9) Project planning (Part 2)

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Estimate costs

This process consists in estimating the **cost of resources** needed to successfully complete the project tasks and therefore the project itself.

Costs are expressed in numbers of **monetary units** (euros, pounds, dollars...).
Human resource costs may be initially measured in numbers of **work period units** (hours, days…) but of course they will eventually need to be converted into monetary units in order to establish the budget of the project.

Cost estimates may be refined as the project moves forward and more details become available.

The result of the cost estimates, as well as the budget, may be presented in various formats, usually in a spreadsheet or in a document produced with a project management application (eg MS Project or ProjectLibre). The use of **standard templates** may be required in certain organizations or circumstances.
The detailed **estimates may be summarized in a cost document** showing costs per type of resource and per task or work package.

In the case of projects that extend over a long period, say more than a year, **inflation** may need to be taken into consideration, in particular for labour costs (salaries may indeed evolve more or less in proportion to inflation).

Likewise, any foreseeable increase or decrease of the **cost of materials**, if any, should be factored in (eg hardware may cost less in year 2 than it does in year 1, so the total amount of a project's **bill of materials** ("BOM") may be significantly reduced).

The cost document should also include all **assumptions** that have been made, as well as known **constraints and risks** that may have an impact on costs.

Certain costs may incorporate a "**contingency reserve**" (or "**contingency allowance**") to take into account any changes that may result from the realization of potential risks identified in the planning process. The reserve may be a percentage of the initial cost estimate or a fixed amount. Contingency reserves should be clearly documented.

Below is a **non-exhaustive list of cost elements** to be taken into consideration.

- **Labour**, for which costs are derived on a pro-rata basis from gross salaries, bonuses, social contributions paid by the employer, perquisites (benefits in kind) and possible end-of-project awards.
- **Overhead**, generally expressed as a percentage of gross labour costs, corresponding to a share of the cost of company-wide or department-wide services such as HR, Finance, Facilities, Marketing, General Management, etc.
- **Hiring** (job posting, recruitment agency services, etc.).
- **Offices** (building, floor space, furniture, utilities including communications), if not already included in the overhead costs.
- **Workstations** (computers and software licences).
- **Servers** (hardware and software licences).
- **Other equipment** (printers, scanners, audiovisual equipment, tools, etc.).
- **Supplies/consumables** (paper, pens, ink cartridges, CD/DVD-ROMs, etc.).
- **Materials** (eg hardware that may be required to build a prototype).
- **Documentation** (reference books, subscriptions to online services, etc.).

- **Competitors' products** (software, online service, etc.).
- **Multimedia assets** (acquisition of rights for elements of content of a product).
- **Travel** (transport, accommodation, food).
- **Events** (eg special, exceptional off-site meetings: venue rental, breaks, meals, etc.).
- **Services** (staff training, brainstorming coach/facilitator, hosting service, etc.).
- **Consultancy** (specific expertise, legal advice and support, accounts auditing, etc.).
- **Contractors** (writing, proofreading, translation, graphic design, software development, testing, etc.).

It may make sense to rent equipment (eg computers) for the duration of certain tasks (eg testing) and/or for the duration of temporary staff contracts. A "**rent or buy**" evaluation should therefore be made as part of the cost estimation process.
Likewise, it may be more cost-effective to **subcontract** certain tasks (eg graphic design, testing) than to perform them in-house. A "**make or buy**" evaluation should therefore be made for such tasks.

The PM may need help from a financial controller to estimate costs. For example, "**overhead**", as mentioned in the above list, is often a percentage of gross labour costs, such percentage being calculated and provided by the Finance department (or the Human Resources department).
However, the PM usually needs to do much of the estimating himself, using whatever sources of information are available, which may require a fair amount of research.

The following spreadsheet provides an **example** of the rough calculation of the **cost (in euros) per day of a salaried employee in France**, taking into account the gross annual salary, the employer's social contributions, a standard overhead rate and the actual number of working days in a year. The cost per day is calculated by dividing the total annual cost by the number of actual workdays in a year.

Weeks per year	52
Days per year excluding weekends	260
Public holidays	10
Total potential workdays	250
Vacation days	30
Total actual workdays in a year	**220**
Gross annual salary	**36,000**
Employer's social contributions (%)	50%
Employer's social contributions	18,000
Annual cost excluding overhead	54,000
Overhead (%)	33%
Overhead	17,820
Annual cost including overhead	71,820
Total cost / gross salary	*2*
Cost per day of work	**326**

The part of an employee's **cost that cannot be allocated directly to a project** (or several projects) over a given period needs to be included in the organization's overhead.
It is also common practice to take into account "**idle time**", ie a fraction of the standard number of work hours during which no work is actually done (breaks, etc.), so the theoretical cost per day of work needs to be increased by some percentage, eg 10%.

In France, a **quick estimate of cost per day** including approximately 9% idle time can be obtained **by dividing the gross annual salary by 100**.

The **cost of contractors** (eg freelances) is often calculated on the basis of a fixed amount per day, but it may be a flat fee negotiated for a given period (the average cost per day hopefully being lower than the "standard" cost as a result of the negotiation…).

Note that contractor fees as well as other costs are always quoted "excluding tax". Value-added tax ("VAT") does not need to be taken into account for the estimation of project costs, except if VAT cannot be reclaimed (if in doubt, check with your Accounting/Finance department…).

Converting human resource costs expressed in work period units into costs expressed in monetary units is done automatically by project management applications based on workload information (eg number of person-days per task) and on monetary cost information (eg amount per resource per day) provided in a "**Resource sheet**", as shown in the following illustrations for project EXONE.

- Project EXONE – Contractor's resource sheet:

Resource Name	Type	Max. Units	Std. Rate
PM	Work	100%	€ 500.00/day
STC	Work	100%	€ 450.00/day
JTC	Work	100%	€ 350.00/day
DVPR1	Work	100%	€ 400.00/day
DVPR2	Work	100%	€ 350.00/day
TSTR1	Work	100%	€ 300.00/day
TSTR2	Work	100%	€ 300.00/day
CLT	Work	100%	€ 0.00/day
TRAVEL	Cost		

Note that the "Standard Rate" for the client (CLT) has been set to 0 in this example in order to restrict the calculation of costs to the contractor's resources and work.

- Project EXONE – Gantt table view featuring the contractor's costs:

	WBS	Task Name	Predecessors	Resource Names	Duration	Start	Finish	Work	Cost
1	**1**	**PROJECT EXONE**			**65 days**	**03/01/17**	**03/04/17**	**177 days**	**€ 65,225.00**
2	**1.1**	**REQUIREMENTS**			**4 days**	**03/01/17**	**06/01/17**	**14 days**	**€ 4,550.00**
3	1.1.1	Review and complete requirements & plan with client		STC;DVPR1;CLT;PM	3 days	03/01/17	05/01/17	12 days	€ 4,050.00
4	1.1.2	Final discussion and agreement with client on req'ts & plan	3	CLT;PM	1 day	06/01/17	06/01/17	2 days	€ 500.00
5	**1.2**	**DESIGN**			**11 days**	**09/01/17**	**23/01/17**	**26 days**	**€ 10,350.00**
6	1.2.1	Write design specifications	4	DVPR1;STC	7 days	09/01/17	17/01/17	14 days	€ 5,950.00
7	1.2.2	Check design with respect to requirements	6	DVPR1;STC;PM[50%]	2 days	18/01/17	19/01/17	5 days	€ 2,200.00
8	1.2.3	Meet with client to discuss & agree on design	7	STC;PM[50%];DVPR1;CLT	2 days	20/01/17	23/01/17	7 days	€ 2,200.00
9	**1.3**	**IMPLEMENTATION**			**46 days**	**24/01/17**	**28/03/17**	**61 days**	**€ 22,800.00**
10	1.3.1	Coding - Alpha version	8	DVPR2;DVPR1	7 days	24/01/17	01/02/17	14 days	€ 5,250.00
11	1.3.2	Debugging phase 1 (following internal Alpha testing)	27;10	DVPR2;DVPR1	3 days	06/02/17	08/02/17	6 days	€ 2,250.00
12	1.3.3	Production of Alpha version and delivery to client	22	DVPR2	1 day	10/02/17	10/02/17	1 day	€ 350.00
13	1.3.4	Debugging phase 2 (following client Alpha testing)	28	DVPR1;DVPR2	2 days	15/02/17	16/02/17	4 days	€ 1,500.00
14	1.3.5	Coding - Beta version	13	DVPR2;DVPR1	8 days	17/02/17	28/02/17	16 days	€ 6,000.00
15	1.3.6	Debugging phase 3 (following internal Beta testing)	29;14	DVPR2;DVPR1	3 days	02/03/17	06/03/17	6 days	€ 2,250.00
16	1.3.7	Production of Beta version and delivery to client	24	DVPR2	1 day	09/03/17	09/03/17	1 day	€ 350.00
17	1.3.8	Debugging phase 4 (following client Beta testing)	30	DVPR1;DVPR2	4 days	16/03/17	21/03/17	8 days	€ 3,000.00
18	1.3.9	Production of Final version and delivery to client	17	DVPR2	1 day	22/03/17	22/03/17	1 day	€ 350.00
19	1.3.10	Debugging phase 5 & delivery (following client Final testing)	31	DVPR2;DVPR1	2 days	27/03/17	28/03/17	4 days	€ 1,500.00
20	**1.4**	**INTEGRATION**			**23 days**	**06/02/17**	**08/03/17**	**5 days**	**€ 1,050.00**
21	1.4.1	Delivery of content subset by client	11FF-2 days	CLT	1 day	06/02/17	06/02/17	1 day	€ 0.00
22	1.4.2	Integration of content subset	21;11	DVPR2	1 day	09/02/17	09/02/17	1 day	€ 350.00
23	1.4.3	Delivery of complementary content by client	15FF-2 days	CLT	1 day	02/03/17	02/03/17	1 day	€ 0.00
24	1.4.4	Integration of complementary content	23;15	DVPR2	2 days	07/03/17	08/03/17	2 days	€ 700.00
25	**1.5**	**TESTING & ACCEPTANCE**			**47 days**	**24/01/17**	**29/03/17**	**32.5 days**	**€ 7,675.00**
26	1.5.1	Prepare test plan and test cases	8	STC[50%];JTC	5 days	24/01/17	30/01/17	7.5 days	€ 2,875.00
27	1.5.2	Internal testing - Alpha version	10SS+3 days;26	TSTR1;TSTR2	4 days	31/01/17	03/02/17	8 days	€ 2,400.00
28	1.5.3	Alpha testing by client	12	CLT	2 days	13/02/17	14/02/17	2 days	€ 0.00
29	1.5.4	Internal testing - Beta version	14SS+5 days	TSTR1;TSTR2	4 days	24/02/17	01/03/17	8 days	€ 2,400.00
30	1.5.5	Beta testing by client	16	CLT	4 days	10/03/17	15/03/17	4 days	€ 0.00
31	1.5.6	Final testing by client	18	CLT	2 days	23/03/17	24/03/17	2 days	€ 0.00
32	1.5.7	Acceptance by client	19	CLT	1 day	29/03/17	29/03/17	1 day	€ 0.00
33	**1.6**	**DEPLOYMENT AT CLIENT'S SITE**	32	DVPR2;JTC;TRAVEL[€ 750.00]	**2 days**	**30/03/17**	**31/03/17**	**4 days**	**€ 2,150.00**
34	**1.7**	**PROJECT MANAGEMENT (After Req'ts WP & before Closure)**	2;33FF	PM[50%]	**60 days**	**09/01/17**	**31/03/17**	**30 days**	**€ 15,000.00**
35	**1.8**	**PROJECT CLOSURE**	34	DVPR1;PM;STC;TSTR1;CLT[50%]	**1 day**	**03/04/17**	**03/04/17**	**4.5 days**	**€ 1,650.00**

- Project EXONE – Client's resource sheet:

Resource Name	Type	Max. Units	Std. Rate
OPM	Work	100%	€ 450.00/day
EDTR1	Work	100%	€ 300.00/day
EDTR2	Work	100%	€ 300.00/day
EDTR3	Work	100%	€ 300.00/day
EDTR4	Work	100%	€ 300.00/day
DATENG	Work	100%	€ 400.00/day
PRFRDR1	Work	100%	€ 250.00/day
PRFRDR2	Work	100%	€ 250.00/day
TSTSP	Work	100%	€ 350.00/day
CTR	Work	100%	€ 0.00/day
CTR_COST	Cost		
HW	Material		€ 3,000.00
MMLIC	Material		€ 2,000.00
TRAVEL	Cost		

Note that the "Standard Rate" for the contractor (CTR) has been set to 0 in this example in order to restrict the calculation of costs to the client's resources and work.

- Project EXONE – Gantt table view featuring the client's costs:

	WBS	Task Name	Predecessors	Resource Names	Duration	Start	Finish	Work	Cost
1	**1**	**PROJECT EXONE**			**66 days**	**03/01/17**	**04/04/17**	**200 days**	**€ 145,734.00**
2	**1.1**	**REQUIREMENTS**			**4 days**	**03/01/17**	**06/01/17**	**11 days**	**€ 4,000.00**
3	1.1.1	Review and complete requirements & plan with contractor		CTR;OPM;DATENG;TRAVEL[€ 1,000.00]	3 days	03/01/17	05/01/17	9 days	€ 3,550.00
4	1.1.2	Final discussion and agreement with contractor on req'ts & plan	3	CTR;OPM	1 day	06/01/17	06/01/17	2 days	€ 450.00
5	**1.2**	**SOFTWARE DESIGN**			**11 days**	**09/01/17**	**23/01/17**	**12 days**	**€ 850.00**
6	1.2.1	Write and check design specifications	4	CTR	9 days	09/01/17	19/01/17	9 days	€ 0.00
7	1.2.2	Meet with contractor to discuss & agree on design	6	OPM[50%];CTR;TRAVEL[€ 400.00]	2 days	20/01/17	23/01/17	3 days	€ 850.00
8	**1.3**	**SOFTWARE IMPLEMENTATION**			**46 days**	**24/01/17**	**28/03/17**	**35 days**	**€ 0.00**
9	1.3.1	Coding, internal testing & bug fixing - Alpha version	7	CTR	12 days	24/01/17	08/02/17	12 days	€ 0.00
10	1.3.2	Delivery of Alpha version by contractor	21	CTR	1 day	10/02/17	10/02/17	1 day	€ 0.00
11	1.3.3	Debugging following Alpha testing	28	CTR	2 days	15/02/17	16/02/17	2 days	€ 0.00
12	1.3.4	Coding, internal testing & bug fixing - Beta version	11	CTR	12 days	17/02/17	06/03/17	12 days	€ 0.00
13	1.3.5	Delivery of Beta version by contractor	25;12	CTR	1 day	09/03/17	09/03/17	1 day	€ 0.00
14	1.3.6	Debugging following Beta testing	29	CTR	4 days	16/03/17	21/03/17	4 days	€ 0.00
15	1.3.7	Delivery of Final version by contractor	14	CTR	1 day	22/03/17	22/03/17	1 day	€ 0.00
16	1.3.8	Debugging following Final testing & delivery for acceptance	30	CTR	2 days	27/03/17	28/03/17	2 days	€ 0.00
17	**1.4**	**CONTENT CREATION & INTEGRATION**			**32 days**	**24/01/17**	**08/03/17**	**69 days**	**€ 19,800.00**
18	1.4.1	Creation of content subset	7	EDTR1;EDTR2;EDTR3;EDTR4	6 days	24/01/17	31/01/17	24 days	€ 7,200.00
19	1.4.2	Proofreading of content subset	18SS+4 days	PRFRDR1;PRFRDR2	3 days	30/01/17	01/02/17	6 days	€ 1,500.00
20	1.4.3	Preparation of content subset & delivery to contractor	9FF-2 days;19	DATENG	3 days	02/02/17	06/02/17	3 days	€ 1,200.00
21	1.4.4	Integration of content subset	20;9	CTR	1 day	09/02/17	09/02/17	1 day	€ 0.00
22	1.4.5	Creation of complementary content	28	EDTR1;EDTR2;EDTR3;EDTR4	6 days	15/02/17	22/02/17	24 days	€ 7,200.00
23	1.4.6	Proofreading of complementary content	22SS+4 days	PRFRDR1;PRFRDR2	3 days	21/02/17	23/02/17	6 days	€ 1,500.00
24	1.4.7	Preparation of complementary content & delivery to contractor	12FF-2 days;23	DATENG	3 days	28/02/17	02/03/17	3 days	€ 1,200.00
25	1.4.8	Integration of complementary content	24;12	CTR	2 days	07/03/17	08/03/17	2 days	€ 0.00
26	**1.5**	**TESTING & ACCEPTANCE**			**41 days**	**01/02/17**	**29/03/17**	**33.5 days**	**€ 10,375.00**
27	1.5.1	Prepare test plan and test cases	18	EDTR1;EDTR2	4 days	01/02/17	06/02/17	8 days	€ 2,400.00
28	1.5.2	Alpha testing	10;27	EDTR3;EDTR4	2 days	13/02/17	14/02/17	4 days	€ 1,200.00
29	1.5.3	Beta testing	13	EDTR3;EDTR4;TSTSP	4 days	10/03/17	15/03/17	12 days	€ 3,800.00
30	1.5.4	Final testing	15	EDTR3;EDTR4;TSTSP[50%]	2 days	23/03/17	24/03/17	5 days	€ 1,550.00
31	1.5.5	Acceptance	16	OPM[50%];EDTR1;EDTR2;EDTR3;EDTR4	1 day	29/03/17	29/03/17	4.5 days	€ 1,425.00
32	**1.6**	**DEPLOYMENT**	31	CTR	**2 days**	**30/03/17**	**31/03/17**	**2 days**	**€ 0.00**
33	**1.7**	**PROJECT MANAGEMENT (After Req'ts WP & before Closure)**	2;32FF	OPM[50%]	**60 days**	**09/01/17**	**31/03/17**	**30 days**	**€ 13,500.00**
34	**1.8**	**CONTRACTOR'S PROJECT CLOSURE**	33	OPM[50%];CTR;TRAVEL[€ 250.00]	**1 day**	**03/04/17**	**03/04/17**	**1.5 days**	**€ 475.00**
35	**1.9**	**OVERALL PROJECT CLOSURE**	34	DATENG;EDTR1;EDTR3;OPM;EDTR2;EDTR4	**1 day**	**04/04/17**	**04/04/17**	**6 days**	**€ 2,050.00**
36	1.10	COST OF WORK DONE BY CONTRACTOR		CTR_COST[€ 89,684.00]				0 days	€ 89,684.00
37	1.11	OTHER NON-LABOUR COSTS		HW[1];MMLIC[1]				0 days	€ 5,000.00

