



# Space project management

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## Cost and schedule management

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## Foreword

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This standard is one of the series of ECSS Standards intended to be applied together for the management, engineering and product assurance in space projects and applications. ECSS is a cooperative effort of the European Space Agency, National Space Agencies and European industry associations for the purpose of developing and maintaining common standards.

Requirements in this standard are defined in terms of what shall be accomplished, rather than in terms of how to organize and perform the necessary work. This allows existing organizational structures and methods to be applied where they are effective, and for the structures and methods to evolve as necessary without rewriting the standards.

The formulation of this standard takes into account the existing ISO 9000 family of documents.

This standard has been prepared by the ECSS cost and schedule management Working Group, reviewed by the ECSS Management Panel and approved by the ECSS Steering Board.

The main evolutions between the present version and the previous one (ECSS-M-60A), published on 19 April 1996, are:

- Functional analysis diagrams have been included, where relevant.
- Cost and schedule management principles have been further developed, providing a detailed description of their constituent elements.
- The document has been restructured in order to maintain a clear correspondence between the descriptive clauses (i.e. 4, 5 and 6) and requirement clauses (i.e. 7, 8 and 9).
- New requirements have been introduced (total of 65 requirements, against 35 in the previous version), especially in the fields of:
  - Project structures,
  - Risk items that impact cost & schedule elements,
  - Cost estimating,
  - Cost control (notion of baseline cost plan),
  - Inventory control.
- DRDs have been defined to specify the content of expected documents (no DRD was defined in the previous version).

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## Introduction

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Cost and schedule management is defined as a collective system of organized processes and actions in support of project management. It allows optimal use to be made of human resources, facilities, materials and funds, thereby achieving a successful completion of the space project with respect to

- cost targets,
- timely completion, and
- technical performance.

To this end, costs and activities are planned and actively controlled, with special care being given to the identification of critical situations that can lead to an adverse impact on the project cost and schedule, so that the relevant recovery actions can be proposed.

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# 1

## Scope

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The requirements specified herein apply to, and affect the customer and supplier at all levels. These requirements, as tailored in the project specific requirement documents, are applicable to any actor in a space project.

When viewed from the perspective of a specific project context, the requirements defined in this Standard should be tailored to match the genuine requirements of a particular profile and circumstances of the project.

**NOTE** Tailoring is a process by which individual requirements or specifications, standards and related documents are evaluated and made applicable to a specific project by selection, and in some exceptional cases, modification of existing or addition of new requirements.

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## 2

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## Normative references

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The following normative documents contain provisions which, through reference in this text, constitute provisions of this ECSS Standard. For dated references, subsequent amendments to, or revisions of any of these publications do not apply. However, parties to agreements based on this ECSS Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the publication referred to applies.

ECSS-P-001B      ECSS – Glossary of terms

ECSS-M-00-03B    Space project management – Risk management

ECSS-M-10B        Space project management – Project breakdown structures

ECSS-M-20B        Space project management – Project organization

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## Terms, definitions and abbreviated terms

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### 3.1 Terms and definitions

For the purpose of this document, the terms and definitions given in ECSS-P-001 apply, in particular for the following terms:

- cost breakdown structure
- estimate (cost) at completion
- estimate (cost) to completion

The following terms are specific to the present standard:

#### 3.1.1

##### **cost reimbursement contract**

generic type of contract in which payments are depending upon incurred costs

#### 3.1.2

##### **economic conditions**

reference period of time during which a set of financial elements (e.g. hourly rates and overheads) are applicable

NOTE Reference economic conditions are those prevailing when the decision to commit to the project is taken. Current economic conditions are the conditions prevailing when the service is provided.

#### 3.1.3

##### **direct manpower cost**

manpower cost charged to the project using the agreed rates

#### 3.1.4

##### **fixed price contract**

generic type of contract in which payments are defined in the business agreement in the form of milestone payment plan(s), and depend upon the achievement of the relevant contractual milestones

#### 3.1.5

##### **cost estimating**

process helping in the determination of the expected costs of a project

### 3.1.6

#### **critical path**

chain of activities critical to the timely completion of the project

## 3.2 Abbreviated terms

The following abbreviations are defined and used within this standard:

<b>Abbreviation</b>	<b>Meaning</b>
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<b>AIV</b>	assembly, integration and verification
<b>CBCP</b>	current baseline cost plan
<b>CBS</b>	cost breakdown structure
<b>CCN</b>	contract change notice
<b>CCS</b>	country/company structure
<b>CIL</b>	critical items list
<b>CPM</b>	critical path method
<b>CR</b>	cost reimbursement
<b>CWP</b>	control work package
<b>DCP</b>	development cost plan
<b>DIL</b>	deliverable items list
<b>EAC</b>	estimate at completion
<b>EC</b>	economic conditions
<b>ETC</b>	estimate to completion
<b>FP</b>	fixed price
<b>FFP</b>	firm fixed price
<b>G&amp;A</b>	general & administrative
<b>MPP</b>	milestone payment plan
<b>MTA</b>	milestone trend analysis
<b>MTC</b>	milestone trend chart
<b>OBCP</b>	original baseline cost plan
<b>PDM</b>	precedence diagram method
<b>PMAC</b>	payment milestone achievement certificate
<b>PEF</b>	price escalation formula
<b>PSS</b>	procedure standard specification
<b>PT</b>	product tree
<b>WBS</b>	work breakdown structure



## Cost and schedule management common principles

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### 4.1 Objectives and relationships

Cost and schedule management is a major factor in the effective, responsible and proactive controlling of projects. It provides a common working baseline for the planning and expenses and across the participants of the project. It ensures a uniform basis and common understanding of the project planning, cost and manpower targets for use by all participants.

The main objectives of Cost and Schedule management are to:

- plan accurately the phasing of procurements, expenses and resources for the project;
- highlight any deviations and hence propose remedial actions, with the aim of completing the project within the given time and financial constraints.

Schedule management includes the activities to accomplish timely completion of the project, i.e.:

- Schedule definition, including activity definition and sequencing, activity duration estimating and schedule baseline establishment;
- Schedule control, including the comparison between the current working schedule and the baseline schedule;
- Schedule reporting.

Cost management includes the activities to complete the project within the approved budget, i.e.

- Cost estimating and planning;
- Cost control;
- Cost reporting.

The main structures to perform these activities are the:

- Work breakdown structure;
- Cost breakdown structure;
- Business agreement structure;
- Country/company structure.

Figure 1 presents an overall functional analysis of cost and schedule management.

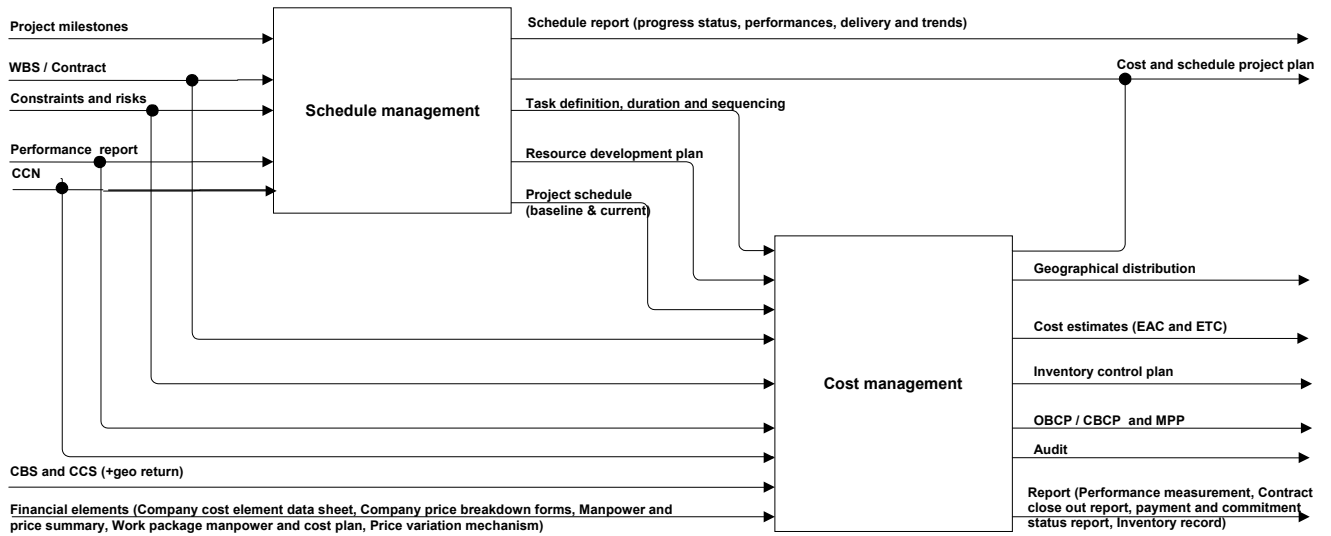


Figure 1: Overall functional analysis

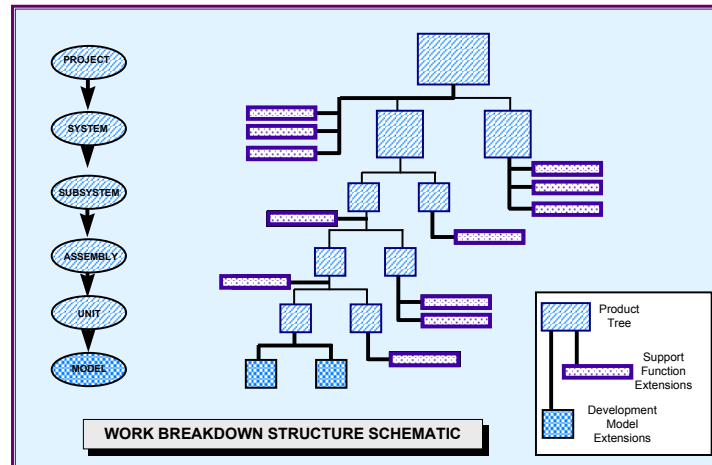
## 4.2 Project structure

### 4.2.1 Work Breakdown Structure

The Work Breakdown Structure (WBS) is an effective project management tool that assists both the customer and the supplier in fulfilling their business obligations.

The purpose of the WBS is to provide a framework for managing planning and control of cost, schedule and technical content. It divides the project into manageable work packages, organized according to the nature of the work. It identifies the total work to be performed with increasing levels of detail.

The WBS is derived from the Product Tree (as defined in ECSS-M-10B), elements of which are extended to include the customer-defined support functions (e.g. project management, engineering, product assurance support) necessary to produce the end item deliverables (development and flight models) and associated services as appropriate for the project (see Figure 2).



**Figure 2: Work Breakdown Structure schematic**

In the specific context of Cost and Schedule management, the WBS is used as a common tool in the project, assisting its participants in:

- Conducting tender comparisons and business agreement negotiations;
- Optimizing the distribution of work amongst the different suppliers;
- Monitoring the schedule of the project:

A network of events (e.g. start, complete) and activities (e.g. design, develop and operate) takes place. The logical relationships between the activities allow the producing and completing of the WBS deliverables. Resources (e.g. labour skill, and materials) and responsible organizations (e.g. mechanical engineering department, fabrication department, supplier) can then be identified for each activity.

The scope and complexity of the work and the management needs for schedule visibility influence the frequency of schedule reporting and their associated levels of detail.

- Estimating, planning and monitoring the cost:

By breaking down the total product tree into successively smaller elements and support functions, management can verify that all activities identified in the WBS actually contribute to the project objectives. In addition, using WBS elements to plan for the work serves as the basis for estimating and scheduling resource needs.

An estimate based on WBS elements helps to plan, coordinate, and control the various project activities that both the customer and the suppliers are conducting. The WBS also provides a common framework for tracking the evolution of estimates, hence forecasting the total cost of the project more accurately.

Proper use of the WBS for technical, schedule, and cost management allows the defining of work and related resources, ensuring that all work is included without duplication of effort. In addition, the WBS is used to accumulate performance data and associated variances to evaluate progress in terms of performance.

To perform data reporting, the WBS is broken down into work-packages. All defined work-packages reflect the total work scope.

Any reporting to the customer is performed using Control work-packages, which are agreed between the customer and the supplier and reflected in the corresponding business agreement. All defined Control work-packages also reflect the total work scope.

Additional information concerning the development of the WBS is provided in Annex R.

