	Fixed Units														
Task B	3 days	Fixed Duration														
Task C	4 days	Fixed Work														
End Project		Fixed Duration														
		Fixed Units														
		Fixed Work														

The image shows a screenshot of a Gantt chart in Microsoft Project. On the left, a task table is visible with columns for Task Name, Duration, and Type. The 'Type' column for 'Task C' is highlighted, and a dropdown menu is open, showing options: 'Fixed Duration', 'Fixed Units', and 'Fixed Work'. To the right, a Gantt chart displays task bars for 'Start Project', 'Task A', 'Task B', 'Task C', and 'End Project' across a timeline from June 10, 2007, to June 17, 2007. Task A is a 2-day task starting on Monday, June 11. Task B is a 3-day task starting on Tuesday, June 12. Task C is a 4-day task starting on Wednesday, June 13. The bars are connected by dependency lines.

**Figure 1: Accessing the Task Type in the GANTT Chart**

The **default** setting for the Task Type is **Fixed Units**.

You can **preset Microsoft Project** to create new Tasks that are of a different Type by selecting the Type in the drop down list found in the middle of the Schedule TAB in the OPTIONS dialog box:



**Figure 2: Setting the Default Value of the Task Type**

**Suggestions:**

1. Before you start assigning Resources, analyze the Tasks in your new project based on the reasoning we will present later on in Section 5.0: Which Settings to use for Task Types and Effort Driven?

If the majority are going to be Fixed Duration, then set the above option to Fixed Duration.

2. During planning, insert both **Task Type** and the **Effort Driven** fields (columns) in your Task View during the stage of resource assignment. This will give you the assurance that you are handling the right Tasks.

**B) Examples for Different Task Types**

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The steps in these examples are exactly what Microsoft Project will execute. However, don't expect them to be logical. More of that later!

1. Create a project from the Template [3T1R Not Assigned.mpt](#) (3 Tasks with a Duration of 8 days and 1 Resource that is not assigned).

2. Save it under any name.

3. Task A consists of developing a Design.

By default, the Task Type is **Fixed Units** (verify it in the Task Information Box).

4. Change the Task Type of Task B to **Fixed Work**
5. Change the Task Type of Task C to **Fixed Duration**

6. Assign Res1 to each of Task A, Task B and Task C in full

7. Insert the column **Type** in the Gantt Chart so you can see your settings.

### **Extend the Duration of Task A (Fixed Units):**

You are late in the design and you decide to extend the Task A by 4 days. You now have 12 days to complete the Task instead of 8.

The total Work = 8 hours x 8 days x 1 Unit = 64 hours.

Enter 12 in the Duration field (overwriting the 8 days) of Task A

What happens to the Work Formula:  $W = \text{Units} \times \text{Duration}$ ?

- Will Microsoft Project decrease the Units (Resources) keeping the Work fixed (64 hours)?
- Will Microsoft Project increase the Work keeping the Units fixed, (1 full time person)?

You have increased the Duration so Work will have to be increased because the Units are Fixed. The new Work is now 8 hours x 12 days x 1 Unit = 96 hours.

### **Extend the Duration of Task B (Fixed Work):**

You have a Fixed Work Task which means the work is fixed at 64 hours. What happens when you extend the Duration by 4 days?

Enter 12 in the Duration of Task B. What will Microsoft Project do?

- Will Microsoft Project decrease the Units (Resources) keeping the Work fixed (64 hours)?
- Will Microsoft Project increase the Work keeping the Units fixed, (1 full time person)?

Since the Type is **Fixed Work**, we can only do 64 hours on this job. Extending the Duration by 4 days forces us to reduce the number of units we need. We now need  $64 \text{ hours} / 12 \text{ days} = 64 / 12 \times 8 = 0.66$  or  $2/3^{\text{rd}}$  of the Resource's daily timing.

### **Add Work Hours to Task C (Fixed Duration):**

Someone informs you that the work being done in Task A is more complex than you thought (more documents, more code, etc). You need twice the number of hours to complete it or 128 hours.

Insert the Work Column in the Gantt Chart and increase the work to 128 hours.

Since the Task Type is **Fixed Duration** and you have increased Work, what will Microsoft Project do?

- Will Microsoft Project decrease the Units (Resources) keeping the Duration fixed (8 days)?
- Will Microsoft Project increase the Duration keeping the Units fixed, (1 full time person)?

Since the Task Type is **Fixed Duration**, Microsoft Project will increase the number of Units to meet the new work load.

### Add Resource to Task A (Fixed Units):

Someone says, you cannot complete Task A on time (now we have 96 hours) so how about adding a resource? The Task Type is **Fixed Units**.