As illustrated above, **non-labour resources and corresponding costs** can be featured in a plan produced with an application such as MS Project (or ProjectLibre).
With MS Project, resources of type "**Material**", such as "HW" (for hardware), are given a unit value in the Resource sheet and a number of units in the Gantt view of the plan, whereas resources of type "**Cost**", such as "TRAVEL", are not given any value in the Resource sheet, so a value needs to be assigned to them in the Gantt view of the plan so that their costs are included in the total cost of the project.

In the above example, "TRAVEL" has been assigned to certain "real" tasks, whereas other non-labour resources have been assigned to "dummy" tasks listed after "OVERALL PROJECT CLOSURE", in particular "CTR_COST", whose value is the price quoted by the contractor for the work done for the client on project EXONE (as explained further on).

The following illustrations are examples of how to feature the costs of resources in a plan produced with a spreadsheet application.

PROJECT EXONE CONTRACTOR'S RESOURCES & COSTS	RESOURCES	DUR'NS	COSTS
		65	€ 65,225
REQUIREMENTS		4	€ 4,550
Review and complete requirements & plan with client	STC;DVPR1;PM;CLT	3	€ 4,050
Final discussion and agreement with client on req'ts & plan	PM;CLT	1	€ 500
DESIGN		11	€ 10,350
Write design specifications	DVPR1;STC	7	€ 5,950
Check design with respect to requirements	DVPR1;STC;PM[50%]	2	€ 2,200
Meet with client to discuss & agree on design	DVPR1;STC;PM[50%];CLT	2	€ 2,200
IMPLEMENTATION		46	€ 22,800
Coding - Alpha version	DVPR1;DVPR2	7	€ 5,250
Debugging phase 1 (following internal Alpha testing)	DVPR1;DVPR2	3	€ 2,250
Production of Alpha version and delivery to client	DVPR2	1	€ 350
Debugging phase 2 (following client Alpha testing)	DVPR1;DVPR2	2	€ 1,500
Coding - Beta version	DVPR1;DVPR2	8	€ 6,000
Debugging phase 3 (following internal Beta testing)	DVPR1;DVPR2	3	€ 2,250
Production of Beta version and delivery to client	DVPR2	1	€ 350
Debugging phase 4 (following client Beta testing)	DVPR1;DVPR2	4	€ 3,000
Production of Final version and delivery to client	DVPR2	1	€ 350
Debugging phase 5 & delivery (following client Final testing)	DVPR1;DVPR2	2	€ 1,500
INTEGRATION		23	€ 1,050
Delivery of content subset by client	CLT	1	€ 0
Integration of content subset	DVPR2	1	€ 350
Delivery of complementary content by client	CLT	1	€ 0
Integration of complementary content	DVPR2	2	€ 700
TESTING & ACCEPTANCE		47	€ 7,675
Prepare test plan and test cases	STC[50%];JTC	5	€ 2,875
Internal testing - Alpha version	TSTR1;TSTR2	4	€ 2,400
Alpha testing by client	CLT	2	€ 0
Internal testing - Beta version	TSTR1;TSTR2	4	€ 2,400
Beta testing by client	CLT	4	€ 0
Final testing by client	CLT	2	€ 0
Acceptance by client	CLT	1	€ 0
DEPLOYMENT AT CLIENT'S SITE	DVPR2;JTC;TRAVEL	2	€ 2,150
PROJECT MGMNT (After Req'ts WP & before Closure)	PM[50%]	60	€ 15,000
PROJECT CLOSURE	DVPR1;STC;TSTR1;PM;CLT[50%]	1	€ 1,650