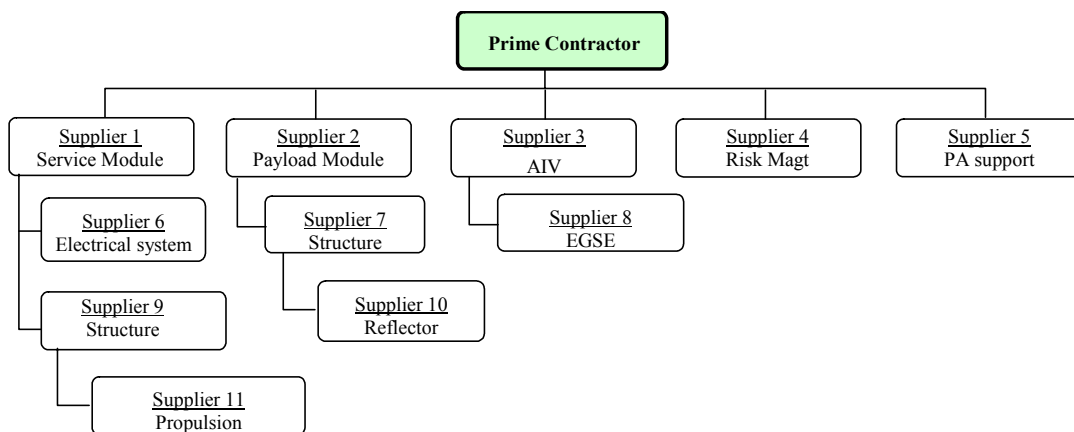
### 4.2.2 Cost Breakdown Structure

The Cost Breakdown Structure (CBS) defines a set of cost categories used to break down all the costs of the project. It provides a common framework for all cost management activities among suppliers for the same project.

The total cost planned for each work package is broken down per cost category (e.g. labour, non-labour, subcontracts). For each cost category, the distinction between direct and indirect costs is identified by each supplier to the customer.

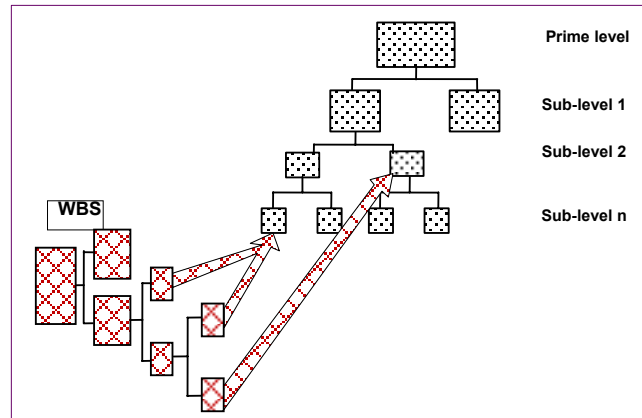
### 4.2.3 Business Agreement Structure

A Business Agreement Structure is a specific type of organization chart, the purpose of which is to identify the project reporting relationships between the respective customers and suppliers. It shows which suppliers are responsible for which work packages, as depicted in Figure 3.



**Figure 3: Business Agreement Structure example**

By relating work packages in the WBS to business agreements in the Business Agreement Structure, contractual responsibilities can be traced. It facilitates the cost management process by providing the means to ensure that all impacts (e.g. liability, financial, technical or schedule) of a change in the business agreement are properly assessed at all levels of the contractual hierarchy (see Figure 4).



**Figure 4: Business Agreement Structure schematic**

#### 4.2.4 Country/Company structure

The Country/Company Structure (CCS) shows the relationships between each company's business agreement for a project and the countries in which the corresponding work is performed. By identifying the relationships between work packages in the WBS and contracts in the CCS, reports can be generated to illustrate how each supplier's work is distributed per country, e.g. for geographical return purposes.

In the case of projects where it is simple to identify the countries in which the works are performed, the CCS is combined with the Business Agreement Structure.

### 4.3 Contract types

#### 4.3.1 General

The way to manage the cost and schedule aspects of a project depends on the contract type of its business agreement. There are two basic contract types: Fixed Price and Cost Reimbursement, which are broken down as defined below.

#### 4.3.2 Fixed price contracts

- a. Firm fixed price: the price of the contract is not subject to any adjustment or revision by reason of the actual costs incurred by the supplier in the performance of his business obligations.
- b. Fixed price with variation: the price of the contract is not subject to any adjustment or revision by reason of the actual costs incurred by the supplier in the performance of his business obligations, except for the update to current economic conditions by applying an agreed price variation mechanism.
- c. Fixed unit price: the price of the contract is defined per unit price of the various supplies and services.

#### 4.3.3 Cost reimbursement contracts

- a. Cost plus fixed fee: it is a cost-reimbursement type of contract which provides for the payment of a fixed fee to the supplier. Its implementation mechanism is described in the business agreement and generally includes the following elements:

- a target cost for the whole project;
  - the above-mentioned fixed fee, which does not vary with actual cost;
  - a cost sharing scheme, defining applicable incentives and penalties depending on how the actual cost spent for the whole project compares with agreed target cost.
- b. Cost plus incentive fee: it is a cost-reimbursement type of contract which provides for the payment of a target fee, which is the fee to be paid to the supplier if the contract is executed in accordance with targets specified in the contract. Its amount is adjusted depending on whether the supplier's execution of the project is below or above the specifications fixed for the above-mentioned targets.
- c. Time and material: it is a cost-reimbursement type of contract of which the price is determined on the basis of the following elements:
- average hourly rates or hourly rates per category, including direct as well as indirect charges, general administrative overhead and profit, either for personnel or for the hire of facilities including operating personnel;
  - material and supplies at cost, which can be increased by a percentage for material handling charges to the extent that they are clearly excluded from the hourly rate;
  - disbursements or payments made to third parties for services rendered in the fulfilment of the contract to the extent that they are clearly excluded from the hourly rate (e.g. travel expenses, transport, computer charges, etc.). Disbursements are approved by the customer and, unless otherwise provided in the contract, are reimbursed at their invoice value without any additional charges.

#### **4.3.4 Ceiling price to be converted into fixed price**

When the parties intend to conclude a firm fixed price contract or a fixed price contract with price variation, and if at the time of concluding the contract there is not sufficient basis for assessing a fixed price, they can conclude a contract with a ceiling price to be converted into a fixed price. Such a contract stipulates a ceiling, which the contract price cannot exceed and within which the supplier commits to deliver in full the supplies and services stipulated in the contract. If an agreement on the fixed price cannot be reached prior to completion of the contract, the contract price is determined, within the limit of the defined ceiling, in accordance with the procedure of cost reimbursement contracts.

## **4.4 Risk management**

### **4.4.1 General description**

Risk management is a systematic process of identifying, analysing, and responding to risks of a project during its entire life cycle (early definition, development, implementation and exploitation phases). It allows maximising of the probability and consequences of positive events and minimizing the probability and consequences of adverse events for project objectives. The approach to risk management is described in detail in ECSS-M-00-03B.

Assuming that the technical and quality requirements are strictly observed and met, any project risk, irrespective of the category to which it belongs, eventually has a cost or schedule impact if it occurs. Cost and schedule

management of a project is supported by an appropriate risk assessment, in order to allow the relevant decisions to be taken early enough in the course of the project development. Developing technical back-up solutions early enough during the project life can seem costly because they are redundant by definition with the primary solution. It can, however, in the long-term turn out to be the cheapest project solution. Proper conduct of risk analysis therefore allows optimization of the overall cost of a project and the risks taken to achieve it.

#### **4.4.2 Risk register**

Risk elements of explicit relevance to cost and schedule management are listed in the Risk Register (see ECSS-M-00-03-B, Annex A). They include, without being limited to:

- programmatic constraints: (Fixed launch date? If project involves cooperation, with which political risk? Missing skills and staff complement?),
- technological challenges (e.g. necessity of new technologies, although not mature at start of the project),
- cost driving elements,
- financial and geographical return constraints,
- penalty and incentive schemes.

#### **4.4.3 Lessons learned**

Performing a critical assessment of the project upon its completion allows both the customer and supplier to define together the strengths and weaknesses of the different options chosen during its different phases.

The resulting lessons learned cover separately all support functions to properly conduct a project (e.g. management, control, engineering, product assurance, and AIV). They are an essential input to the risk management of future projects.

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## 5

# Schedule management principles

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## 5.1 Schedule definition

### 5.1.1 General

To support proactive project management, the work to be performed for a project is planned to a level of detail commensurate with the project phase for which the schedule is established.

Developing a network of activities, milestones and relationships between them allows for effective schedule analysis, risk evaluation and mitigation. The identification of the critical path helps to anticipate the definition of corrective measures on such critical activities so as to avoid schedule drift.

Schedule reporting, including critical path, between supplier and customer provides the necessary overall visibility of the project status at any time.

### 5.1.2 Activities definition / Activities sequencing

The network of activities is derived from the agreed Work Breakdown Structure (WBS). The activities are put in sequence linked by relationships reflecting the logical dependencies that exist between the activities. Project activity overall logic is described in a technical manner in the System Engineering Management Plan and Design and Development Plan (see ECSS-E-10 Part 1B, subclause 4.2).

A duration is estimated for each network of activities. Duration estimation is commonly based on a mixture of previous experiences, expert opinions, supplier information and common sense. The risk analysis process provides valuable input to define the required schedule contingencies. Schedule contingencies are usually allocated to the last activity within a project phase or sub-project phase.

Once the activity identification, network logic and durations have been performed and the customer requirements (e.g. key milestones) duly taken into account, the resulting network is analysed using an agreed project calendar taking into account working hours, working days and company holidays and available critical resources such as personnel, machines, tools and facilities.

This iterative process results in a schedule that is validated, logical, complete and compliant with the business agreement.

### 5.1.3 Key milestones

For overall visibility, key milestones are established in the schedule following their agreement between customer and supplier.

Depending on the project phase, the following key milestones, as a minimum, are included in the schedule and linked to the identified activities:

- Start and end of the project phases;
- Design reviews including supplier design reviews such as Preliminary Design Reviews (PDR), Critical Design Reviews (CDR);
- Production reviews such as Manufacturing Readiness Reviews (MRR), Major Inspection Points (MIP);
- Test reviews like Test Readiness Reviews (TRR);
- Delivery Review Boards (DRB);
- Business agreement milestones such as Payment Milestones;
- Delivery dates for Customer Furnished Equipment.

### 5.1.4 Resource allocation

Project resource allocation covers all resource types and takes into account periods of unavailability of each identified resource.

By this means, critical periods of under-load or over-load are identified in advance, and non-critical activities can be rescheduled to suit the availabilities.

During the process of schedule development all critical resources are taken into account.

During the project lifetime, the supplier uses the current working schedule and the updated resource allocation for such internal processes as:

- capacity planning,
- progress measurement methods, and
- booking of critical resources like tooling, machines and facilities.

For cost reimbursement contracts, the overall resource allocation is used as input for the development cost plan (see subclause 6.3.2).

## 5.2 Schedule control

### 5.2.1 Baseline schedule

The baseline schedule describes the activities and their sequences that meet the project objectives for timely completion of the project or project phase. It is developed by the supplier and agreed by the contractual parties and is the reference for schedule reporting and performance measurement.

The baseline schedule is coherent with the agreed product tree and describes the flow of the work as defined in the WBS.

The definition of the baseline schedule follows the principles given in subclause 5.1. The level of detail of the baseline schedule depends on the level of detail of the Work Breakdown Structure. The baseline schedule contains the customer constraints, activities and milestones of the supplier and lower level suppliers.

As a minimum, the baseline schedule contains

- key milestones,
- descriptions of the activities,
- start and finish dates of activities,
- duration of activities, and
- identification of the critical path activities.

The baseline schedule is included in the project business agreement. The impact of any agreed change on schedule dates and logic is included in the updated version of the baseline schedule.

### **5.2.2 Current working schedule**

The current working schedule documents the actual status of completed and planned activities and of the planned activity sequence. For completed activities, actual dates are given and for future activities the planned dates are used. The current schedule identifies the most realistic view of the project status given by the supplier to the customer, and hence does not necessarily reflect an agreed and accepted project status.

The current working schedule is identical in its structure, level of detail and content, to the baseline schedule (see subclause 5.2.1). It conforms to the principles described in subclause 5.1.

At the start of the project, the baseline schedule is identical to the working schedule, as no progress has been made (both schedules show only the planned status of the project). As the project progresses, the current working schedule can differ from the baseline schedule due to the progress made, reflected by updating the status of activities and the activity sequence.

The current working schedule reflects the following information:

- up-to-date status of activities;
- up-to-date status of key milestones;
- suppliers procurement status.

The comparison between the current working schedule and the baseline schedule forms the basis for the overall project progress assessment. If the current working schedule shows delays against the baseline schedule, the necessary corrective actions are identified, assessed and implemented so as to converge back to the baseline schedule.