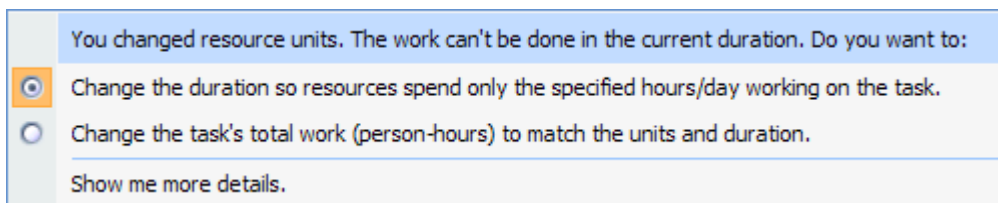
Double click on the Task A to get the Task Information Box. Use the Resource Tab to increase the Resource Units from 1 to 2.

Wait: this is funny because we have just received a request to increase Units! So what will happen?

- Will Microsoft Project decrease the Duration?
- Will Microsoft Project increase the Work?


It is difficult to predict. Don't rely on your intuition here. Simply try it with an example and see what happens.

Well, even Microsoft Project does not know which way to go. It produces a Smart Tag. Click it and it will give you Microsoft Project's two choices, defaulting to the first one: increase the Duration:



**Figure 3: An Example of a Smart Tag for the Work Formula**

As you can see, as they look, things are not that simple.

 **Warning:** in all the above, we simply changed some of the 3 factors. If you decide to add or remove full resources from an existing assignment, another factor comes in: the Effort Driven check box. We will discuss this next.

(See later examples in Section 4.0: Try ALL Combinations in the Work Formula).

Finally, if things were only a matter of varying the Task Type, the Work Formula would be simple to manage. However, we have another setting: **Effort Driven** which we will discuss next.

### 3.0 What is the Effort Driven Setting?

For each Task, Microsoft Project has a check box that determines whether the Task is **Effort Driven** or not. The **default** setting is for Tasks to be Effort Driven.

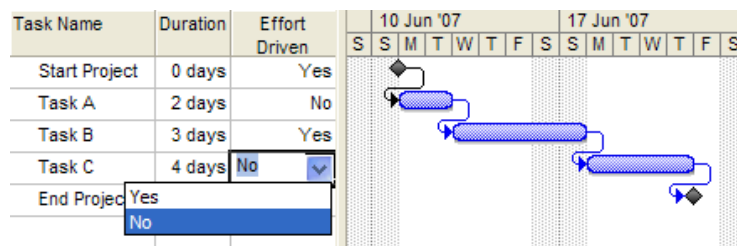
#### A) Accessing the Effort Driven Flag or Check Box

**Effort Driven** is a Flag Field in the Task table. Right click on any column in the Gantt Chart and Insert Column and you can scroll down to see it and hence insert it.

The Effort Driven field can be **accessed** . . .

- As a column that you insert in Task tables that allows you a Yes/No entry
- As a check box in the Task Information Box
- As a check box in the Split Form in the Task view

Here is a capture of the Task Table showing the Effort Driven column with its option:



Task Name	Duration	Effort Driven	10 Jun '07							17 Jun '07							
			S	S	M	T	W	T	F	S	S	M	T	W	T	F	S
Start Project	0 days	Yes															
Task A	2 days	No															
Task B	3 days	Yes															
Task C	4 days	No															
End Project	Yes																

Figure 4: Accessing the Effort Driven Columns in the GANTT Chart

You can preset Microsoft Project to create new Tasks that are not **Effort Driven** by disabling the check box found in the middle of the Schedule TAB in the OPTIONS dialog box.

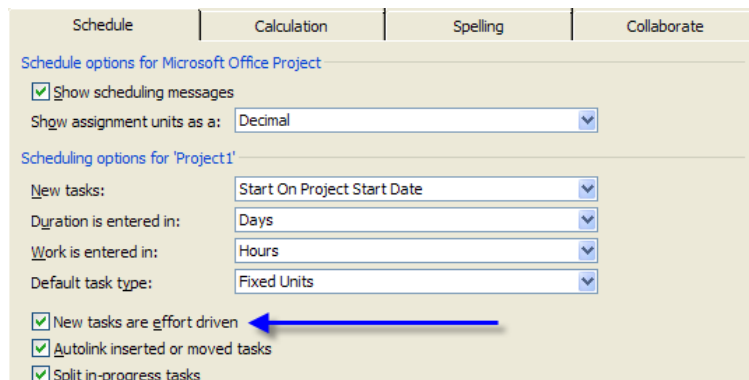


Figure 5: Setting the Default Value of the Effort Driven Box

### Suggestions:

1. Before you start, analyze the Tasks in your new project based on the reasoning we will present later on in Section 5.0: Which Settings to use for Task Types and Effort Driven?

If the majority are going to be Effort Driven, then keep the default setting in the **Options/Schedule** TAB.