HUMAN RSRCs	Costs/day
PM	€ 500
STC	€ 450
JTC	€ 350
DVPR1	€ 400
DVPR2	€ 350
TSTR1	€ 300
TSTR2	€ 300
CLT	€ 0

OTHER COST ITEMS	Costs
TRAVEL	€ 750

PROJECT EXONE CLIENT'S RESOURCES & COSTS	RESOURCES	DUR'NS	COSTS
		66	€ 145,734
REQUIREMENTS		4	€ 4,000
Review and complete requirements & plan with contractor	OPM;DATENG;CTR;TRAVEL1	3	€ 3,550
Final discussion and agreement with contractor on req'ts & plan	OPM;CTR	1	€ 450
SOFTWARE DESIGN		11	€ 850
Write and check design specifications	CTR	9	€ 0
Meet with contractor to discuss & agree on design	OPM[50%];CTR;TRAVEL2	2	€ 850
SOFTWARE IMPLEMENTATION		46	€ 0
Coding, internal testing & bug fixing - Alpha version	CTR	12	€ 0
Delivery of Alpha version by contractor	CTR	1	€ 0
Debugging following Alpha testing	CTR	2	€ 0
Coding, internal testing & bug fixing - Beta version	CTR	12	€ 0
Delivery of Beta version by contractor	CTR	1	€ 0
Debugging following Beta testing	CTR	4	€ 0
Delivery of Final version by contractor	CTR	1	€ 0
Debugging following Final testing & delivery for acceptance	CTR	2	€ 0
CONTENT CREATION & INTEGRATION		43	€ 19,800
Creation of content subset	EDTR1;EDTR2;EDTR3;EDTR4	6	€ 7,200
Proofreading of content subset	PRFRDR1;PRFRDR2	3	€ 1,500
Preparation of content subset & delivery to contractor	DATENG	3	€ 1,200
Integration of content subset	CTR	1	€ 0
Creation of complementary content	EDTR1;EDTR2;EDTR3;EDTR4	6	€ 7,200
Proofreading of complementary content	PRFRDR1;PRFRDR2	3	€ 1,500
Preparation of complementary content & delivery to contractor	DATENG	3	€ 1,200
Integration of complementary content	CTR	2	€ 0
TESTING & ACCEPTANCE		38	€ 10,375
Prepare test plan and test cases	EDTR1;EDTR2	4	€ 2,400
Alpha testing	EDTR3;EDTR4	2	€ 1,200
Beta testing	EDTR3;EDTR4;TSTSP	4	€ 3,800
Final testing	EDTR3;EDTR4;TSTSP[50%]	2	€ 1,550
Acceptance	EDTR1;EDTR2;EDTR3;EDTR4;OPM[50%]	1	€ 1,425
DEPLOYMENT	CTR	2	€ 0
PROJECT MGMNT (After Req'ts WP & before Closure)	OPM[50%]	60	€ 13,500
CONTRACTOR'S PROJECT CLOSURE	OPM[50%];CTR;TRAVEL3	1	€ 475
OVERALL PROJECT CLOSURE	OPM;DATENG;EDTR1;EDTR2;EDTR3;EDTR4	1	€ 2,050
	CTR_COST;HW;MMLIC		€ 94,684

HUMAN RSRCs	Costs/day
OPM	€ 450
EDTRs	€ 300
DATENG	€ 400
PRFRDRs	€ 250
TSTSP	€ 350
CTR	€ 0

OTHER COST ITEMS	Costs
CTR_COST	€ 89,684
HW	€ 3,000
MMLIC	€ 2,000
TRAVEL1	€ 1,000
TRAVEL2	€ 400
TRAVEL3	€ 250

Determine the budget

The budget of the project is determined by **adding up all estimated costs**.

The budget, which represents the total amount of funds required for the project to be successfully completed, should be officially **approved by the project sponsor**.

If the budget amounts to more than had been authorized in the project charter, the sponsor may approve the corresponding extension to the budget or request that it should be aligned with the initial estimate. In the latter case, the project plan will need to be reworked.

Individual task costs generally do not require formal approval. In some cases however, the budget for work packages with a significant cost may require such an approval.

The **authorized budget** is the **baseline** for the evaluation of the project's "**cost performance**".

In addition to the contingency reserves that may have been included in the cost estimates, the budget may incorporate a "**management reserve**", ie a percentage or a lump sum added to the total cost estimate to provide for any possible cost increase due to "**imponderables**". The management reserve should be clearly documented.

If **funding** can be (or has to be) **staged**, a corresponding view of the budget should be provided in order to show the funding requirements for each stage of the project. A stage may be a phase of the project or a time period (eg month, quarter, year).

As mentioned in chapter 6 ("P&L"), a budget (or price) established by a contractor (or subcontractor) for the execution of part of a client's project generally includes a **profit margin**. The absolute value of the profit margin is added to the total cost of the work executed by the contractor.

When expressed as a percentage, the margin is calculated by convention in relation to the price of the work, not to its cost.

As for the mark-up percentage, it is calculated in relation to the cost of the work, not to its price. Of course, the absolute values of the margin and the mark-up are identical. (For details, return to chapter 6, section "Margin vs Mark-up".)

For example, if the total cost is estimated at 100,000 euros and the required profit margin is 20%, the price should amount to 125,000 euros, the result of 100,000/0.8, as per the following formula: Price = Cost / (1 - Margin%).

If that price is accepted, the client will pay 125,000 euros to the contractor, which will cover the contractor's cost of 100,000 euros and provide the contractor with a profit margin of 25,000 euros (which is what was required, ie 20% of 125,000 euros).
In other words, the contractor applies a 25% "mark-up" to costs in order to include a 20% profit margin in the price to be paid by the client (100,000 x 1.25 = 125,000).

Below are two spreadsheets that provide **examples of summary budgets**.

- Project EXONE – Contractor's budget:

Project EXONE: contractor's budget	
Estimated cost of project	**€ 65,225**
Management reserve (10% of estimated cost)	€ 6,523
Total cost of project	**€ 71,748**
Mark-up% (% of total cost of project)	25%
Mark-up amount	€ 17,937
BUDGET (price to be paid by the client)	**€ 89,684**
Profit margin amount	€ 17,937
Profit margin % (% of budget/price)	20%

The price of the contractor's work, 89,684 euros, includes a 20% profit margin for the contractor, which is equivalent to a 25% mark-up applied to the contractor's total cost estimate of 71,748 euros (65,225 euros plus a 10% "Management reserve").

- Project EXONE – Client's budget:

Project EXONE: client's budget	
Internal costs	
Pre-3/1/17: Req'ts writing + Contractor selection	€ 4,500
3/1/17 through to 4/4/17	€ 44,650
Total Internal costs	**€ 49,150**
External & other costs	
Software development	€ 89,684
Content proofreading	€ 3,000
Product testing (beta & final)	€ 1,750
Server and software	€ 3,000
Multimedia asset licences	€ 2,000
Travel	€ 1,650
Total External & other costs	**€ 101,084**
TOTAL Cost	**€ 150,234**
Management reserve (10% of total cost)	€ 15,023
BUDGET	**€ 165,257**

In the client's budget, the cost of "Software development" is the price quoted by the contractor (89,684 euros) for its work on project EXONE. This budget also includes costs incurred by the client for writing the requirements specification and selecting a contractor, both of these tasks having been performed before the start date featured in the EXONE project plan.

Note that, as in the example above, costs are often broken down into "Internal costs" and "External (& other) costs".

Develop the human resource plan

This process, which uses the estimate of task resources as primary input, should identify the **skills and number of persons** required to successfully complete the corresponding project tasks. The human resource plan should also define the **organization of the project team**, in the form of a chart and/or matrix.

An example of organization chart is provided in chapter 10 ("The project team").

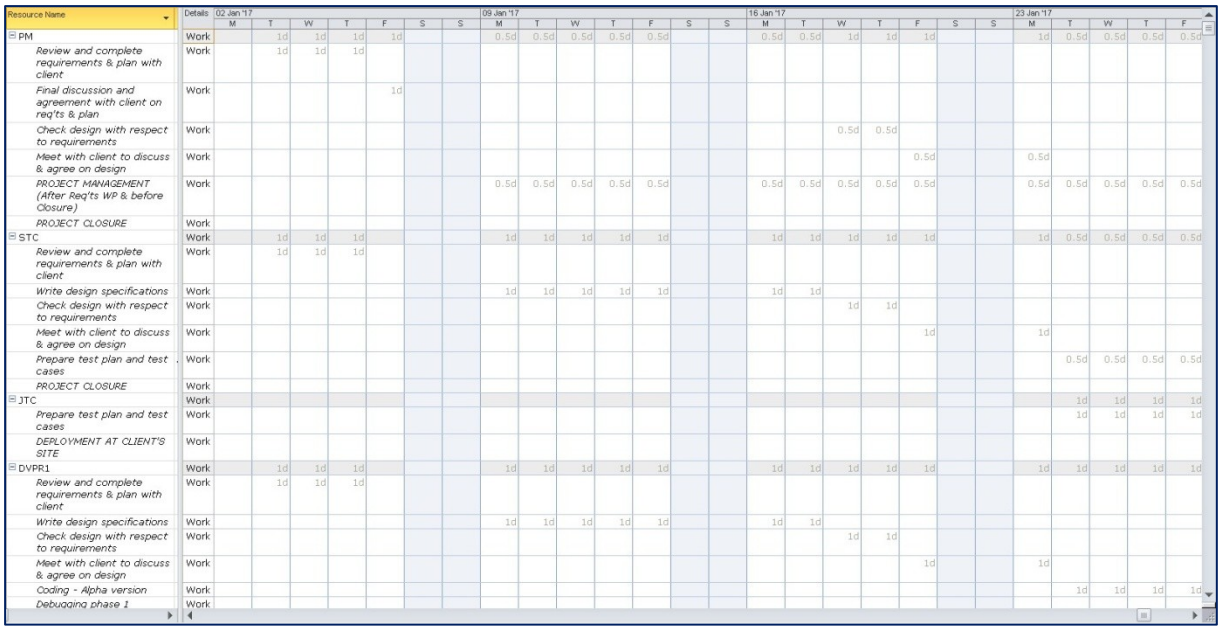
For each team member (not necessarily identified by name at this stage of the planning process), the following information should be documented:

- **role** (or function), for example consultant, developer, editor, tester;
- **position** in the organization, for example subproject manager;
- **responsibility**: the work to be performed;
- **competency**: the skills required to perform the work;
- **authority**: the degree of freedom (with set boundaries) for decision-making in areas such as resource assignment, methodology, quality control, communication.