### **5.2.3 Performance evaluation**

The current working schedule is compared to the baseline schedule and the resulting differences assessed by the supplier. This includes the status of the completed activities and the current forecast of future activities and milestones.

Elements of this evaluation are:

- actual achievement dates of business agreement milestones (such as Payment Milestones),
- actual work progress,
- actual activity duration,
- actual contingencies,
- changes in or of the critical path.

The commonly used project schedule presentation is the Gantt chart (or Bar chart). In a Gantt chart each activity is represented by a bar, the length of

which corresponds to the duration of the activity. The links between the bars are shown with arrows as illustrated below. The critical path is typically highlighted. Customer and supplier agree on the way the activities are grouped in the Gantt chart presentation. The activities can be grouped in conformance with the Work Breakdown Structure, product tree, project phase, customer supplier hierarchy or other preferred sequence.

Figure 5 shows an example of a Gantt chart.

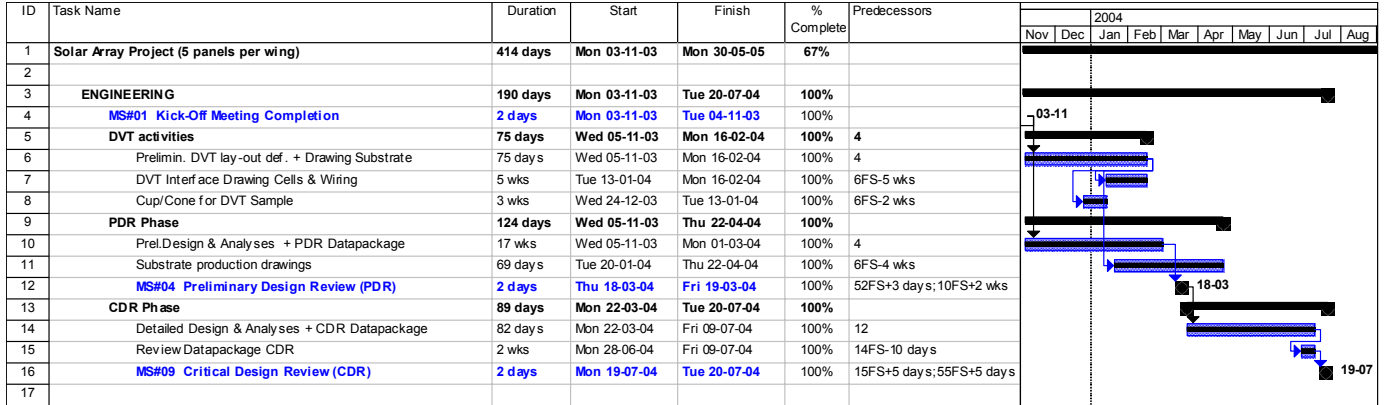
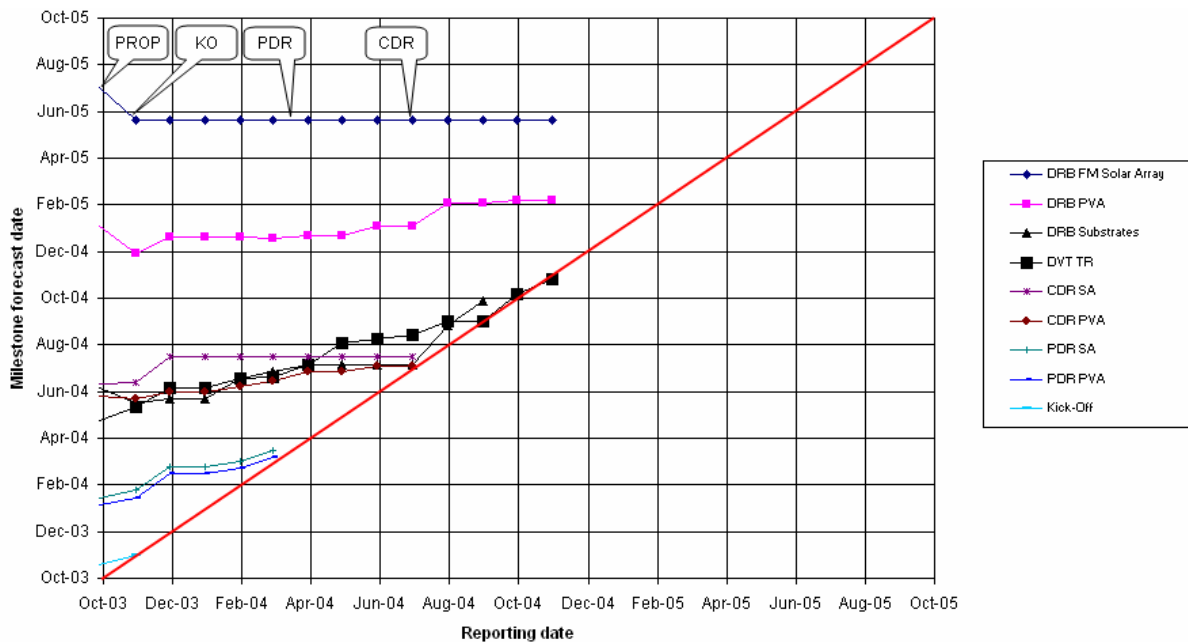


Figure 5: Gantt chart example

The evolution of the planned dates for key milestones within the project lifetime results in a trend analysis, which is one key method of assessing the project status. Different representations of trend analysis exist, of which the following are two examples:

A Milestone Trend Chart (MTC) allows the performing of milestone trend analysis (MTA). In a MTC, the dates of milestones are drawn in a graph versus the reporting dates of the schedule. The slope of the graph indicates whether the considered milestone progresses consistently (zero slope), is delayed (positive slope) or accelerated (negative slope). Figure 6 shows one example of an MTC illustration with a number of milestones.



**Figure 6: Milestone trend chart example**

Figure 7 shows an example of a Milestone List.

A concise overview of the project is obtained through a “traffic light” presentation by comparing the baseline and current working schedule for each identified milestone.

In the following list the traffic light is defined as:

- green: on schedule with more than 10 days margin
- yellow: current date within +/- 10 days of baseline date
- red: current date more than 10 days later than baseline

Milestone	Baseline	Current	
Finish of development	1/ Jun 04	8/ Jun 04	●
Design review	1/ Nov 04	10/ Oct 04	●
Start manufacturing	1/ Feb 05	25/ Jan 05	●
Delivery	1/ Jul 05	20/ Aug 05	●

**Figure 7: Milestone list example**

## 5.3 Schedule reporting

### 5.3.1 General

Schedule reporting helps to satisfy the information requirements for schedule control and performance measurement. It provides clarity regarding the project status and progress. It supports the work of achieving the project objectives and supports the decision making process of the actors at all levels of the project.

Schedule reporting is implemented within the supplier's organization and between the supplier and customer. The form, content, level of detail and frequency of the schedule reporting are defined in the customer/supplier business agreement.

### **5.3.2 Schedule progress information**

The baseline schedule constitutes the reference for schedule control and progress reporting. The supplier reports periodically to the customer in the current working schedule on the progress achieved. Both baseline and current working schedules are maintained by the supplier.

The following items are reported as a minimum:

- Activities started, together with their actual start date;
- Activities completed, together with their actual finish date;
- Forecast completion dates for activities in progress;
- Validity assessment of the defined sequences, relationships and constraints of planned activities.

Evolution of major project events selected as key milestones are reported in conjunction with the above information and is commonly presented in the form of a milestone trend chart (as defined in subclause 5.2.3 above).

Reported items are based on work packages and corresponding schedules (see ECSS-M-20B, subclause 5.3.3 c.).

During the project phases, project reviews are held (see ECSS-M-30A, clauses 4 and 7; ECSS M-30-01A). They include formal presentations and reports on project progress and evaluation.

The supplier formally notifies the customer, independently from the nominal reporting cycle, within a short time notice agreed upon between the parties:

- any event that can significantly affect the achievement of the agreed schedule objectives, and
- any situation resulting in a substantial schedule change.

Any reported schedule information is accompanied with a description of assumptions and resulting effects. Causes of deviations from baseline schedule are explained, and remedy actions are proposed.

### **5.3.3 Reporting system and tools**

There are different schedule reporting means to ensure effective communication between supplier and customer concerning project progress and evaluation, and to initiate or support decision making, e.g.:

- Formal meetings
- Formal reports
- Review meetings (see ECSS-M-30A, clauses 4 and 7; ECSS-M-30-01A)
- Agreed minutes of meeting (see ECSS-M-20B, subclause 5.3.1 e.)
- Agreed action item list (see ECSS-M-20B, subclause 5.3.1 g.)
- Trend report (see subclause 5.2 above)
- Problem notification report
- Comparison of planned and actual data (see ECSS-M-20B, subclause 5.3.3)
- Gantt charts (see subclause 5.2)
- Traffic light representation of the milestone status (see subclause 5.2).

## 6

# Cost management principles

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## 6.1 General

The objective of Cost Management is to ensure a rapid assessment of proposed payment profiles, of actual expenditures, and of risks and deviations. Furthermore, it facilitates the prediction of potential deviations, and the definition and implementation of corrective actions to avoid cost overruns. It also provides the forecasting of future incomes and expenses to support budget and cash flow planning and ensures the visibility on the current project commitments.

In conjunction with Schedule Management, it provides the means to harmonize the schedule planning and the cost plans for accurate time phasing of costs and resources. When used with Change Management, it provides the means to evaluate changes for their cost impact.

## 6.2 Contractual and financial interfaces

### 6.2.1 Audited rates and cost structure

Audited rates are the rates that are examined and specified during financial audits performed between the first level customer, or another recognized entity, and the supplier concerned, independent of the contract price type. Through the financial audits, the structure of expenses is specified and for each supplier the breakdown between the direct and indirect cost categories is agreed, including the general overhead structure.

Audited rates are normally defined for the following cost categories: labour, internal special facilities, other direct cost elements and general expenses.

### 6.2.2 Currency and exchange rates

The request for proposal or the business agreement prescribes the currency and exchange rate to be used in cost estimates and reports.

### 6.2.3 Contract change notice (CCN)

A contract change notice (CCN) is the means by which changes to the business agreement are made, i.e.

- Any change with a financial or schedule impact on the project is submitted by the supplier to the customer;
- The change is notified to the customer with accompanying documentation defining classification of the change, technical, schedule and cost impacts in accordance with the specified contractual regulations;

- The customer's decision is given after a proper impact assessment (technical, cost and schedule) is performed.

The agreement reached between the customer and the supplier is documented in a CCN. The implementation of the CCN results in a new baseline agreed for the project, against which cost control, analysis and reporting is performed.

## 6.3 Cost estimating and planning

### 6.3.1 Cost estimating

Cost estimating is the process of determining the expected costs of a project. This activity is of high importance at project management level because an accurate and reliable cost estimate has a positive impact on the total project cost. In addition:

- Over-estimating cost can result in a project or programme not being funded (on the customer side), or not being selected (on the supplier side).
- Under-estimating cost prevents decision-maker from allocating the proper funding to support the project and therefore increases the risk of failure.
- A proper cost estimate supports the project or programme budgeting and funding process.
- Repeated and documented cost estimates allow sound comparisons to support the decision-making process.

Specific cost estimating techniques used in the frame of value engineering activities are addressed in ECSS-E-10 Part 8.

**To perform the cost estimation for a project, the main activities are:**

- Generate and maintain a reference data repository,
- Cost estimate preparatory activities,
- Selection of method and construction or implementation of cost model(s),
- Performance and maintenance of cost estimate,
- Drafting of cost estimate report,
- Approval of cost estimate report,
- Update cost estimate report.

#### Reference data repository

Carrying out cost estimating activities supposes the existence and the maintenance of a reference data repository that constitutes the prerequisite infrastructure for all further cost estimating processes.

Cost models are derived from the reference data repository in which costs and associated technical and programmatic data are permanently maintained. The source of this cost information can be:

- proposal data (usually real open competition fixed prices),
- previous studies data,
- historical costs, provided that a clear breakdown of the CCNs prices per WBS element has been done and that the nature of the cost growth (accidental or inherent) has been identified.

The repository is also used for picking up close references for direct throughput or analogy-based estimates.



### **Cost estimating preparatory activities**

The objective of the cost estimating preparatory activities is to establish a common baseline to be used by the project team to develop its estimates. For this preparatory step, an important input is the work breakdown structure (WBS). The main task consists of analysing the deliverables described in the WBS to identify all the tasks needed to achieve the project goals. In addition, comparing cost item check lists with the activities listed in the WBS serves as a reality check and allows discovery of tasks that were overlooked or duplicated.