2. During planning, insert both **Task Type** and the **Effort Driven** fields (columns) in your Task View during the stage of resource assignment. This will give you the assurance that you are handling the right Tasks.

### **B) What are Effort Driven Tasks?**

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This is the classic situation of a job that requires 6 days for 1 person and hence 3 days for 2 and so on (the obsessively linear rule of 3).

Microsoft Project treats such Tasks differently:

- Before assignment, you can change around in the resources as you wish. Microsoft Project will hold its breath and not calculate.
- After you confirm the assignment by pressing OK, Microsoft Project will compute the Work (in hours) and assume that this is it: these are the hours need to complete the job. From now on, if you change the assignment or the duration, this number of hours will remain the same.

After computing the work load in hours, you can ask yourself the questions:

- How many resources do I have to complete the Work (which determines the Duration) OR
- How many days do I have to complete the Work (which determines the number of Units)

**Same Type of Resource?** In Effort Driven Tasks, work is estimated as the hours of **only 1** type of resource. By increasing the number of units, the Work remains the same but the Work gets shared over a larger quantity of the same resource hence reducing the Duration.

It does not make sense to have a Carpenter and an Electrician on this type of Task because adding a Carpenter to the assigned Electrician will not help the latter.

However, you can have a list of individual resources such as Tom, Dick and Harry, each of whom will be carrying out the same kind of work, hence adding or removing them will assist or retard the rest.

**Mixing Resources:** if you absolutely must mix Resources for an Effort Driven Task, you need to break the Tasks into two parallel Tasks. For example, suppose you need 1 supervisor to monitor 5 excavators. The more excavators you have, the sooner you will finish but you still need 1 supervisor. Therefore, you need to create 2 Tasks, one for the Supervisor and one Excavation. (They need to have the same duration and must start together).

We will set a Task as **Effort Driven** whenever:

- We know that the Task is based on a single estimate of the workload AND
  - When that work is carried out by the **same type of Resource**
1. Create a project with Task A and Task B and save it under any name.
  2. Keep Task A with the default setting of Effort Driven.  
Clear (Disable) the Effort Driven box of Task B.
  3. Create two Resources Res1 and Res2
  4. Assign Res1 to Task A  
Assign Res2 to Task B
  5. Create a new Resource Res3
  5. Add Res3 as a new assignment to Task A. What will Microsoft Project do?
    - Will it increase the Work because we have more staff?
    - Will it decrease the Duration because we have more staff?

Since the Task is set to Effort Driven, and the Task is set by Default to Fixed Units, Microsoft Project will reduce the Duration.

### **C) What are Non-Effort Driven Tasks?**

---

These are Tasks that are NOT based on a fixed amount of work.

#### **Example:**

- Installation of a Transformer
- This requires 1 supervisor, 2 workers, 1 electrician and 0.5 welders.
- The job must finish in 2 working days.

If you add more people, that won't help. (In fact, it might delay work).

#### **Another example:**

- You allocate two weeks (10 working days) for Peer Review of a Design.
- Two peer reviewers are assigned in full to complete the review
- The total Work = 2 units x 8 hours x 10 days = 160 hours

They will not help each other complete the job earlier. Someone says: Joe knows the design area well. Let him also review the Design. Adding Joe as a 3<sup>rd</sup> peer reviewer will not reduce the Duration. It will simply increase the required Work hours by 8 x 10 = 80 hours (bringing the total Peer Review to 240 hours).

In contrast with Effort Driven Tasks, the Work is not fixed. Only the Duration or the Units can be fixed.

Again, as in the first setting, Duration (or Units) can be changed. They are not permanently fixed. Someone says, we must finish the project sooner, please ask your

reviewers to review the design in 8 instead of 10 working days. The Duration is now shorter and the work has shrunk to  $2 \times 8 \text{ hours} \times 8 \text{ days} = 128 \text{ hours}$ .

1. Continue with the previous project
2. Add Res3 to Task B

Because Task B is not Effort Driven Task, Microsoft Project will simply add Work hours to the job.

You can see by now that there is no simple logic to summarize the behavior of Microsoft Project for all possible combinations of Task Type (3) and Effort Driven (2). Furthermore, and this is critical, Microsoft Project can behave differently depending on whether you are adding a resource or you are doubling the units of an existing resource.

Next, we will review ALL combination in the Work Formula.