The process should result in a "**staffing management plan**", indicating how staff will be acquired and featuring a **schedule for staff acquisition and release**, as well as requirements for training, team-building, etc. That schedule and those requirements obviously have a direct impact on the project's budget.

Some of the people required for the project may already be "on board", and some may not be available or not needed full-time (they may alternate between different projects).

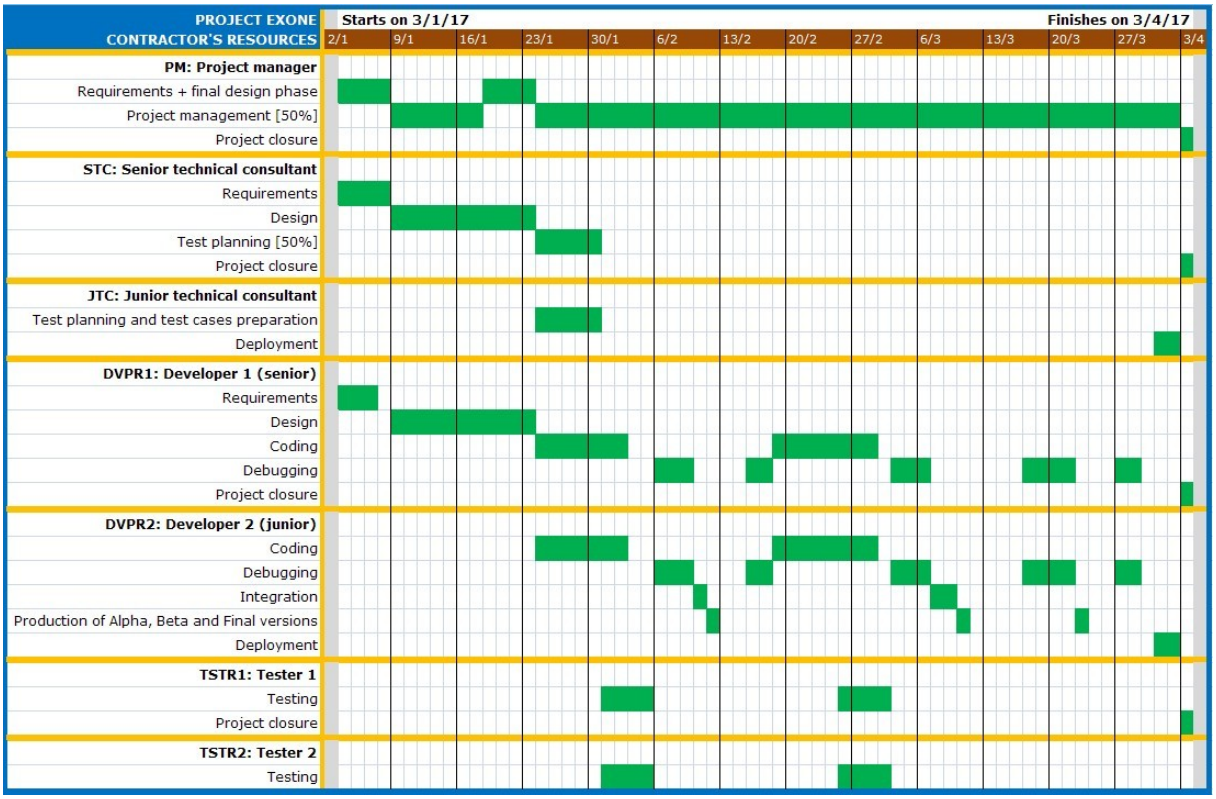
The "**Resource usage**" feature of MS Project (or ProjectLibre) provides details of resources assigned to a project and the periods during which each person is busy on the project, as shown below for part of the contractor's work on project EXONE.

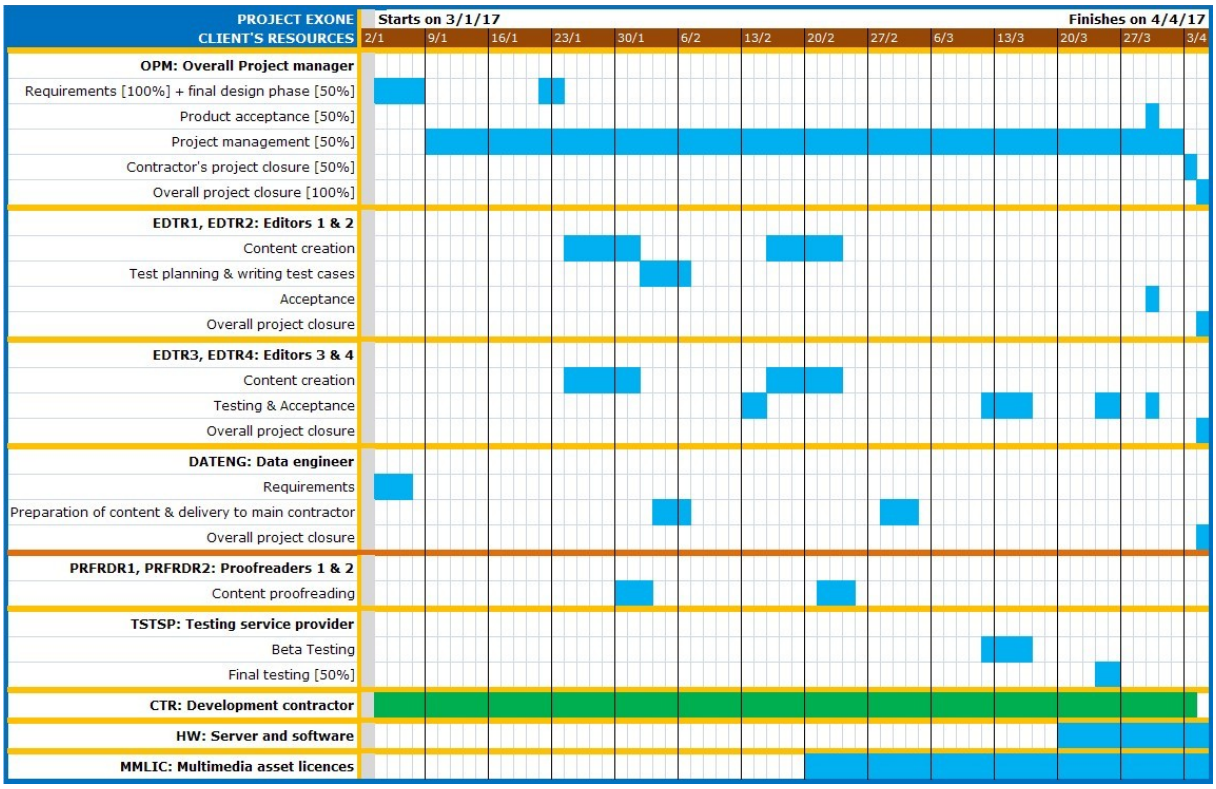


Any resource overload will be flagged by the software in the Resource usage view, which is of course very useful and should lead to modifying resource assignment in order to avoid any such overload.