All cost driving parameters are identified at this stage as an entry for the selection or elaboration process of the cost models.

From this stage, the supplier works according to its cost estimating plan (see Cost Estimating plan DRD).

### **Selection of the cost estimating method and construction of cost model(s).**

The selection of the cost estimating method and the construction of cost model(s) consist of:

- developing a list of base assumptions;
- collecting input data;
- selecting the best cost estimating method (or combination of methods) according to the project phase and data available;
- selecting the most appropriate tool/model or creating or adapting a model to estimate cost.

Each method relies on specific inputs. Bottom-up cost estimates, for instance, are based on the resource requirements (i.e. the description of the resources needed, when they are needed, and for how long), resource cost rates, and the activity duration estimates to calculate cost estimates for each activity. Finally, historical information and risk information are used to help determine which approaches and methods yield the most accurate estimates. More details on each method are given in informative Annex Q.

### **Performance and maintenance of cost estimating**

The performance assessment of the defined cost estimating methods consists of running the models, and eventually adjusting the resulting values to:

- perform the cost estimating analysis and a sensitivity analysis to identify and rank the main cost drivers,
- assemble all elementary cost models including cost risk assessment models in a project cost model representing a cost simulation of the project,
- determine the cost figure to be retained for meeting an a priori level of confidence expressed by the decision-makers.

### **Drafting of cost estimate report**

The output of the estimating process is a cost estimate report (see cost estimate report DRD in Annex H). This report consists of capturing the cost estimate results, in a continuous approach from project initiation through completion. It is important to keep the cost estimate up-to-date in order to defend the estimate over time and provide valuable information and an accurate picture of the project for decision-makers.

### **Approval of cost estimate report**

Once the draft cost estimate report has been produced, it is then reviewed and approved according to the cost estimating plan, prior to its release to the

customer at agreed milestones.

### **Cost estimates updates**

The cost estimate report is a living document. Its evolution can result either from the internal review and approval process, or later through including customer feedback or requests for modifications of the technical or programmatic hypothesis.

The updating of the cost estimate is performed by taking into account the modifications at different levels:

- Simply correcting any potential errors in the application of the models and associated hypothesis;
- Establishing more appropriate cost models for specific items;
- Taking into account a modified technical or programmatic hypothesis and re-running the whole cost estimating process.

### **6.3.2 Development Cost Plan (DCP)**

The Development Cost Plan (DCP) shows how the anticipated cumulative expenses of the project are developing over time. The project DCP is divided in sub-sets of DCPs based upon the Work Breakdown Structure and the agreed cost breakdown structure. The time phasing periods of the DCP are defined by the customer.

### **6.3.3 Payment plans**

Payment plans are subject to a business agreement between the customer and the supplier. They allow the customer and the supplier to plan their expenses and incomes, respectively. Depending on the requirements of the customer, payment plans are generally derived from:

- milestones, forming altogether a milestone payment plan (MPP), derived from the milestone list defined in the schedule. The MPPs include measurable payment events, generally either technical (e.g. deliveries) or programmatic (e.g. reviews);
- planned expenses of the project (for cost reimbursement contracts). In such case, the DCP is used to derive the forecast payment plan.

### **6.3.4 Price variation mechanism**

A price variation mechanism<sup>1</sup> is agreed for each supplier, linking the current economic conditions with the reference economic conditions. It allows one to take due account of the evolving economic conditions as the project activities progress. It ensures that the reference costs, fees or prices are upgraded to the current applicable economic conditions throughout the project lifetime.

The price variation mechanism is associated with:

- a price escalation formula using agreed indices, which reflect the nature of the activities performed,
- agreed amounts serving as the basis for escalation computation.

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<sup>1</sup> Although defined as "price" variation mechanism, such mechanism also applies to cost elements and fees in case of cost reimbursement business agreements.

The price escalation formulae commonly used in business agreements are as follows:

$$P = P_0 * (a + b * S/S_0 + c * M/M_0)$$

where:

- a, b and c are weighting factors and  $a+b+c = 1$ ;
- P = revised amount expressed at current economic conditions;
- $P_0$  = basis amount expressed at the reference economic conditions, subject to revision;
- S, M = various agreed indices associated with the price escalation formula, expressed at current economic conditions;
- $S_0, M_0$  = value of the agreed indices at the reference economic conditions.

### **6.3.5 Geographical distribution**

Geographical distribution reflects the distribution per country of the business agreement price. It is deduced from the Country/Company Structure (CCS). In some cases, a dedicated geographical distribution is imposed as a requirement, together with specific implementing rules.

### **6.3.6 Inventory Control plan**

Inventory Control is the instrument for accounting of the customer's assets. Items that are produced or purchased specifically for the purpose of a project, and used exclusively or predominantly within the said project, become the customer's property. They are subject to Inventory Control provided that they

- are paid for or made available by the customer,
- are not included in the Deliverable Items List (DIL),
- have a lifetime in use greater than a duration specified in the business agreement, and
- have a purchase value or, in the case of items manufactured in house, an estimated market value greater than a threshold specified in the business agreement.

Items subject to Inventory Control are documented in an Inventory List.

The Inventory Control procedures are described in an Inventory Control Plan, which identifies the items to be controlled and how they are classified, marked, recorded, treated, maintained, operated, stored and disposed of. It also addresses the procedures applicable to inventory audits and physical inspection.

Some of the inventory classifications to be considered are: consumable items, capital items, production support equipment, tools, customer furnished equipment, contractor acquired equipment, standard equipment, residuals, attractive items and logistics support items.

For marking purposes, a unique inventory control number is given to all moveable assets.

## 6.4 Cost control

### 6.4.1 Baseline Cost Plan

The set of financial data on which the customer and the supplier have reached an agreement constitutes the Baseline Cost Plan. Any update to that Plan follows a formal change procedure agreed by the parties. The evolutions of the Baseline Cost Plan are put under configuration control.

The initial business agreement includes the Original Baseline Cost Plan (OBCP). The OBCP, together with the financial impact of changes contractually agreed thereafter, constitutes the Current Baseline Cost Plan (CBCP):

$$\text{Original Baseline Cost Plan (OBCP)} + \text{Approved changes} = \text{Current Baseline Cost Plan (CBCP)}$$

The applicable Baseline Cost Plan (original or current) serves as a basis for actively exercising manpower and cost monitoring, controlling and reporting, and for assessing any change.

### 6.4.2 Estimate at Completion (EAC) and Estimate to Completion (ETC)

#### 6.4.2.1 General

The Estimate at Completion (EAC) and the Estimate to Completion (ETC) are regularly prepared and submitted by the supplier to the customer at specific cut-off dates. The data are expressed in the economic conditions agreed with the customer. The EAC gives an estimate of the total expenses of the project upon its completion.

The ETC is a part of the EAC. The ETC is the total expenses estimated for work to be performed from the defined cut-off date and until the work is completed.

#### 6.4.2.2 Cost Reimbursement contracts

For Cost Reimbursement contracts the EAC and ETC are prepared for all agreed Control Work Packages, they are time phased and follow the Cost Breakdown Structure. They are based on all incurred costs up to the cut-off date and on the estimated cost of the remaining work up to completion, including the approved, known and potential contract changes.

#### 6.4.2.3 Fixed Price contracts

For Fixed Price contracts, the EAC is based on the agreed milestone payment plans.

It includes all payments made together with their associated escalation payments, all future forecast payments and their associated dates, and the approved, known and potential Contract Change Notices (CCN).

### 6.4.3 Price variation

Price variation computation is made on the basis of agreed amounts (generally derived from the DCP or from the Milestone Payment Plan), applying the agreed Price Escalation Formula (PEF) and using agreed indices.

The submission procedure of the resulting escalation amount is defined in the business agreement. As an example, it can be submitted in two steps through one provisional and one final invoice. The supplier submits the provisional invoice - using preliminary indices - at a time agreed with the customer. The final invoice is submitted following terms agreed with the customer, but based on the availability of the relevant final indices.

#### **6.4.4 Geographical distribution control**

The procurement process is performed with permanent interaction between the customer and the supplier to control the evolution of the geographical distribution of the project and to ensure that the geographical distribution objectives can be met. Once the procurement process is finalized, only CCNs can affect the geographical distribution.

#### **6.4.5 Inventory control**

Inventory control ensures that all property items are uniquely identified and that changes to such items affecting their configuration, quality, reliability, performance, value or usefulness to the end customer, as well as their physical location, movements or transformation are traced and recorded.

In line with the procedures defined in the Inventory Control Plan, inventory control provides the accountability to the customer for items produced or purchased specifically for the purpose of a project, and used exclusively or predominantly within the said project.

Although any item purchased under the contract remains the customer's property, a minimum item value is specified for each class of item to determine whether or not an item is subject to inventory control.

All items under inventory control are disposed of as prescribed by the customer.

#### **6.4.6 Financial audits**

In case of a cost reimbursement contract, the customer has the right, either itself or through an authorized representative (relevant national authority or international organization) to verify the correctness of the reported cost data with respect to the internal company accounts of the supplier at any time, after due notification. Financial audits are generally performed on a yearly basis.

#### **6.4.7 Payment Milestone Achievement**

A payment milestone is linked to the successful completion of measurable payment events (generally either technical or programmatic, see subclause 6.3.3 above), as agreed in the business agreement. It is formalized through the submission of a Payment Milestone Achievement Certificate (PMAC) or any other formal document agreed by the parties.

### **6.5 Cost reporting**

#### **6.5.1 Reports applicable to all contract types**

They are submitted by the supplier to the customer with a periodicity defined in the business agreement, regardless of the type of contract agreed:

- OBCP;

- CBCP;
- EAC;
- Financial elements enabling the customer to establish the project Geographical Distribution;
- Price variation mechanism relevant elements;
- Inventory Records.

### **6.5.2 Reports specific to Cost Reimbursement Contracts**

The reports are submitted by the supplier to the customer with a periodicity defined in the business agreement:

- Actual versus planned costs of the applicable CBCP, including analysis of deviations;
- Cost Sharing scheme status;
- ETC;
- Financial Statement of cost incurred, to be updated after finalization of the corresponding financial audit.

## Cost and schedule management common requirements

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### 7.1 Project structure

#### 7.1.1 Work Breakdown Structure

A WBS shall be established in conformance with ECSS-M-10 and Annex A, Work Breakdown Structure DRD.

AIM: Provide a framework for managing planning and cost.

EXPECTED OUTPUT: Work Breakdown Structure.

#### 7.1.2 Cost Breakdown Structure

a. Based on the CBS defined by the customer that conforms to Annex B, Cost Breakdown Structure DRD, the supplier may extend the CBS to include additional cost categories.

b. The cost categories proposed to be added to the customer CBS shall be agreed by the customer.

AIM: Define a set of cost categories applicable to all participants in the project.

EXPECTED OUTPUT: Applicable CBS.

c. Based on the CBS applicable to the project as defined by the customer, the supplier shall identify the indirect cost elements of his own cost structure.

AIM: Identify the cost categories of the supplier, which are not directly chargeable to the customer.

EXPECTED OUTPUT: List of cost categories not directly chargeable to the customer

#### 7.1.3 Business Agreement Structure

a. The supplier shall submit a Business Agreement Structure that covers all elements of the WBS, for customer's approval.

b. The Business Agreement Structure shall be maintained up to date during the project life cycle.

AIM: Define the hierarchical lines and reporting relationships applicable to the project.

EXPECTED OUTPUT: Approved project Business Agreement Structure.

#### **7.1.4 Country/Company structure (CCS)**

- a. The supplier shall provide a CCS that covers all elements of the WBS, for customer's approval.
- b. The CCS may be combined with the Business Agreement Structure in case the countries, in which the works are performed, are easily identified.
- c. The CCS shall be maintained up to date during the project's life cycle.

AIM: Define the breakdown of the project work per country.

EXPECTED OUTPUT: Approved project CCS.

## **7.2 Risk management**

- a. The supplier shall identify from the risk register, established in conformance with ECSS-M-00-03, those risk elements of explicit relevance to Cost and Schedule management.

AIM: Define the project areas where margins need to be provisioned.

EXPECTED OUTPUT: Risk elements of specific relevance to Cost and Schedule management.

- b. The supplier shall take into account the lessons learned from similar projects when defining his overall needs.
- c. The supplier shall perform and document, upon completion of the project, a critical analysis of the decisions taken in the course of the project development.

AIM: Identify the positive and negative aspects of the way in which the project has been conducted.