## 4.0 Try ALL Combinations in the Work Formula

There are two Task fields that have a direct effect on the Work Formula: the **Task Type** (3 options) and the **Effort Driven** (2 options) check box. (These were discussed in the previous two Sections. We therefore have 6 combinations

For each **combination**, we will try 5 **scenarios**:

1. Add new Resources to the Task (not the same as item 3 below)
2. Remove already assigned Resources in full
3. Double (or Half) the number of Units (not the same as item 1 above)
4. Double (or Half) the Duration of the Task
5. Double (or Half) the number of Work hours

Multiplying the above and we get  $2 \times 3 \times 5$  entries = 30 scenarios. No one will ever remember Microsoft Project's behavior in all of these scenarios. We will start by trying them all just to take stock of what happens. We can then simplify them by dropping the duplicates, the overlaps and the useless combinations.

### A) Test the 30 Combinations

---

We can simplify our discussion by starting with 2 dimensions: Effort or Not Effort Driven AND the Task Type. These give us 6 combinations:

	Effort Driven	Not Effort Driven
Fixed Units	1 (Default)	2
Fixed Duration	3	4
Fixed Work	5	6

**Figure 6: The Six Combinations of the 2 Fields**

This is the heart of our Reverse Engineering exercise.

Use the project by downloading the file: [Work Formula - Scenarios TEMPLATE.mpt](#)

The 30 scenarios are grouped under the above 6 combinations and use the same color coding. Under each combination, you will find 5 scenarios as listed above.

### B) How to use the Work Formula Template?

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1. Open a new project using the Template and save it under any name
2. For each Task, apply the changes shown in the Task Name

3. When the Task says Double/Half, first double the factor and view its results.

Then undo the change (Control Z) and half the factor.

4. View the Smart Tags if they come up.

**Duration** and **Work** are shown as columns in the Task View. Change them directly in their columns. Smart Tags will show up if needed.

**Resources:** when using the split form, the Smart Tags do not come up. So avoid using it if you don't have to. Use the Task Information Box to modify or add/remove resources.

On completing the above, download and open the Excel Workbook

[Work Formula - Combinations.xls](#) so you can review the similarities in the combinations. The Excel Sheet has a test table to compare Scenarios with one another in different combinations.

### C) The Fixed Unit Combinations 1 and 2

Combination 1 - Effort Driven - Fixed Units							
Effort Driven?	Type	Work	=	Duration	x	Units	Task
Yes	Fixed Units			Decrease	←	Add	01
Yes	Fixed Units			Increase	←	Remove	02
Yes	Fixed Units			Decrease	←	Increase	03
Yes	Fixed Units			Increase	←	Decrease	03
Yes	Fixed Units	Increase	←	Increase			04
Yes	Fixed Units	Decrease	←	Decrease			04
Yes	Fixed Units	Increase	→	Increase			05
Yes	Fixed Units	Decrease	→	Decrease			05

Combination 2 - Non-Effort Driven - Fixed Units							
Effort Driven?	Type	Work	=	Duration	x	Units	Task
No	Fixed Units	Increase	←			Add	06
No	Fixed Units	Decrease	←			Remove	07
No	Fixed Units			Decrease	←	Increase	08
No	Fixed Units			Increase	←	Decrease	08
No	Fixed Units	Increase	←	Increase			09
No	Fixed Units	Decrease	←	Decrease			09
No	Fixed Units	Increase	→	Increase			10
No	Fixed Units	Decrease	→	Decrease			10

**Figure 7: All Scenarios for Fixed Units: Combinations 1 and 2**

1. In combination 1, the Add/Remove are the same as Increase/Decrease Units.

The reason is because for Effort Driven Tasks, adding resources is assumed to be of the same kind as existing resources. Therefore, new resources are treated the same as additional units. In both cases, the Duration will be decreased.

2. In combination 2, the Add/Remove are NOT the same as Increase/Decrease Units

This is critical. It means Microsoft Project differentiates between adding a new Unit and doubling an existing Unit. The reason for that is for Non-Effort Driven Tasks, Microsoft Project assumes that the Resources are different and do not "add up" to help each other. Therefore, adding a resource would increase work while doubling Units would make Combination 2 behave like combination 1, ie, decrease the Duration.

The rest of the scenarios are the same whether we have an Effort or a Non-Effort Driven Task.

This is the main reason for using Effort Driven when Units are Fixed as we will see in the next sub-section.

3. In the **special case** where Units are Increased/Decreased (because this is a Fixed Unit Task), Microsoft Project will change the Duration.