Since MS Project (or ProjectLibre) provides a view that may extend over several pages, as in the above example, it is also useful to create an **overview of resource usage** (if possible on a single page…), which can be derived from the project plan and easily prepared with a spreadsheet.

Here are two one-page **summary resource usage tables** for project EXONE, the first one concerning the contractor, the second one concerning the client.





In the above example, the client's resources include "external" people and other resources that are actually "procurements", which is the subject of the next section.

Note that activities related to human resources (staffing, training, etc.) take time, which needs to be taken into account in the overall project plan.

More information on human resources is provided in chapter 10 (“The project team”).

Plan procurements

This process consists in identifying project needs that can or must be met by **acquiring products or services from "vendors"** (or "sellers"), ie external suppliers, service providers and contractors, as opposed to needs that can or must be met by the in-house project team.
The process involves a "**make or buy**" analysis of tasks and resources.

The **procurement plan** documents the purchasing decisions, the methods to be used for **identifying vendors** (eg Request for Proposal (RFP), Request for Quotation (RFQ), Call for Tenders…) and the criteria to be used for **evaluating and selecting vendors**. It should also document the possible **risks** attached to each purchasing decision.

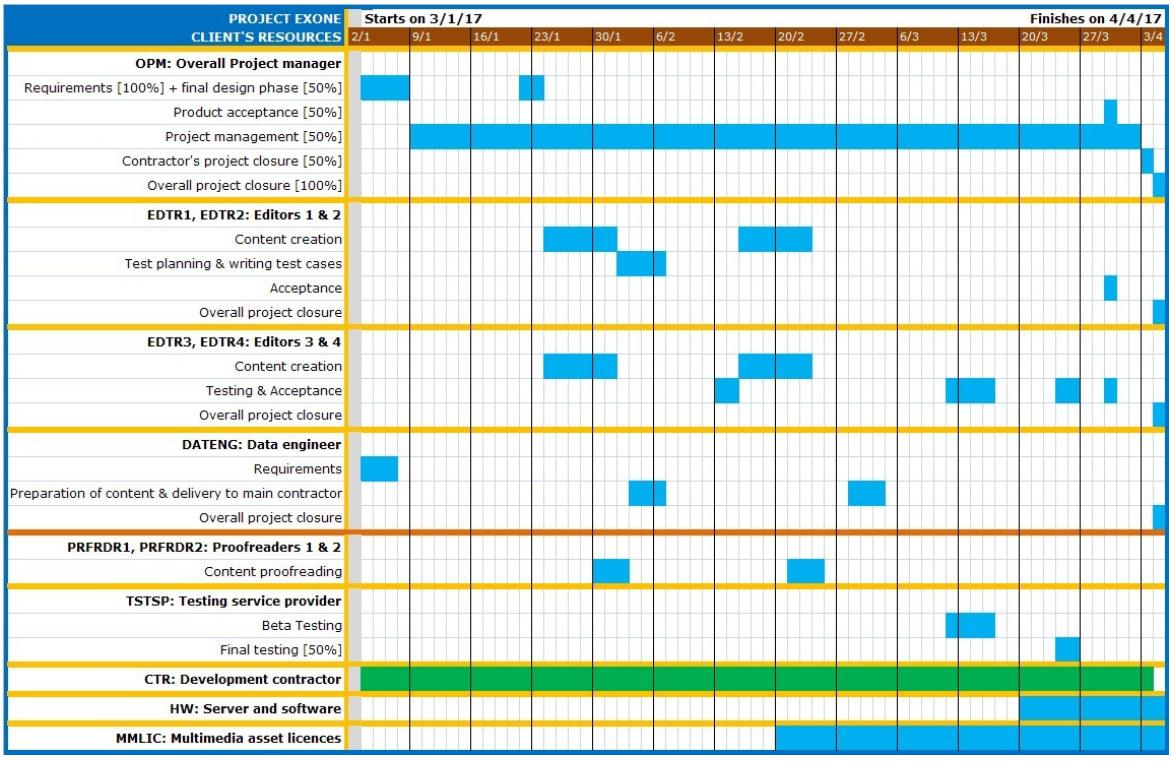
As mentioned in chapter 8 ("Requirements specification"), parts of the overall requirements specification document may be reused to prepare specific requirements documents for those of the vendors who need a formal "**Statement of Work (SOW)**".

The procurement plan should also indicate the **type(s) of contract and financial terms & conditions** to be used for the various categories of vendor.

Finally, the plan should include a **schedule** indicating at which stages of the project the various resources will be needed.

As mentioned for human resources, it is useful to provide an **overview of the procurement schedule** in tabular format.

The client's **summary resource usage table** for project EXONE below, already shown on the previous page, includes "external" people and other resources which are actually "procurements", namely the proofreaders, the testing service provider, the development contractor, the server & software, and the multimedia asset licences.



Note that activities related to procurement (preparation of SOWs, selection of contractors, drafting and negotiating contracts, etc.) take time, which needs to be taken into account in the overall project plan.

More information on procurement is provided in chapter 11 ("Contractors & contracts").

Plan quality

This process consists in identifying **quality requirements and standards** that will be applied to the project and to the resulting product, as well as documenting how **compliance** with such requirements and standards will be achieved and demonstrated.

The quality plan must of course take into account the **product acceptance criteria** specified in the requirements document and the **testing tasks** to be performed at various stages of the project. It may refer to the establishment at execution time of a detailed **test plan** and **test cases**, and, if applicable, it should take into account the requirement for any **automatic tests** that need to be developed.

As mentioned at the end of chapter 8 ("Requirements specification"), specific testing phases may be required, such as an "**operational acceptance testing**" (OAT) phase and an "**operational health check**" (OHC) phase. If such phases are specified by the project owner, they need to be featured in the quality plan. Work related to quality assurance during a product's **warranty period** must also be featured in the plan.

The plan should also describe the processes to be put in place for **quality control and assurance of the project** itself (as opposed to the resulting product).
For example, a well-thought-out **workflow**, with appropriate **validation steps**, eg for content creation or for software design and coding, contributes not only to meeting quality requirements for the product but also to the productivity of the project team.

Quality "**metrics**" may be defined for certain requirements of the project, such as compliance with the approved schedule and budget. A metric is a numeric value that can be measured. A certain degree of tolerance may be attached to a metric, corresponding to a maximum-allowed deviation from a standard that has been set.

The **cost of quality** ("**COQ**") corresponds to the cost of resources needed to meet quality requirements. Quality planning should therefore be performed in close relationship and interaction with the planning processes concerning tasks (some of which may be directly related to quality control/assurance, such as testing), resources, durations and costs.

For example, "pair programming", one of the recommended practices of eXtreme Programming ("XP") has a positive impact on the quality of coding, but a negative impact on resource requirements and therefore on cost (at least in the short term).
(See chapter 12 for more details on "XP".)
Likewise, proofreading is required to ensure a good quality of texts, but it has a price.

Poor quality also has a cost, which may actually be higher than the cost of quality (for example, **bugs can "kill"** a product or even people, or at least have a very negative impact on a company's image). However, a "**cost vs benefit**" analysis may lead to the conclusion that a given level of quality is sufficient.

> *A few months before the EHM was due to be released, a sample of its text content, including several hundred articles, and the same sample extracted from Microsoft Encarta were submitted to a team of proofreaders. The result showed that the average number of typos and other errors was almost the same for both samples, so the EHM was no worse than Encarta in this respect. However, the quality objective that had been set for the EHM content was not achieved, so the decision was made to have all of the EHM's articles proofread, which delayed the completion of the project by a few months and added a substantial amount to the editorial cost.*
> *A second round of proofreading would probably have been useful (given the total number of articles, over 40,000), but it was decided that the additional cost and delay would not be justified by the marginal benefit in terms of quality of content.*

More information on quality is provided in chapter 16 ("Testing").