EXPECTED OUTPUT: Lessons learned report.



## 8

# Schedule management requirements

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## 8.1 Schedule definition

a. The supplier shall develop and maintain a schedule that takes into account the activities to be performed and the resources to be allocated.

b. The critical path shall be identified when defining the project schedule.

AIM: Develop and maintain a schedule, which demonstrates supplier's ability to meet business agreement delivery dates with sufficient confidence.

EXPECTED OUTPUT: Agreed schedule logic.

c. For network analysis purposes, the supplier should use the Precedence Diagram Method (PDM) that represents the activities and connects them with links to show dependencies

NOTE Common and commercial available schedule software tools support this PDM method.

d. Customer and supplier shall agree upon a project calendar reflecting working hours, working days and holidays to be taken into account during scheduling.

AIM: Define a common baseline between customer and supplier with respect to working and non-working time.

EXPECTED OUTPUT: Agreed project calendar.

## 8.2 Schedule control

a. The supplier shall define and submit for customer's approval a baseline schedule that conforms to the Annex C, schedule DRD.

AIM: Agree upon reference data for schedule control and schedule reporting.

EXPECTED OUTPUT: Agreed baseline schedule.

b. The supplier shall include in the baseline schedule the agreed contractual changes having an impact on the project schedule.

AIM: Ensure the coherence of the baseline schedule with the business agreement status.

EXPECTED OUTPUT: Updated baseline schedule.

c. The supplier shall define and maintain up to date a current working schedule that conforms to the Annex C, schedule DRD.

d. The supplier shall submit the current working schedule to the customer for

review and comment.

AIM: Ensure a continuous follow-up of the actual progress of the project.

EXPECTED OUTPUT: Current working schedule.

e. The supplier shall perform continuous performance measurement of the project.

AIM: Facilitate the assessment of the current schedule status by the customer.

EXPECTED OUTPUT: Representation of the performance measurements in the format and level of detail agreed by the customer and the supplier.

f. The supplier shall notify the customer, independently from the nominal reporting cycle, within a short time notice agreed upon between the parties

- any event that can significantly affect the achievement of the agreed schedule objectives, and
- any situation resulting in a substantial schedule change.

AIM: Inform customer as early as possible about likely identified risk event.

EXPECTED OUTPUT: Schedule alert reporting.

### 8.3 Schedule reporting

The supplier shall provide a schedule report that conforms to Annex D, schedule progress report DRD.

AIM: Get an adequate and clear understanding of the schedule progress and trends.

EXPECTED OUTPUT: Schedule progress report.

## Cost management requirements

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### 9.1 Contractual and financial interfaces

#### 9.1.1 Audited rates and cost structure

- a. The rates and cost structure of the companies shall be approved by the relevant national authority or international organization.
- b. The rates and cost structure may be audited by the relevant national authority or international organization.

AIM: Ensure coherence of cost data.

EXPECTED OUTPUT: Audited rates and cost structure.

#### 9.1.2 Economic conditions

The cost information (e.g. estimates and reports) shall be expressed in the economic conditions specified by the customer.

AIM: Allow proper correlation between planned and actual cost/price throughout the life cycle of the project.

EXPECTED OUTPUT: Cost data based on specified economic conditions.

#### 9.1.3 Currency and exchange rates

The supplier shall conform to the currency and exchange rates applicable to the project.

AIM: Ensure coherence of cost data.

EXPECTED OUTPUT: Consistent project cost data.

#### 9.1.4 Contract Change procedure

Any submitted CCN shall conform to Annex P, contract change notice DRD.

AIM: Ensure that the agreed baseline is maintained up to date.

EXPECTED OUTPUT: Current Baseline Cost Plan.

## 9.2 Cost estimating and planning

### 9.2.1 Cost estimating

- a. The supplier shall provide a project cost estimating plan that conforms to Annex G, Cost estimating plan DRD.
- b. Any supplier proprietary data in the cost estimating plan shall not be disclosed to any non-authorized party without the supplier's agreement.

AIM: Define the processes and organization linked to the elaboration and delivery of cost estimates in the frame of the business agreement.

EXPECTED OUTPUT: Cost estimating plan.

- c. The supplier shall provide a project cost estimating report that conforms to Annex H, Cost estimate report DRD.
- d. The supplier shall maintain up to date the project cost estimating and its related reports, to be submitted at intervals agreed with the customer.
- e. Any supplier proprietary data in the cost estimating report shall not be disclosed to any non-authorized party without the supplier's agreement.

AIM: Establish the project cost estimating in a structured and traceable manner in order for the customer and supplier to share a common understanding of what the forecast project cost is.

EXPECTED OUTPUT: Cost estimating report.

### 9.2.2 Project financial information

The supplier shall provide the company Price Breakdown Forms for the project that conform to Annex E, Company Price Breakdown Forms DRD.

AIM: Provide financial information relating to the project.

EXPECTED OUTPUT: Company Price Breakdown Forms.

### 9.2.3 Development Cost Plan (DCP)

- a. The supplier shall develop a DCP, as defined in 6.3.2 and based upon the Product Tree, WBS and CBS and the Company Price Breakdown Forms.
- b. The DCP shall be time-phased as agreed with the customer.

AIM: Ensuring coherence of all submitted cost data and facilitating their consolidation and analysis.

EXPECTED OUTPUT: Development cost plan.

### 9.2.4 Milestone Payment Plans

The supplier shall develop Milestone Payment Plan that conforms to Annex I, Milestone Payment Plan DRD.

AIM: Define a financial basis for the business agreement

EXPECTED OUTPUT: Milestone Payment Plan.

### 9.2.5 Price Variation Mechanism

- a. The supplier shall propose a Price Variation Mechanism to be applied during execution of the work.
- b. The Price Variation Mechanism should include the following information, mutually agreed by the parties:
  - Amounts that are the basis of the price variation computation;
  - Indices, generally reflecting the evolution of raw material prices and of the remuneration of labour categories representative of the project activities;
  - A price escalation formula associating the two elements mentioned above, defining how the revised price (cost or fee, as applicable) is computed.

AIM: Define a mechanism linking the current economic conditions with the reference economic conditions of the contract.

- c. For Fixed Price contracts with duration of less than 2 years, a Firm Fixed Price should be agreed.

AIM: Avoid unnecessary administrative burden.

EXPECTED OUTPUT: Price Variation Mechanism.

### 9.2.6 Geographical Distribution

- a. The supplier shall propose a work distribution compliant with the geographical distribution specified by the customer, that conforms to Annex F, Geographical distribution report DRD.
- b. The supplier shall submit a summary of the proposed geographical distribution of work

AIM: Provide visibility on the planned geographical distribution.

EXPECTED OUTPUT: Geographical Distribution forecast.

## 9.3 Cost control

### 9.3.1 Original Baseline Cost Plan

#### 9.3.1.1 Original Baseline Cost Plan for Cost Reimbursement contracts

- a. The supplier shall provide the Original Baseline Cost Plan (OBCP) for himself and for all his lower tier suppliers that conforms to Annex L, OBCP and CBCP DRD for Cost Reimbursement, for customer approval.
- b. The OBCP shall be broken down according to the cost categories in the CBS.
- c. The OBCP shall be used as the reference for all Control Work Packages.

AIM: Document the agreed financial data of the project.

EXPECTED OUTPUT: Original Baseline Cost Plan (OBCP).

### **9.3.1.2 Original Baseline Cost Plan for Fixed Price contracts**

The supplier shall provide the Original Baseline Cost Plan (OBCP) for himself and for all his lower tier suppliers that conforms to Annex M, OBCP and CBCP DRD for Fixed Price, for customer approval.

AIM: Document the agreed financial data of the project.

EXPECTED OUTPUT: Original Baseline Cost Plan (OBCP).

### **9.3.2 Current Baseline Cost Plan**

The supplier shall update the Original Cost Baseline Plan (OBCP) to incorporate all agreed changes.

AIM: Keep an up to date record of the agreed financial data of the project and its evolutions.

EXPECTED OUTPUT: Current Baseline Cost Plan (CBCP).

### **9.3.3 Estimate at Completion (EAC) and Estimate to Completion (ETC)**

#### **9.3.3.1 Cost Reimbursement Contracts**

a. The supplier shall submit an Estimate at Completion and an Estimate to Completion to the customer that conform to Annex N, EAC and ETC for Cost Reimbursement DRD.

b. The supplier shall submit the EAC and ETC based on agreed cut-off dates and economic conditions, showing commitments and payments, taking account of the schedule, physical progress of the work, including all agreed, submitted or known potential changes.

NOTE Potential changes include identified change proposals (either an answer to a change request or a change proposal initiated by the supplier), which are pending complete supplier assessment.

c. The ETC shall detail the estimated cost and manpower data for the work to be performed from the cut-off date until project completion including all agreed, submitted or known potential changes.

d. EAC and ETC data shall be prepared for each agreed Control Work Package defined in the Work Breakdown Structure, time phased, and subdivided into the agreed cost categories of the Cost Breakdown Structure.

AIM: Perform a critical assessment, at a given cut-off date, of the estimated total project cost upon its completion.

EXPECTED OUTPUT: Estimate at Completion and Estimate to Completion.

e. The supplier shall ensure that the claimed actual expenditures (i.e. expenses and manpower) are reconcilable with those recorded in its internal accounting system.

AIM: Ensure the consistency and traceability of the cost data.

EXPECTED OUTPUT: Consistent cost reporting.

### **9.3.3.2 Fixed Price Contracts**

The supplier shall submit an Estimate at Completion to its customer on agreed cut-off dates and at agreed economic conditions that conforms to Annex O, EAC for Fixed Price DRD.

AIM: Perform a critical assessment, at a given cut-off date, of the estimated total project price upon its completion.

EXPECTED OUTPUT: Estimate at Completion.

### **9.3.4 Price Variation Mechanism**

The supplier shall provide the customer with the computation of price variation applying the agreed formula and indices and the relevant supporting documentation upon submission of escalation invoices.

AIM: Ensure the proper application of price variation.

EXPECTED OUTPUT: Escalation amounts relevant to the agreed prices, costs and fees as applicable.

### **9.3.5 Geographical Distribution Control**

a. The supplier shall maintain up to date and submit to its customer a report on the actual geographical distribution of work of the project, that conforms to Annex F, Geographical distribution report DRD.

NOTE: Once the procurement process is finalized, only an approved CCN can formally affect the project geographical distribution.

AIM: Keep an up-to-date record of geographical distribution status.

EXPECTED OUTPUT: Up-to-date record of geographical distribution.

b. The supplier shall specify the impact of any planned project change on the current geographical distribution.

AIM: Establish proper geographical distribution trends.

EXPECTED OUTPUT: Up-to-date forecast geographical distribution.

### **9.3.6 Inventory Control**

Based on the Inventory Control requirements defined by the Customer, the supplier shall submit an Inventory Control Plan applicable to the project that describes the organization, methods, means and procedures to manage the project inventory, for customer's approval.

AIM: Define procedures ensuring proper treatment and accountability of all items that are produced or purchased for the purpose of the project

EXPECTED OUTPUT: Inventory Control Plan.

### **9.3.7 Financial audits**

In the case of a cost reimbursement contract, the customer shall have the right to audit, either itself or through an authorized representative (relevant national authority or international organization), the claimed expenses against the internal company accounts, in accordance with the dispositions of ECSS-M-20B, subclause 5.3.4.

AIM: Verify the financial claim after having ensured the proper accounting of the expenses relating to the project.

EXPECTED OUTPUT: Financial audit report.

### **9.3.8 Payment Milestone Achievement**

a. The customer and the supplier shall agree on a way to certify and document the achievement of payment milestones.

b. The supplier shall certify the achievement of each milestone.

AIM: Ensure that payment process is initiated only upon or after successful completion of the corresponding milestone.

EXPECTED OUTPUT: Payment Milestone Achievement certificate or any other formal document agreed by the parties.

## **9.4 Cost management reporting**

### **9.4.1 Cost and manpower report**

a. For cost reimbursement contracts, the supplier shall submit cost and manpower reports that conform to Annex K, Cost and manpower report DRD.

b. For cost reimbursement contracts, the incurred expenditures shall be reported per control work package applying the agreed Cost Breakdown Structure and audited rates.

AIM: Provide visibility to the customer of the actual cost development of the project.

EXPECTED OUTPUT: Cost and manpower report.

### **9.4.2 Inventory record**

a. The supplier shall record, store, maintain, refurbish, keep up to date with respect to their location, value, operation ability and safety, all items of the project in an Inventory record that conforms to Annex J, Inventory record DRD.

b. The supplier shall dispose of items under his custody according to the Customer's requirements in accordance with the approved Inventory Control Plan.