## D) The Fixed Duration Combinations 3 and 4

Combination 3 - Effort Driven - Fixed Duration							
Effort Driven?	Type	Work	=	Duration	x	Units	Task
Yes	Fixed Duration				?	Add	11
Yes	Fixed Duration				?	Remove	12
Yes	Fixed Duration	Increase			←	Increase	13
Yes	Fixed Duration	Decrease			←	Decrease	13
Yes	Fixed Duration	Increase	←	Increase			14
Yes	Fixed Duration	Decrease	←	Decrease			14
Yes	Fixed Duration	Increase	→			Increase	15
Yes	Fixed Duration	Decrease	→			Decrease	15

Combination 4 - Non-Effort Driven - Fixed Duration							
Effort Driven?	Type	Work	=	Duration	x	Units	Task
No	Fixed Duration	Increase			←	Add	16
No	Fixed Duration	Decrease			←	Remove	17
No	Fixed Duration	Increase			←	Increase	18
No	Fixed Duration	Decrease			←	Decrease	18
No	Fixed Duration	Increase	←	Increase			19
No	Fixed Duration	Decrease	←	Decrease			19
No	Fixed Duration	Increase	→			Increase	20
No	Fixed Duration	Decrease	→			Decrease	20

**Figure 8: All Scenarios for Fixed Duration: Combinations 3 and 4**

1. In combination 3, the Add/Remove are NOT the same as Increase/Decrease Units. Since this is Effort Driven and since Duration is Fixed, Microsoft Project is forced to change the Units. Adding a new Resource will cause Microsoft Project to change the units of the existing Resource. It resorts to cutting the existing resource by half and not responding to your request to add a whole new Resource. For example, you add 1 Resource to an existing 1 Resource and Microsoft Project will reduce both resources to 0.5 units to meet the constant Work and fixed Duration.
2. In combination 4, the Add/Remove are the same as Increase/Decrease Units  
  
The reason is because for Effort Driven Tasks, adding resources is assumed to be of the same kind as existing resources. Therefore, new resources are treated the same as additional units. In both cases, Work will be decreased (because this is a Fixed Duration Task).
3. The rest of the scenarios are the same whether we have an Effort or a Non-Effort Driven Task. This is the main reason for using Effort Driven when Duration is Fixed as we will see in the next sub-section.
4. In the **special case** where Duration is Increased/Decreased (because this is a Fixed Duration Task), Microsoft Project will change Work.

## E) The Fixed Work Combinations 5 and 6

Combination 5 - Effort Driven - Fixed Work							
Effort Driven?	Type	Work	=	Duration	x	Units	Task
Yes	Fixed Work			Decrease	←	Add	21
Yes	Fixed Work			Increase	←	Remove	22
Yes	Fixed Work			Decrease	←	Increase	23
Yes	Fixed Work			Increase	←	Decrease	23
Yes	Fixed Work			Increase	→	Decrease	24
Yes	Fixed Work			Decrease	→	Increase	24
Yes	Fixed Work	Increase	→	Increase			25
Yes	Fixed Work	Decrease	→	Decrease			25


  

Combination 6 - Non-Effort Driven - Fixed Work							
Effort Driven?	Type	Work	=	Duration	x	Units	Task
No	Fixed Work			Decrease	←	Add	26
No	Fixed Work			Increase	←	Remove	27
No	Fixed Work			Decrease	←	Increase	28
No	Fixed Work			Increase	←	Decrease	28
No	Fixed Work			Increase	→	Decrease	29
No	Fixed Work			Decrease	→	Increase	29
No	Fixed Work	Increase	→	Increase			30
No	Fixed Work	Decrease	→	Decrease			30

**Figure 9: All Scenarios for Fixed Work: Combinations 5 and 6**

1. When setting Fixed Work for any Task, Microsoft Project enables the Effort Driven check box and does not allow you to change it. This means that combinations 5 and 6 are both Effort Driven. That makes sense because Fixed Work means Effort Driven.

Therefore, 5 and 6 are identical in all scenarios.

 **Conclusion:** you need only consider combination 5.

2. In combination 5, the Add/Remove are the same as Increase/Decrease Units. This is based on the same logic discussed for Combination 1 earlier. Fixed Work means Resources help each other. Therefore, adding a New Resource or doubling the Units will result in the same effect: decreasing the Duration. In this situation, Combinations 1 and 5 are similar. However, they differ in other aspects as we will see.
3. In the **special case** where Work is Increased/Decreased (because this is a Fixed Work Task), Microsoft Project decided that Duration shall be changed.

## 5.0 Which Settings to use for Task Types and Effort Driven?

In this Section, we will try to develop a framework that will help us decide how to set the 2 fields for a specific Task: the **Effort Driven** box and the **Task Type**.

This Section starts with the Task Type. As we saw in the previous post, the Effort Driven setting **only has an effect** if you are adding or removing resources. In the cases where you are changing Duration, Work or Unit levels, the Effort Driven setting does not have any effect.

### What do we Estimate?

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**Without exception**, for each Task, you must start with one estimate of one of the 3 factors of the Work Formula. You either start by estimating Duration, Units or by computing the hours (days) of Work needed. This estimate would be based on:

- Experience with similar tasks
- Availability of resources
- Complexity of the work computation
- Contractual restrictions
- Etc

If you have a Task for which you have no estimate for the 3 factors, you are in trouble.