Plan communications

This process involves determining what the **information needs** of the project stakeholders are, and **how, when** and **by whom** such information will be provided.

Information should be given in the **right format**, at the **right time**, with the **right impact**, to those people who "**need to know**", including, as appropriate, all or selected members of the project team. **Adequate and effective communication** requires time and money, which needs to be taken into account in the overall project plan.

The **communications plan** should provide the following information:

- types of information to be communicated,
- language(s) to be used,
- a glossary of terms and abbreviations specific to the project (to avoid ambiguity and misinterpretation),
- time-frame and frequency of communications,
- communication methods (meetings, memos, standard forms, e-mail, intranet…),
- persons with communication responsibility,
- escalation paths and procedures.

More information on communications is provided in subsequent chapters of this guide.

Plan risk management, identify and analyze risks

A risk is "**the possibility of something bad happening at some time in the future**", according to the Oxford English dictionary. Furthermore, "anything that can go wrong will go wrong", according to Murphy's law (see en.wikipedia.org/wiki/Murphy%27s_law).

Risks are inherent in any project. Obviously, **risks cannot be planned, but how to manage them can**.

Planning risk management is the process of defining **how to deal with project risks**. It also ensures that sufficient time and resources are allocated to risk management.

The **risk management plan** is closely related to other parts of the project plan such as those dealing with tasks, resources, procurement, budget and schedule.
A risk management plan should cover the following areas.

- **Methodology**: approaches, tools and data sources that may be used to perform risk management.
- **Roles and responsibilities** of team members who need to be involved in risk management.
- **Budgeting** for the costs involved in risk management.
- **Timing**: defines when the risk management processes will be applied in the project's life cycle.
- **Risk categories**: a structured list or table or diagram showing the various possible areas of risk.
- **Risk impact levels** should be defined, for example: low, moderate, high, very high or unacceptable.

The **impact of risks** relates to the effect they might have on the project objectives: scope, time (schedule), cost (budget), quality, etc.

The risk management plan should also include a **list of identified risks** (or "**risk register**"), preferably sorted by category, with attributes such as **estimated probability** (ie the likelihood of the risk materializing) and **impact level**, as well as actions already undertaken or to be undertaken for each risk, and of course an **evaluation of the cost of minimizing (mitigating) or eliminating risks**.

It is generally impossible in the planning stage to identify all of the risks that might impact the project, but the risk management processes that have been defined should **ensure that risks that appear in the course of the project will be dealt with appropriately**.

Defining risk management processes and identifying risks and associated costs involve **expert judgment**, the analysis **of historical data** (from previous projects), if available, as well as **teamwork** for reviewing the various components of the project management plan and tasks to be performed. **Brainstorming** workshops may be useful for this purpose.

The **cost** associated with a risk attached to a given item (task, work package, resource, supply, service, situation…) may be a **lump sum or a percentage** of the item's initial cost estimate.

Taking into account the **probability of risk materialization** is a tricky matter. For example, the possibility that a contractor used for the execution of a major part of a project might go out of business before completing its work on the project may be viewed as a low-probability risk, but its impact, should the risk materialize, might be very high. In such a case, as a PM, you should either neglect the risk (because of its low probability) or factor it into the plan with a cost corresponding to its full estimated impact level, regardless of its probability of occurrence.

Estimating the probability and impact levels of risks enables you to **prioritize risks** and thus to focus on those that are **most likely** to materialize and are the **most significant**.

Actions taken to **minimize** (mitigate) or even **eliminate** a risk may result in the **addition of tasks** (eg prototyping or testing iterations) **or resources** (eg editors, developers, testers) to the project, which will automatically result in **additional costs**. It is good practice to make such additional costs **explicit** and to clearly indicate that they correspond to the estimation of risks.

The elimination of a risk may require **changing the project's scope**, for example giving up some of the product's functions and/or features.

Instead of or in addition to work-package-level or task-level risk evaluation, a lump sum or percentage may be added to the project's total cost estimate, as a global "**provision for risk**" (sometimes also called "**management reserve**").

As a PM on the project owner's side, you need to make sure that the **requirements specification** mentions risks that have already been identified.
As a PM on a project implementation entity's side, you must take into account and evaluate not only those risks that are documented in the requirements specification, but also any additional risks identified as a result of **in-depth analysis** of the requirements, as well as those identified during the project planning process.

In the same way as the subdivision of work is represented by a WBS diagram, risk categories may be summarized in a "**risk breakdown structure (RBS)"**, which is a helpful **checklist** for the process of **risk identification**.

Below is an example of risk categories presented in the form of an RBS derived from the RBS documented in *A Guide to the Project Management Body of Knowledge ("PMBOK® Guide")* published by the Project Management Institute (pmi.org).

Examples of risk

A few **examples of risk** in some of the above categories are given below.

Requirements

Achieving website accessibility objectives may not be feasible due to technical constraints such as the use of JavaScript. If full compliance with accessibility standards is a "must have" feature but cannot be guaranteed by the developer, there is a risk that the product will be excluded from certain markets.
The risk may be eliminated by selecting a developer who can provide the necessary guarantee and is prepared, by contract, to accept to pay damages should the requirement not be met.
The risk may be mitigated by modifying the requirements so as to limit accessibility to a subset of the website's functions or to a subset of accessibility features.

> *The online version of the EHM was required to comply with W3C/WAI accessibility requirements for websites. The developer informed Hachette of the risk that full accessibility might not be provided because there might not be enough time and budget to evaluate and implement adequate technical approaches to accessibility for some of the EHM's features. In order to limit the risk, the accessibility requirement was dropped for the major issue at stake, namely the "Advanced search" function, which was typically of interest to only a small percentage of users.*

Technology

Advanced technology to be used in the implementation of a project may be an area of risk if it is not absolutely stable and/or fully mastered. If the project cannot be completed without such technology, the cost of the associated risk needs to be factored into the budget by estimating the additional time and/or resources required to fully develop and debug the technology, and/or required for learning how to incorporate it into the product being built.

Complexity and interfaces

The complexity of a project is obviously a key factor of risk. For example, a simple, straightforward static website development project is generally less risky than the development of a full-blown new information system with transactional applications intended to function in an environment with a complex network architecture.
Minimizing such a risk requires choosing the right development contractor, ie a company that has a proven track record of successful implementation of complex systems.

This risk category also includes **technical dependencies**, relating for example to the operating systems with which a software application is expected to be compatible. If a new version of an operating system (OS) is due to be released before the application launch deadline, there is a risk of incompatibility. In order to minimize such a risk, the developer should test the application with a beta version of the OS concerned and make any necessary code changes to ensure full compatibility.

> *The first version of the Hachette Multimedia Dictionary (DHM, a predecessor of the EHM) was initially released on the same day of August 1995 as Windows 95. Unfortunately, the DHM turned out to be incompatible with Windows 95! Fortunately, the problem was easy to fix, but the cost of the initial incompatibility was fairly high: a version "1.1" of the DHM had to be produced, a new batch of CD-ROMs had to be manufactured, and a product replacement process had to be put in place in order to deal with customer complaints.*
> *The developer was supposed to have tested the DHM with a beta version of Windows 95, but the work had not been done properly nor thoroughly checked.*

Suppliers and contractors

A given contractor may be working on several projects at the same time and could be tempted to reassign resources on a temporary basis to another client's project, because of an emergency situation. In such a situation, the risk incurred by the project at stake is a schedule slippage and a possible impact on quality due to lack of focus on the part of the developers.
Such a risk may be compensated by a provision in the contract for penalties to be paid by the developer in case the agreed deadline for product delivery and product quality requirements are not met.