AIM: Ensure the traceability of the customer's property.

EXPECTED OUTPUT: Up to date inventory record.

c. The customer shall have the possibility to perform audits and physical inspection of all project assets in line with the dispositions of ECSS-M-20B, subclause 5.3.4.

AIM: Ensure the integrity of the customer's property.

EXPECTED OUTPUT: Inspection report.



## Annex A (normative)

# Work Breakdown Structure - DRD

---

### A.1 DRD identification

#### A.1.1 Requirement identification and source document

- ECSS-M-10B, requirements of section 5.5.
- ECSS-M-60B, requirement 7.1.1.

#### A.1.2 Purpose and objective

The objective of the work breakdown structure (WBS) is to provide, in a single document, a framework for project in Cost and Schedule management activities (as defined in ECSS-M-60B) and for managing technical content. It assists project's participants in:

- Conducting tender comparisons and business agreement negotiations;
- Optimizing the distribution of work amongst the different suppliers;
- Monitoring the schedule of the project.

The WBS divides the project into manageable work packages, organized by nature of work. It identifies the total work to be performed down to a level of detail agreed between the customer and supplier.

### A.2 Expected response

#### A.2.1 Response identification

The requirements for document identification contained in ECSS-M-50 shall be applied to the WBS.

#### A.2.2 Scope and contents

The WBS shall provide the information presented in the following sections:

##### <1> Introduction

The WBS shall contain a description of the purpose, objective and the reason prompting its preparation (e.g. programme or project reference and phase).

##### <2> Applicable and reference documents

The WBS shall list the applicable and reference documents supporting the generation of the document.

##### <3> Tree structure

- a. The WBS shall provide a logical and exhaustive breakdown of the

product tree elements, that includes the Customer's defined support functions (e.g. project management, engineering, product assurance support) necessary to produce the end item deliverables (development and flight models) and the necessary services as appropriate for the project.

- b. Each WBS element at completion shall represent a quantifiable output.
- c. A coding scheme for WBS elements that represents the hierarchical structure when viewed in text format shall be used.

**NOTE** a common coding system facilitates communications among all project participants.

**EXAMPLE** to each WBS element is assigned a code used for its identification throughout the life of the project. It can be a simple decimal or alphanumeric coding system that logically indicates the level of an element and related lower-level subordinate elements.

- d. The WBS shall identify all Control work-packages.
- e. The Control work-packages may be further broken down by the supplier in several more detailed work-packages.
- f. All defined work-packages together shall cover the total work scope.
- g. The WBS shall be presented either as a graphical diagram or an indentured structure.
- h. For each element identified in the WBS, the following information shall be provided as a minimum:
  - WBS element description;
  - WBS element identification code;
  - supplier's name (at least for the product tree elements described in the WBS).

### **A.2.3 Special remark**

None.

## Annex B (normative)

### Cost Breakdown Structure - DRD

---

#### B.1 DRD identification

##### B.1.1 Requirement identification and source document

ECSS-M-60B, requirement 7.1.2.

##### B.1.2 Purpose and objective

The Cost Breakdown Structure (CBS) defines the breakdown of all the costs of the project into agreed cost categories to be used for all Cost management activities. It also provides the framework used for cost summarization with other structures as well as a clear distinction between direct and indirect cost categories.

#### B.2 Expected response

##### B.2.1 Response identification

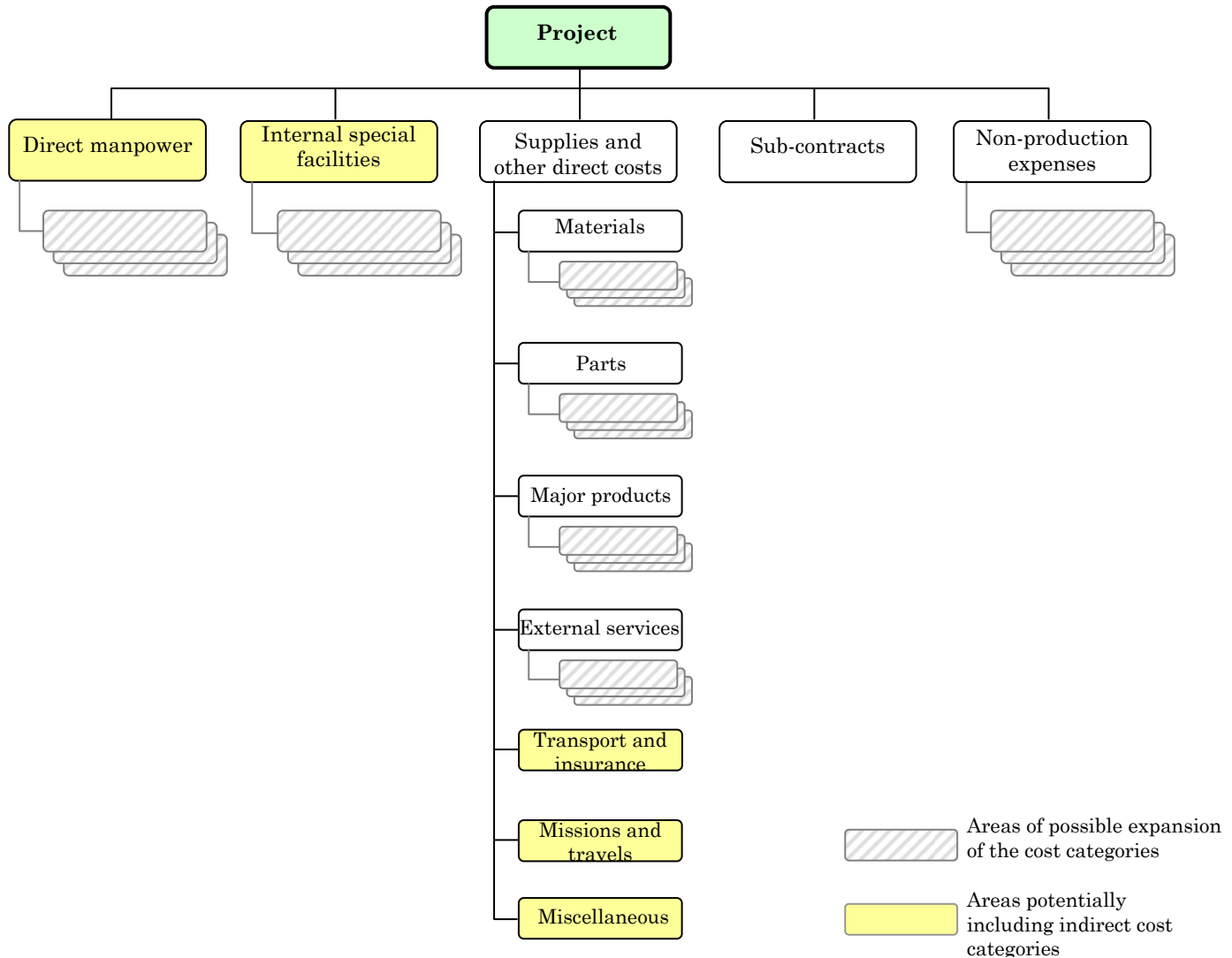
The requirements for document identification contained in ECSS-M-50 shall be applied to the CBS.

##### B.2.2 Scope and contents

Any space project shall use the standard CBS depicted hereafter, which identifies areas

- which can be further broken down in additional cost categories, and
- which can potentially include indirect cost categories.

Margin and profit are not considered herein as cost categories, since it does not reflect an expense to be borne by the supplier for the execution of the project. However they are generally expense types borne by the customer for the benefit of his supplier.



The following main cost categories shall be used:

- Direct manpower
- This is the manpower effort, which can be accounted as direct manpower cost to the project, using the agreed hourly rates. The company's cost structure is generally broken down in several manpower cost categories in accordance with its accounting principles and methods. The company's manpower structure can include indirect cost categories.
- Internal special facilities
- They are specialized technical means, which represent, for example, computer facilities and integration hall for which standard unit charging rates have been defined. The work unit used for each identified facility is also defined. The company's structure can include indirect cost categories relating to internal special facilities.
- Supplies and other direct costs
- They are either parts to be incorporated, with or without transformation, into the project work, or subcontracts or services relating to studies or manufacturing works. They are broken down as follows:

- Materials  
Raw material, mechanical parts, semi-finished products or electrical/electronic components, that are subject to transformation and assembly operations.
- Parts  
The smallest items used in a piece of equipment. They can be standard commercial parts or specific to space projects (e.g. high reliability EEE components). In general, parts are provided through a centralized parts procurement agent.
- Major products  
Worked items (such as sets, devices and modules) performing a function that can be directly incorporated or used without transformation. Major products are usually designed by a specialized supplier for the benefit of one or several purchasers.
- External services  
Services to be rendered by a third party such as, but not limited to, hire of facilities and expertise, computer services, manpower support.
- Transport and insurance  
Transport and insurance costs of the deliverable items or of a part thereof. The company's structure can include indirect cost categories relating to Transport & Insurance.
- Missions and travels  
Transport and accommodation costs for personnel who need to travel for the benefit of the project out of the production place. Mission and travel costs for personnel belonging to an indirect cost category are generally treated as indirect costs.
- Miscellaneous  
All other direct costs, not covered by the above categories, in so far as they enter into the project's production costs (e.g. translation and document reproduction).

- Subcontracts

They reflect the subcontracts expenses between the customer and its suppliers, established with a view to undertaking work which is sufficiently important and specific to require the drawing up of particular technical specifications and hence the conclusion of a specific business agreement. It excludes those elements which fall under a definition contained under the cost category "Supplies and other direct costs".

- Non-production expenses

They reflect the applicable overheads on subcontracts and general expenses (General & Administrative expenses, Research & Development expenses and other applicable general expenses) which are applicable to the project with rates in line with the approved company's structure.

### **B.2.3 Special remark**

None.

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## Annex C (normative) Schedule - DRD

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### C.1 DRD identification

#### C.1.1 Requirement identification and source document

ECSS-M-60B, requirement 8.2.a. for baseline schedule.

ECSS-M-60B, requirement 8.2.c. for current working schedule.

#### C.1.2 Purpose and objective

The objective of the schedule is twofold as follows:

- For the baseline schedule, establish a reference data base agreed between both contractual parties (the baseline schedule contains all reference data for the purpose of schedule control).
- For the current working schedule, provide an overview of the on-going activities and of the milestone status (for activities not yet completed, the current working schedule reflects the most probable prediction given by the supplier to the customer).

### C.2 Expected response

#### C.2.1 Response identification

The requirements for document identification contained in ECSS-M-50 shall be applied to the schedule.

#### C.2.2 Scope and contents

The schedule shall provide the following information, for both the baseline and current working schedules:

- key milestones;
- main and key inspection points (MIP / KIP);
- identification of the activities;
- flow of the activities (logical links between activities);
- start / finish date of activities;
- duration of activities;
- identification of the critical path activities;
- lower suppliers planned end dates.

When defining the schedule, the total float for each activity with respect to the agreed milestones shall be available.

### **C.2.3 Special remark**

The schedule should be presented in the form of a Gantt-Chart.



## Annex D (normative)

### Schedule Progress Report - DRD

---

#### D.1 DRD identification

##### D.1.1 Requirement identification and source document

ECSS-M-60B, requirement 8.3.

##### D.1.2 Purpose and objective

The objective of the schedule progress report is to provide the customer with a clear understanding of the schedule status, progress and trends.

#### D.2 Expected response

##### D.2.1 Response identification

The requirements for document identification contained in ECSS-M-50 shall be applied to the schedule progress report.

##### D.2.2 Scope and contents

The schedule progress report shall provide following information:

- baseline schedule and associated key milestones;
- current working schedule;
- milestone trend analysis for the key milestones;
- clarification and justification on deviations with respect to the baseline schedule;
- proposal of remedy actions;
- validity assessment of defined sequences, relationships and constrains of the planned activities;
- status of deliverable items.

##### D.2.3 Special remark

None.

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## Annex E (normative)

# Company Price Breakdown Forms - DRD

---

### E.1 DRD identification

#### E.1.1 Requirement identification and source document

ECSS-M-60B, requirement 9.2.2, for Project financial information.

#### E.1.2 Purpose and objective

The objective of the Company Price Breakdown form is to show manpower and cost data of the project broken down according to the cost categories defined in the CBS. When broken down per period or per work package, the corresponding Company Price Breakdown Forms also give an overview of the development in time of the project, and of the different work packages of the project respectively.