**General Guideline:** for a specific Task, if you are reasonably confident of the estimate of one of the 3 factors, and that such an estimate will remain constant during the project, then select the Task Type related to that factor. That estimate becomes the independent variable while the other two are the dependent on it.

## A) When to use Fixed Duration

This is the darling of most project managers. It is the simplest to estimate and to sell. But, it is not necessarily the most suitable or accurate.

**Use Fixed Duration** for Tasks when you are reasonably sure of your estimate of the Duration. Another condition is that the Duration can remain more or less constant while Units and Work might vary widely.

Therefore, in the Work Formula, the Duration is the **Independent Variable**. Find it and the rest will follow.

### Typical activities that invite the use of Fixed Duration:

- Contractual limitations on the Task
- Technical limitations on the Task (running a Transformer for x hours to test its environmental impact)
- Meetings, conferences, training sessions with preset duration
- The same Task is conducted by different resources on their own: peer review, audits, testing. Adding more resources will not change the Duration
- Schedule challenges or restrictions. Many Tasks are restricted because of what follows after them: you only have 2 weeks to finish Task A because Task B must start on...
- Tasks in between milestones. For example:

Task A: Design and approval (Must finish on 5 May)

Task B: Development of software

Task C: Testing cycle and approval (Must start on 30 November)

Both design and testing activities have milestones that are set the client. Development is normally a work driven task. However, being flanked by two Fixed Duration Tasks makes it difficult for the PM to let it be a Fixed Work Task.

The following flowchart shows you how to decide when to use Fixed Duration and whether to use the Effort Driven setting or not:

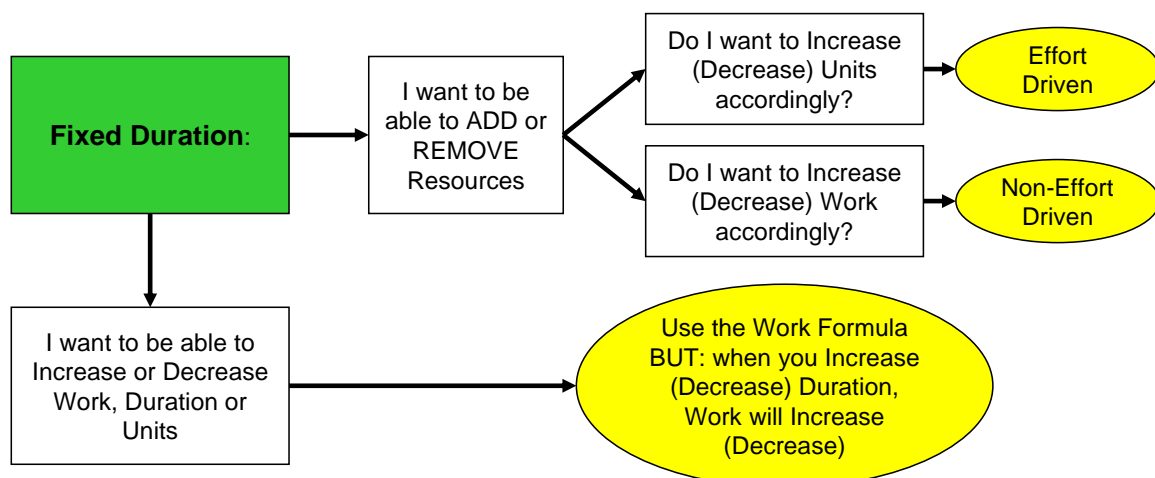


Figure 10: Decision Logic for Fixed Duration

## B) When to use Fixed Units

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In situations of limited resources, Units are often constant. For example, if you have a project where most of the resources are in your department, then you know almost certainly that you can only use 2 developers or 3 engineers.

**Use Fixed Units** for Tasks when you are reasonably sure of your estimate of the Units needed for the Task. Another condition is that the Unit levels should remain more or less constant while Duration and Work can vary widely.

Therefore, only when availability is clearly known can you use this setting.

Examples of known Unit availability:

- You only have 2 carpenters, do what you can do
- You have a preset number of members on the team for this particular project
- You know that a progress meeting will involve 7 members, no more and no less.

This situation invites the use of Fixed Units.

Other than that, it is difficult for a PM to start the Work Formula by asking: how many Units do I need? There is no objective answer to this question. If the answer says, it depends on what duration you have or what work is to be done, the Units are then not an **independent** variable. The number of resources is often the **Dependent Variable**: determine Work or Duration and Resources can be known

Again, if you ask: how many Units do I need, what you need is always capped by what is available. If availability is not clear, PMs will not start estimation by assessing the number of resources needed.