> *Here is another example of risk and associated cost: based on previous experience working with a software development contractor, Hachette's top management wanted to reduce the risk represented by total reliance on an external development company for its EHM project.*
> *So management authorized the hiring of a software development engineer who would work in close cooperation with the development company in order to monitor project activities performed by the contractor, to participate in the development effort, and to facilitate the transfer of technology and knowhow, should development need to be internalized at some point in the future.*
> *It turned out, after completion of version 2 of the EHM, that the contractor decided to stop its multimedia software development activity, so production of version 3 was done internally, with a development team that included the above-mentioned engineer and three engineers who had worked for the contractor and who were hired by Hachette.*

Another example of a risk situation is that of a supplier supposed to manufacture and deliver a piece of new-technology hardware at a certain price by a certain date, but who may be unable to do so (at the specified price and/or by the specified deadline).
Again, such a risk may be compensated for by a provision in the contract for penalties to be paid by the supplier in case the agreed deadline for product delivery and product price specifications are not respected.
The risk may be minimized by choosing another supplier or delaying the product launch or increasing the estimated cost of its bill-of-materials.

Weather

Weather conditions may have a direct impact on certain projects, typically in the area of construction, but they generally have no influence (other than a possible influence on the morale of the project team…) on projects that are executed indoors, such as content creation and software development.
However, a contractor may be located in a part of the world where there is a risk of a natural disaster (earthquake, etc.). Depending on the estimated probability of a disaster and the importance of the contractor to the project, the risk may be accepted (possibly with a contingency reserve) or avoided by choosing a different contractor located in a naturally safer part of the world.

> *A company that did software development work for Hachette was initially based in California. Its offices and equipment suffered severe damage due to an earthquake in 1994, so it decided to relocate to Northern Florida (where it would only be exposed to hurricanes…).*

Project dependencies

Apart from obvious **intra-project dependencies** (eg a given task depending on the completion of another), the implementation of a project ("project A") may require deliverables resulting from another project ("project B"), which is an example of **inter-project dependence**.
Assume for example that some of the functions of a product to be developed require low-level software building blocks common to several products, such building blocks being designed and coded by software engineers in your company's R&D department.
As PM for project A, you have no control over project B. However, you need to identify and evaluate the risk of project B's deliverables being late and/or inadequate, which requires closely liaising with project B's PM as part of project A's planning process (as well as during its implementation).
Reducing the risk attached to such a situation may require a contingency plan ("plan B"!) featuring the development of an alternative solution to project B's deliverables (with obvious additional costs).

Resources

Hiring people can take longer than expected. A delay in the availability of the adequate people for the project can jeopardize its completion on schedule. Such a risk may be reduced by providing enough time for the hiring process and/or by making the jobs more attractive (in terms of responsibilities and/or compensation, with an impact on cost…).
The risk may be avoided by using a specialized agency that will generally be able to rapidly provide personnel on a temporary basis (but usually at a higher cost than direct hiring would involve).

Funding

Funding that is not fully guaranteed at the time a project is initiated is of course a major problem and risk. If a source of funds appears uncertain (or is believed to be unreliable), the cost of the related risk is at least equal to the amount of money supposed to come from that source. An obvious solution consists in finding an alternative source, which is however easier said than done!

A funding risk for a contractor may be a situation where its client's payment schedule provides for only a small percentage (say 10%) of the total fee to be paid upon signature of the project execution contract, while the contractor very well knows that the costs it will incur as soon as work is started or that it has already incurred in preparing the response to the RFP will not be totally covered by the initial payment.
In order to minimize or eliminate such a risk, the contractor will need to negotiate more favourable terms of payment with its client.

Should the client turn out to be inflexible, then the contractor may be forced to withdraw from the project, which may be safer than facing a cash-flow problem that may have dramatic consequences.

Estimating (resources, durations, costs, etc.) is **not an exact science**, so there is always a **risk of error** (which, in very rare cases, might even be a positive risk…). A negative risk may be translated into a **contingency reserve** to be added, for example, to the duration or cost of a given task.

> *As mentioned above (under "Estimating task resources"), a 15% margin of error was incorporated in the calculation of the duration and, consequently, resources required for the indexing of the EHM articles, following the measurement of a work sample.*

As a PM, your estimates may depend on input from other people, such as developers who are probably in a better position than you are to evaluate, for example, the time required to design and code a certain piece of software (unless you are not only a PM but also an experienced developer…). Most developers however tend to be optimistic, so a safe course of action may consist in having several developers provide you with distinct workload estimations from which you will derive your own estimation, using some technique such as the "Three-point estimate" (for what it is worth!) already described in this chapter (under "Estimating task durations").
Another more brutal method consists in adding a percentage, possibly based on experience with other projects, to the estimation provided by developers (or any other categories of people for that matter). For example, if the developers' estimate is 50 days, add 30% and assume that 65 days will be required!

Planning

This area is more general than just "estimating". It covers all facets of project planning, such as the scope definition, the work breakdown structure (WBS), the definition and sequencing of tasks in the various work packages (WPs), etc. Of course, **the longer the project** is expected to last, **the higher the risk** of planning errors being made.

Minimizing risks due to planning involves at least the following initial steps:

- provide (or obtain) a comprehensive and unambiguous requirements specification,
- create a comprehensive WBS,
- provide a comprehensive description of all WPs in terms of tasks to be performed,
- clearly identify all of the dependencies between tasks,
- identify the critical path(s) in the project schedule.

Any **uncertainty in the requirements** specification obviously **needs to be eliminated** before any serious planning can be undertaken.

There should be **no "holes"** in the WBS or in the description of WPs (the "100% rule" previously mentioned under "Creating the Work Breakdown Structure" needs to be applied).

Close attention must be paid to the **critical paths**, since they allow no margin of error should any of the corresponding tasks take longer than planned.

It may actually be useful to create "**cushions**" between dependent tasks. For example, you could add a number of well-identified **"dummy" tasks** between real tasks. The sole function of dummy tasks is to absorb any delay in the completion of preceding tasks, so dummy tasks should be given a duration but they do not require any resources.

Note that the connections between dummy tasks and real tasks in a network diagram are usually represented by a dotted line.

Example of risk evaluation

As an example, here is a summary presentation of a few risks identified for a hypothetical project on a main contractor's side, along with a description of the course of action to be taken for each risk and an evaluation of its impact on the project's costs, following an in-depth review of a client's requirements specification (in its initial state), and based on input from the Software Development team, Legal and Finance.

Risk factors	Risk probability level	Risk impact level	Actions taken or to be taken	Cost of risks	
				Already included in budget	To be added to budget
Requirements unclear, many grey areas, ambiguities to be resolved.	High	High	Q&A spread over a week + two-day meeting with client to review, refine and agree on requirements.	4,500	
The client didn't ask for a mock-up interface before the prototype phase: disagreement on interface may cause rework and delay in following tasks.	High	High	Interface mock-up phase in two iterations to be proposed to client, in order to agree on interface before further design and development steps.		10,000
Our network architect may not be available at the time he is needed for network design.	Moderate	Moderate	Use an external consultant (already identified) in case our expert is unavailable.		3,000
Members of our development team disagree on workload estimates for phases 1 and 2 of application coding.	High	High	The amount factored into the budget for phases 1 and 2 coding has been calculated on the basis of a weighted average of indivual estimates, validated by a senior developer, but a contingency reserve of 15% should be added.		9,450
Debugging the system after client testing may take longer than allowed by the schedule imposed by the client.	High	High	More time and resources have been allocated to testing; need to negotiate schedule change with client.	5,250	
One of the client's sites at which the system is to be deployed might not be ready at the scheduled date: risk of delay in deployment and related payment.	Low	High	Need to negotiate with client in order to obtain at least 50% of amount to be paid on the scheduled date, whatever the delay on deployment due to the client.		
The client's terms of payment provide for only 10% upon signature of contract: not sufficient to fund the first phases of the project before the next scheduled payment.	High	Unacceptable	Legal & Finance feel confident they will obtain a 20% down payment at contract signature. If they don't, we should opt out of the project!		
Given the complexity and length of the project, there is a natural degree of uncertainty regarding task durations and resource usage.	Very high	Very high	A management reserve of 10% should be added to the total cost of the project.		75,000
			TOTAL COST OF RISKS	9,750	97,450

> See the following articles for **more information on Risk Management:**

>> en.wikipedia.org/wiki/Risk_management

>> www.risk-doctor.com/pdf-files/hha0404.pdf