The Company Price Breakdown Forms are used to set up the Baseline Cost Plan and EAC/ETC for Cost Reimbursement contracts.

### E.2 Expected response

#### E.2.1 Response identification

The requirements for document identification contained in ECSS-M-50 shall be applied to the Company Price Breakdown.

#### E.2.2 Scope and contents

The Company Price Breakdown Forms shall provide the information presented in the following sections:

**<1> Header (or Footer)**

- Project title and contract/proposal reference
- Company name
- Issue date
- Currency, economic conditions and contract type

**<2> Cost categories, as defined in the CBS, presented as follows:**

- Direct manpower (number of labour hours and corresponding hourly rate, for each labour category)
- Internal special facilities (number of units and corresponding rate, for each facility)
- Supplies and other direct costs, detailed according to the agreed CBS
- Subcontracts

- Non-production expenses
- Profit applicable to the project costs
- Total Price

NOTE 1. when the above information is provided for the whole project, the ESA PSS-A2 form conforms to this DRD.

NOTE 2. when the above information is provided for the whole project, however broken down in each identified work package, the ESA PSS-A8 form conforms to this DRD.

NOTE 3. when the above information is provided for the whole project, however broken down in each time period agreed between the supplier and the customer (from start to end of the project), the ESA PSS-A10 form conforms to this DRD.

### **E.2.3 Special remark**

This DRD applies also when preparing for financial proposals.

## **Annex F (normative)**

# **Geographical Distribution Report - DRD**

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### **F.1 DRD identification**

#### **F.1.1 Requirement identification and source document**

ECSS-M-60B, requirement 9.2.6, for Geographical distribution forecast.

ECSS-M-60B, requirement 9.3.5, for Geographical distribution control.

#### **F.1.2 Purpose and objective**

The objective of the geographical distribution report is to provide visibility on the planned or actual geographical distribution and its forecast trends.

### **F.2 Expected response**

#### **F.2.1 Response identification**

The requirements for document identification contained in ECSS-M-50 shall be applied to the geographical distribution forecast.

#### **F.2.2 Scope and contents**

The geographical distribution forecast shall provide the following information:

- Report cut-off date
- Reference cut-off date economic conditions
- For each country, the following information:
  - Company name;
  - Equipment/Activity description;
  - Contract type;
  - Price per activity of the company's internal work share (or project turnover) at business agreement economic conditions;
  - Price per activity of the company's internal work share (or project turnover) at the reference economic conditions agreed for geographical distribution reporting purpose;
  - Subtotal per country at the agreed reference economic conditions.
- Total current baseline price at the agreed reference economic conditions

#### **F.2.3 Special remark**

None.

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## Annex G (normative)

### Cost Estimating Plan - DRD

---

#### G.1 DRD identification

##### G.1.1 Requirement identification and source document

ECSS-M-60B, requirement 9.2.1.

##### G.1.2 Purpose and objective

The objective of the cost estimating plan is to provide in a single document all elements necessary to ensure that the performance of cost estimating meets customer requirements.

#### G.2 Expected response

##### G.2.1 Response identification

The requirements for document identification contained in ECSS-M-50 shall be applied to the cost estimating plan.

##### G.2.2 Scope and contents

The cost estimating plan shall provide the information presented in the following sections:

###### <1> Applicable and reference documents

The cost estimating plan shall contain the list of applicable and reference documents, used in support to the generation of the document

###### <2> Management

###### <2.1> Organization

- a. The cost estimating plan shall describe the organizational context, both technical and managerial, within which the prescribed cost estimate activities shall be implemented.
- b. The cost estimating plan shall also describe the interfaces with other internal or external structures if possible and not impacted by other industrial business agreement.
- c. The Core Team members or pre-selected sub-contractors shall adhere to the cost estimating plan requirements of the prime contractor.

###### <2.2> Responsibilities

The cost estimating plan shall describe the allocation of responsibilities and authorities for cost estimating activities to

organizations and individuals within the programme or project structure.

### <3> Activities

#### <3.1> General

- a. The cost estimating plan shall identify all functions and processes, both technical and managerial, required for performing cost estimate activities of the programme or project in a timely manner.
- b. The cost estimating plan shall introduce the following, as a minimum:
  - implementation and mandate of the Cost Estimating entity within the organization of the Supplier;
  - cost estimate preparatory activities;
  - selection of method and construction of cost model(s);
  - performance of cost estimate;
  - approval cycle and procedure;
  - reporting and current update of cost estimate.

#### <3.2> Implementation and mandate of the cost estimating entity

The cost estimating plan shall:

- describe how the cost estimating entity is implemented within the company's organization chart,  
EXAMPLE Is the cost estimating function centralized or decentralized?
- indicate the responsibilities and mode of intervention of the cost engineering entity  
EXAMPLE Does the cost engineering entity only provides models to projects, which, then, perform estimates by themselves? Does the cost estimating entity provide a full costing or only part of the cost items?

#### <3.3> Cost estimating preparatory activities

The cost estimating plan shall:

- describe the process for acquiring, processing and maintaining reference data for developing models,
- address how the input data is gathered, and
- explain how clarification interviews of specialists are carried out

#### <3.4> Selection of method and construction of cost model(s)

The cost estimate plan shall explain:

- How the methods are selected in relation with the class of estimate and in particular the expected level of accuracy.  
EXAMPLE Are cost items estimated using several independent methods?
- How the total cost is obtained, including those items derived by application of cost-to-cost relations to other items.

#### <3.5> Performance of cost estimating

The cost estimating plan shall:

- explain how the cost estimating entity deals with the exhaustive identification and breakdown of the cost items and the treatment of the case of non defined cost items;



- present how ranges of values are determined to account for uncertainty and sensitivity analysis to the main cost drivers, and
- explain how cost risk estimate is performed.

#### **<3.6> Approval cycle and procedure**

The cost estimating plan shall explain how the approbation of cost estimates is organized within the organization in order to guarantee the timely delivery of the cost estimates within the frame of the agreed contractual dates

#### **<3.7> Current update of cost estimate**

The cost estimating plan shall explain how the evolution of the hypothesis is tracked and fed into the cost models.

EXAMPLE Does the cost engineering entity has an internal information link allowing to respond rapidly to design options that would generate cost over a certain target?

#### **<4> Schedule and resources**

##### **<4.1> Schedule**

The cost estimating plan shall establish the sequence and coordination for all the cost estimate activities and all the events affecting the cost estimate plan's implementation.

##### **<4.2> Resources**

The cost estimating plan shall identify the tools, techniques, equipment, personnel, and training necessary for the implementation of cost estimate activities.

### **G.2.3 Special remark**

The content of the cost estimating plan may be combined with the project management plan (i.e. ECSS-M-00B, Annex B DRD).

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# Annex H (normative)

## Cost Estimate Report - DRD

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### H.1 DRD identification

#### H.1.1 Requirement identification and source document

ECSS-M-60B, requirement 9.2.1.

#### H.1.2 Purpose and objective

The objective of the cost estimate report is to provide in a single document the project or programme cost estimate, along with the details how the estimates were determined, what are the main cost and risk drivers and a list of recommendations that need to be taken into consideration at project or programme management level.

### H.2 Expected response

#### H.2.1 Response identification

The requirements for document identification contained in ECSS-M-50 shall be applied to the cost estimate report.

#### H.2.2 Scope and contents

The cost estimate report shall provide the information presented in the following sections:

##### <1> Introduction

The cost estimate report shall introduce the following items:

- the purpose and objective of the cost estimating report;
- a brief description of what was done during the cost estimate exercise, and its outcome;
- identification of organizations that contributed to the preparation of the document.

##### <2> Applicable and reference documents

The cost estimate report shall contain the list of applicable and reference documents, used in support to the generation of the document.

##### <3> Quality of estimate

The cost estimate report shall characterize the expected quality level and features of the estimate. This characterization may be done using references to codes and standards.

EXAMPLE: ACE International recommended best practice No 17R-97

**<4> Hypothesis used**

The cost estimate report shall describe what the hypothesis were made to perform the cost estimating analysis, including:

- Economic conditions
- Currency
- Inclusions and exclusions
- Heritage/Technology Readiness Level
- Design status
- Engineering Difficulty
- Hardware matrix
- Spares philosophy
- Identification of main cost drivers
- Market situation (e.g. monopoly, and open competition)
- Cost sharing

**<5> Method and Cost model(s) description**

The supplier shall indicate for each of the cost items which method has been used.

**<6> Cost breakdown tables**

The customer and the supplier shall mutually agree in advance on the template format and the level of details to be produced.

**<7> Cost sensitivity analysis**

The cost estimate report shall identify, rank and describe how the main cost drivers influence the global cost.

**<8> Cost Risk assessment**

The cost risk assessment shall be based on the risk register. If absent at the time of the assessment, a register shall be constituted at this stage and for this purpose.

The cost estimate report shall identify the main cost risk items and the associated mitigations proposed.

The supplier shall refer to its cost estimating plan (as defined in ECSS-M-60B, Annex G) and to ECSS-M-00-03B.

The supplier shall provide cost figures associated with confidence level. Unless otherwise agreed with the customer, the supplier shall present ranges at agreed confidence level with the customer.

In case of stochastic analysis, the supplier shall explain how the distribution profiles are chosen and parameters fixed for the different cost items.

**<9> Recommendations**

The cost estimate report shall summarize the findings, shall restate the accuracy and confidence level to be given to the analysis and shall make all necessary recommendations for the sake of the proper execution of the Project or Programme.

Based on the cost sensitivity analysis and the identified risk drivers, the cost estimating report shall identify any recommendation that need to be taken into consideration at project or programme management level.

### **H.2.3 Special remark**

Sections <4> to <8> shall be repeated for each option or alternates.

Section <9> shall synthesize findings for baseline and all options and alternates.

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# Annex I (normative)

## Milestone Payment Plan - DRD

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### I.1 DRD identification

#### I.1.1 Requirement identification and source document

ECSS-M-60B, requirement 9.2.3.

#### I.1.2 Purpose and objective

The objective of the Milestone Payment Plan is to define measurable payment events.

### I.2 Expected response

#### I.2.1 Response identification

The requirements for document identification contained in ECSS-M-50 shall be applied to the Milestone Payment Plan.

#### I.2.2 Scope and contents

The Milestone Payment Plan shall provide the information presented in the following sections:

<1> **Header (or Footer)**

- Project title and contract / proposal number
- Date of issue
- Company name
- Activity description
- Contract type
- Currency and economic conditions
- Total contract price

<2> **Milestone table**

- Milestone number and nature of payment (advance payment, progress payment, final payment)
- Milestone definition
- Milestone achievement date (indicative information)
- Milestone amount

#### I.2.3 Special remark

None.

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## Annex J (normative)

### Inventory Record - DRD

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#### J.1 DRD identification

##### J.1.1 Requirement identification and source document

ECSS-M-60B, requirement 9.4.2.

##### J.1.2 Purpose and objective

The objective of the Inventory Record is to maintain full visibility on all customer' property items under the supplier's control, to ensure that such items are uniquely identified and that any change to it is traced and recorded.

#### J.2 Expected response

##### J.2.1 Response identification

The requirements for document identification contained in ECSS-M-50 shall be applied to the Inventory Record.

##### J.2.2 Scope and contents

###### <1> Introduction

The Inventory Record shall contain a description of the purpose, objective, content and the reason prompting its preparation.

###### <2> Applicable and reference documents

The Inventory Record shall list the applicable and reference documents in support to the generation of the document.

###### <3> Inventory Record information

The Inventory Record shall provide the following information for any customer property under supplier's control:

- Unique Item Number
- Description of Item
- Property Owner
- Quantity
- Part Number / Serial Number / Type code
- Related WBS code
- Manufacturer
- Classification (Category)
- Normal/Residual

- Acquisition Value (e.g. original purchase price)
- Date of purchase or production
- Price Basis
- Contractor Code (e.g. Custodian)
- Contract Number
- Physical Location (e.g. Facility, Building, or Room)
- Planned Method of Disposal
- Description and date of any change to the property item

### **J.2.3 Special remark**

The non-exhaustive list of property item categories listed in the informative Annex S of ECSS-M-60B should be considered when defining the item classification in the Inventory Record.

## Annex K (normative)

# Cost and Manpower Report - DRD

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### K.1 DRD identification

#### K.1.1 Requirement identification and source document

ECSS-M-60B, requirement 9.4.1.

#### K.1.2 Purpose and objective

The objective of the Cost and Manpower Report is to give a detailed status on the expenses incurred during the development and implementation of the project for Cost Reimbursement Contracts.