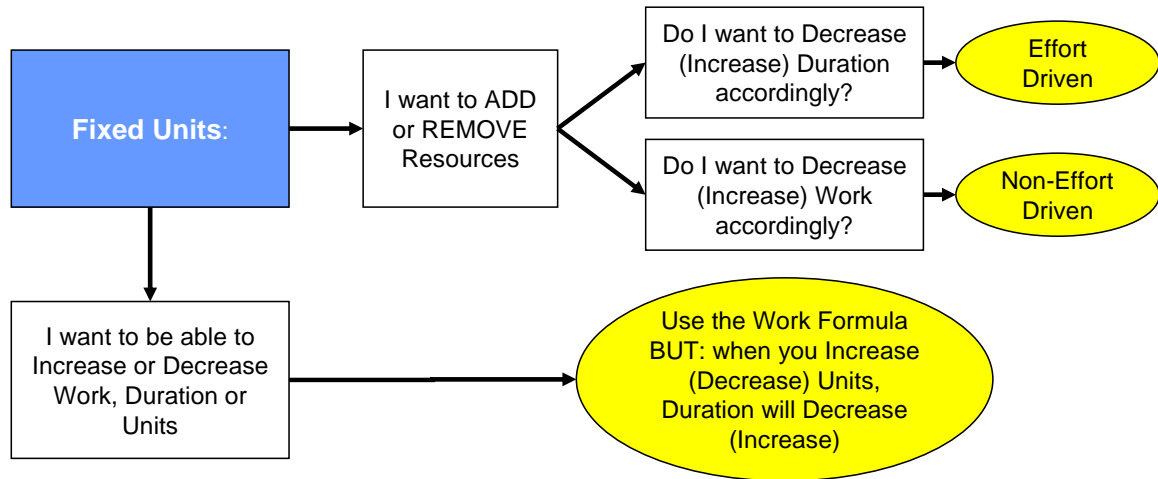
### **Typical activities that invite the use of Fixed Units:**

These are mostly in operational projects based on department work: the number of Units is constant or relatively stable. Examples of such activities are:

- Budget preparation
- Quality Assurance
- Refresher training
- Moving offices
- Supervision
- Management of tasks
- Progress reporting

In all these activities, we know the number of Units and so we can use the Units as the independent variable in the Work Formula.

The following flowchart shows you how to decide when to use Fixed Units and whether to use the Effort Driven setting or not:



**Figure 11: Decision Logic for Fixed Units**

### C) When to use Fixed Work

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**Fixed Work** is the nightmare of Project Managers. Behind every estimate of hours there is a hidden and complex computation which few Project Managers are willing to complete, verify, fight for or get peer reviewed. The easy way: pad the estimate or use last year's estimate. Both are not recommendable.

Understandably, a PM will shy away from using the Work hours as **the independent variable** in the Work Formula. Some of the reasons are:

- Most projects are one time jobs. The PM may not have the right data or framework to estimate the hours (or days) of work for a particular Task.
- In most sectors, there are no precise methods for computing such work hours. For years, the software industry tried that and failed. The exception is the construction industry (see below).
- The intrinsic assumption that the rule of 3 works: doubling the resources will half the duration. In most cases, this is not true. In some, or many, adding resources may delay work or may require additional supervision and related resources.
- Psychologically, if a PM requests 200 hours of work, he/she is stuck with that estimate because it becomes difficult to explain why additional work is needed. It is often easier to request more duration or more units than to request more hours of work.

However, there are exceptions. Some projects have linear Tasks that have a repetitive nature:

- Laying out a pipeline
- Building a highway
- Installing 750 A/C grills in 20 floors
- Testing 4000 cables
- Pouring 2000 cubic meters of concrete in the foundation of a building

The work is large but it is based on repeating a Task whose Work hours are simple to compute. It is not difficult for an engineer to estimate how many hours are required to install an A/C grill or test a cable or pour a cubic meter of concrete. This is where bottom up estimating shines.

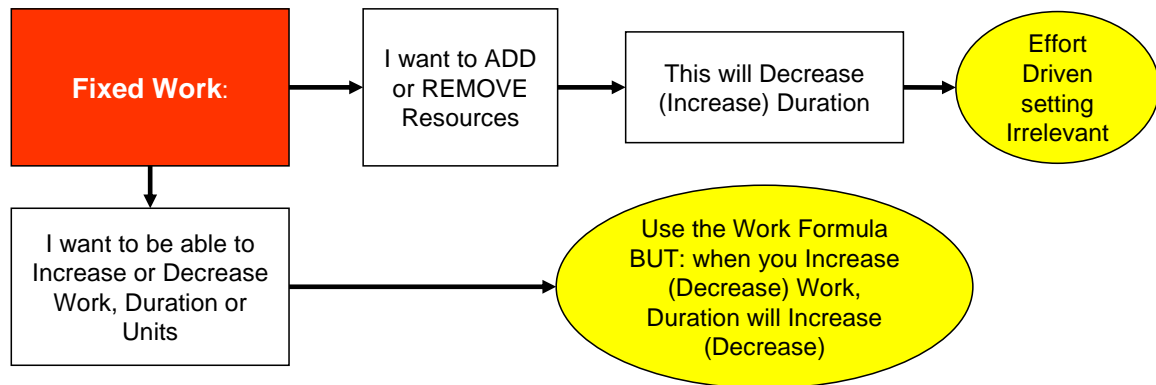
Such repetitive types of tasks invite the use of Fixed Work.

**Use Fixed Work** when:

1. Repetitive Tasks require the same type of resource:
  - Photocopying
  - Pouring concrete
  - Installing A/C grills
2. Tasks where you are sure that the **Rule of 3** actually when adding resources, ie, when adding a resource to a Task will result in an actual reduction of duration because the work is shared between the new set of resources.

Although the list seems short, yet it applies to a large number of Tasks in projects. However, there could be projects without a single Fixed Work Task. For example, a design project for a new power station is unlikely to have Tasks as described above.

The following flowchart shows you how to decide when to use Fixed Work and whether to use the Effort Driven setting or not:



**Figure 12: Decision Logic for Fixed Work**

## D) Effort Driven or NOT

As mentioned earlier, the Effort Driven setting **only affects** our scenarios if we are:

- Adding a new Resource to a Task
- Removing already assigned Resources from a Task

**Assumption:** behind Effort Driven Tasks is the assumption that the new Resource is of the same type as the existing resources.

If you review the Excel workbook [Work Formula - Combinations.xls](#) you can see all scenarios. Let us take the first 2 combinations (we reviewed in an earlier post):

Combination 1 - Effort Driven - Fixed Units							
Effort Driven?	Type	Work	=	Duration	x	Units	Task
Yes	Fixed Units			Decrease	←	Add	01
Yes	Fixed Units			Increase	←	Remove	02
Yes	Fixed Units			Decrease	←	Increase	03
Yes	Fixed Units			Increase	←	Decrease	03
Yes	Fixed Units	Increase	←	Increase			04
Yes	Fixed Units	Decrease	←	Decrease			04
Yes	Fixed Units	Increase	→	Increase			05
Yes	Fixed Units	Decrease	→	Decrease			05

Combination 2 - Non-Effort Driven - Fixed Units							
Effort Driven?	Type	Work	=	Duration	x	Units	Task
No	Fixed Units	Increase	←			Add	06
No	Fixed Units	Decrease	←			Remove	07
No	Fixed Units			Decrease	←	Increase	08
No	Fixed Units			Increase	←	Decrease	08
No	Fixed Units	Increase	←	Increase			09
No	Fixed Units	Decrease	←	Decrease			09
No	Fixed Units	Increase	→	Increase			10
No	Fixed Units	Decrease	→	Decrease			10

**Figure 13: Comparing Combinations 1 and 2 for Adding/Removing Resources**

You can see that the 2 combinations do not differ when it comes to the Effort Driven setting unless you are adding or removing resources. If you review the Excel workbook, there is on the right hand side a small table where a test checks whether scenarios in different combinations are the same or not. It shows that 1 and 2, then 3 and 4, do not differ unless you are adding or removing Resources. (Of course, for combinations 5 and 6, the Effort Driven setting is enabled for both).

The following table is a summary that shows how the setting of Effort Driven affects the different scenarios in the 4 combinations (ie, when adding or removing Resources). Same comment regarding 5 and 6 as in the previous paragraph.

Combination 1 - Effort Driven - Fixed Units							
Effort Driven?	Type	Work	=	Duration	x	Units	Task
Yes	Fixed Units			Decrease	←	Add	01
Yes	Fixed Units			Increase	←	Remove	02

Combination 2 - Non-Effort Driven - Fixed Units							
Effort Driven?	Type	Work	=	Duration	x	Units	Task
No	Fixed Units	Increase	←			Add	06
No	Fixed Units	Decrease	←			Remove	07

Combination 3 - Effort Driven - Fixed Duration							
Effort Driven?	Type	Work	=	Duration	x	Units	Task
Yes	Fixed Duration				?	Add	11
Yes	Fixed Duration				?	Remove	12

Combination 4 - Non-Effort Driven - Fixed Duration							
Effort Driven?	Type	Work	=	Duration	x	Units	Task
No	Fixed Duration	Increase	←			Add	16
No	Fixed Duration	Decrease	←			Remove	17

**Figure 14: Comparing 1, 2, 3 and 4 for Adding or Removing Resources**

Combinations 5 and 6 do not differ since Microsoft Project enables the setting and does not allow you to change it: because Fixed Work = Effort Driven in all cases.