### K.2 Expected response

#### K.2.1 Response identification

The requirements for document identification contained in ECSS-M-50 shall be applied to the cost and manpower report.

#### K.2.2 Scope and contents

The cost and manpower report shall be expressed at current economic conditions, using the applicable audited rates and cost structure. It shall provide the information presented in the following sections:

##### <1> Header

- Project title and contract number
- Date of issue
- Currency
- Current economic conditions considered
- Applicable project schedule
- Control work package reference

##### <2> Content

- Reporting Period Start
- Reporting Period Finish
- For each Control Work Package (CWP):
  - CWP Number
  - CWP Title
  - For the period considered and cumulative from project start, in line with the applicable category identified in the CBS:

- \* Current planned man-hours, quantities, and costs as per CBCP
- \* Actual man-hours, quantities, and costs
- \* Deviation on man-hours, quantities and costs (planned vs. actual)
- CWP totals for the above
- A summary of the above costs for each business agreement of the project

### **K.2.3 Special remark**

None.

## **Annex L (normative)**

# **OBCP and CBCP for Cost Reimbursement - DRD**

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### **L.1 DRD identification**

#### **L.1.1 Requirement identification and source document**

ECSS-M-60B, requirement 9.3.1.1, for OBCP.

ECSS-M-60B, requirement 9.3.2, for CBCP.

#### **L.1.2 Purpose and objective**

The objective of the OBCP is to formally document the contractually agreed cost and manpower data. The objective of the CBCP is to formally document the current contractually agreed Baseline Cost Plan.

### **L.2 Expected response**

#### **L.2.1 Response identification**

The requirements for document identification contained in ECSS-M-50 shall be applied to the OBCP and CBCP for Cost Reimbursement contracts.

#### **L.2.2 Scope and contents**

##### **<1> Introduction**

The OBCP (respectively CBCP) shall contain a description of the purpose, objective and the reason prompting its preparation (e.g. project reference and phase).

##### **<2> Applicable and reference documents**

The OBCP (respectively CBCP) shall list the applicable and reference documents supporting the generation of the document, such as the applicable business agreements, minutes of meeting, complete list of the agreed CCNs taken into account.

##### **<3> Company Price Breakdown Form**

The following Company Price Breakdown Forms shall be provided, as defined in ECSS-M-60B, Annex E:

- Whole company price aggregated for the whole project (e.g. ESA PSS-A2 form);
- Whole company price broken down in each identified work package (e.g. ESA PSS-A8 form);
- Whole company price broken down per time period (e.g. ESA PSS-A10 form).

**<4> Milestone Payment Plan**

The applicable milestone payment plans shall be provided as defined in ECSS-M-60-B, Annex I.

**<5> Price variation Mechanism**

The up to date price variation mechanism information, taking into account all agreed CCNs for the CBCP (price escalation formula, indices, agreed amounts serving as the basis for escalation computation), shall be provided for all lower-tier suppliers under the supplier's responsibility.

**<6> Travel Plan**

The following information shall be provided exclusively in the OBCP. It should be provided in the CBCP:

- Forecast travel period
- Purpose of the travel
- Number of staff involved
- Expected duration

**<7> Cost sharing scheme**

The up to date information relating to target costs, fixed fees and incurred costs relevant to the project shall be provided.

**L.2.3 Special remark**

None.

## Annex M (normative)

# OBCP and CBCP for Fixed Price - DRD

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### M.1 DRD identification

#### M.1.1 Requirement identification and source document

ECSS-M-60B, requirements 9.3.1.2, for OBCP.

ECSS-M-60B, requirement 9.3.2, for CBCP.

#### M.1.2 Purpose and objective

The objective of the OBCP is to formally document the contractually agreed cost and manpower data. The objective of the CBCP is to formally document the current contractually agreed Baseline Cost Plan.

### M.2 Expected response

#### M.2.1 Response identification

The requirements for document identification contained in ECSS-M-50 shall be applied to the OBCP and CBCP for Fixed Price contracts.

#### M.2.2 Scope and contents

##### <1> Introduction

The OBCP (respectively CBCP) shall contain a description of the purpose, objective and the reason prompting its preparation (e.g. project reference and phase).

##### <2> Applicable and reference documents

The OBCP (respectively CBCP) shall list the applicable and reference documents supporting the generation of the document, such as the applicable business agreements, minutes of meeting, complete list of the agreed CCNs taken into account.

##### <3> Company Price Breakdown Form

The company price aggregated for the whole project (e.g. ESA PSS-A2 form) shall be provided in the OBCP exclusively, in conformance with the Company Price Breakdown Form, as defined in ECSS-M-60B, Annex E.

##### <4> Milestone Payment Plan

The provided milestone payment plan shall be based on information defined in ECSS-M-60-B, Annex I.

**<5> Price variation Mechanism**

The information relevant to the price variation mechanism (price escalation formula, indices, agreed amounts serving as the basis for escalation computation) shall be provided in the OBCP exclusively for all lower-tier suppliers under the supplier's responsibility.

**M.2.3 Special remark**

None.



# Annex N (normative)

## EAC and ETC for Cost Reimbursement - DRD

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### N.1 DRD identification

#### N.1.1 Requirement identification and source document

ECSS-M-60B, requirement 9.3.3.1.

#### N.1.2 Purpose and objective

The objective of the Estimate at Completion (EAC) and of the Estimate to Completion (ETC) is to define at regular intervals the total planned price at completion of the project, for Cost Reimbursement contracts. Hence, it allows the monitoring of the project evolutions throughout the project lifetime. It also ensures the consistency and analysis of the forecast cost.

### N.2 Expected response

#### N.2.1 Response identification

The requirements for document identification contained in ECSS-M-50 shall be applied to the EAC and to the ETC for Cost Reimbursement.

#### N.2.2 Scope and contents

The EAC and ETC shall provide the information defined in the following sections:

<1> **Introduction**

<2> **Overview and general assessment**

<3> **Header**

- Project title and contract no.
- Date of issue
- Cut-off date
- Currency
- Economic conditions
- Applicable programme schedule

<4> **Content**

The actual expenses up to the cut-off date and the forecast expenses up to completion of the project shall be presented as follows:

- Company Price Breakdown Forms, as defined in ECSS-M-60B Annex E, for each Control work package where applicable;

- Work Package Deviation summary against the Current Baseline Cost Plan, at Control work package level;
- Summary of all project changes, identifying:
  - CCN Approved
  - CCN Submitted
  - Potential changes not yet submitted

NOTE Potential changes include identified change proposals (either an answer to a change request or a change proposal initiated by the supplier), which are pending complete supplier assessment.

- Incentive and Penalty status;
- Analysis of the EAC and CBCP evolutions and deviations;
- Limit of Liability analysis against incurred cost;
- All information relating to target cost, fixed fee and cost sharing, updated up to the agreed cut-off date;

In addition to the above, the actual travels performed and the forecast travel plan covering the next EAC period should also be provided.

### **N.2.3 Special remark**

The ETC is the part of the EAC showing the estimated cost and manpower data for work to be performed from the cut-off date and until the work is completed.

## Annex O (normative)

### EAC for Fixed Price - DRD

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#### O.1 DRD identification

##### O.1.1 Requirement identification and source document

ECSS-M-60B, requirement 9.3.3.2.

##### O.1.2 Purpose and objective

The objective of the EAC is to define at regular intervals the total planned price at completion of the project for Fixed Price contracts. Hence, it allows the monitoring of the project throughout the project lifetime. It also ensures the consistency and analysis of the forecast cost.

#### O.2 Expected response

##### O.2.1 Response identification

The requirements for document identification contained in ECSS-M-50 shall be applied to the EAC for Fixed Price.

##### O.2.2 Scope and contents

The EAC shall provide the information defined in the following sections:

<1> **Introduction**

<2> **Overview and general assessment**

<3> **Header**

- Project title and contract number
- Date of issue
- Cut-off date
- Currency
- Economic conditions
- Applicable programme schedule

<4> **Content**

- Summary of all project changes, identifying:
  - CCN Approved
  - CCN Submitted
  - Potential changes not yet submitted

NOTE Potential changes include identified change proposals (either an answer to a change request or a change

proposal initiated by the supplier), which are pending complete supplier assessment.

- Updated MPP as defined in ECSS-M-60B Annex I
- Agreed amounts, incorporating baseline amounts and approved CCNs, applicable to Price Variation (not applicable for Firm Fixed Price contracts)

### **O.2.3 Special remark**

None.

## Annex P (normative)

# Contract Change Notice - DRD

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### P.1 DRD identification

#### P.1.1 Requirement identification and source document

ECSS-M-60B, requirement 9.1.4.

#### P.1.2 Purpose and objective

The objective of the Contract Change Notice (CCN) is the systematic recording of contractual changes.

### P.2 Expected response

#### P.2.1 Response identification

The requirements for document identification contained in ECSS-M-50 shall be applied to the CCN.

#### P.2.2 Scope and contents

The CCN shall provide the following information:

- Contractor Code (as in Country Company Structure/Business Agreement Structure)
- Contract Code (as in Country Company Structure/Business Agreement Structure)
- Title of area affected (work package, etc)
- WP Reference
- Initiator of change
- Description of change
- Reason for change
- Price, currency and price type
- Effect on other contract provisions (e.g. target cost and fixed fee)
- Start/End of work
- Schedule impact
- Signatures as necessary per organizational hierarchy together with the corresponding dates

#### P.2.3 Special remark

None.

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## Annex Q (informative)

# Cost Estimating Methods

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Several general methods to estimate costs for project elements are:

- Parametric,
- Analogy based,
- Bottom-up

Other methods are used, they are however, variations of the above methods.

The choice of method depends on the time, resources, and reference project data available. It is strongly linked to the project phase. The Table U.1 provides some information concerning the most reliable use of cost estimate methods versus the project phase.

**Table U.1: Cost estimate method vs. project phase**

	Phase 0 & A	Phase B	Phase C	Phase D
<b>Parametric</b>	(1)	(1-2)	(3)	(3)
<b>Analogy based</b>	(1)	(1-2)	(3)	(3)
<b>Bottom-up</b>	(3)	(2)	(1)	(1)

Where:

- (1) – Primary method
- (2) – Secondary method
- (3) – Occasionally used method

### Methods overview:

#### **Bottom-up estimating**

Bottom-up estimating also known as analytic estimating consists of examining each individual work package or activity and estimating its costs for different categories of labour, materials, facilities, equipment and other services. This method is time consuming and laborious, but usually results in accurate estimates if well prepared and detailed input documents are used. The difficulty in using such methods is to ensure that all the detailed cost items covering the whole scope are actually identified. This is why such a method is preferred for establishing a committing price. To the contrary, in early stages, when many alternates and options are still opened and the definition still subject to major changes, a lot of effort compiling numerous cost items becoming obsolesces makes the methods heavy and costly to use. Long response time needed is also frequently not compatible with the expected delivery date of the Cost Estimate report.

#### **Analogy based estimating**

Analogy based estimating uses a top-down approach. It refers to cost data from a similar project or activities to estimate the overall project cost. It is often

used when information about the project is limited, especially in the early phases. Analogy based estimating needs a limited effort especially if the application remains at a rather high level of the product tree but it asks for expert judgment and true similarity between the current and previous projects to obtain acceptable accuracy. Discrepancies to true similarity, corresponding to the most frequent case, needs a good understanding of the model limits and sensitivity usually acquired through participation to the development and regular use of the model. Although such a model does not have calculated validity range boundaries, the normal practice is to use reference point as close as possible to the case to be estimated. The inherent simplicity of the models derived from this method makes it very appealing for non-cost estimating specialists and frequently result in important variances in the cost figures produced.

They usually are technology-dependent, this making them difficult to use for highly innovative elements of the projects.

### **Parametric estimating**

Parametric estimating is a technique that develops estimates based upon the examination and validation of the relationships which exist between a project's technical, programmatic, and cost characteristics, and the resources consumed during its development, manufacture, maintenance, and/or modification.

The parametric estimating methods use a wide variety of mathematical expressions that ranges from simple ratios to complex non-linear mathematical expressions.

They are empirical relations such as rules of thumb or more elaborated mono or multivariate cost estimating relationships (CERs). The CERs are computed using least squares linear regression of data series themselves or their logarithm as appropriate.

The accuracy of the model depends on the number of the data points that have been used and the quality of their normalization<sup>2</sup>. The quality of fit of the CER is quantified by its coefficient of determination ( $R^2$ ). In addition, we characterize the potential cost estimating error for the level of confidence that we want to achieve especially when the number of data points used for building the model is rather low. This is the most common case in the Space domain. This also provides a quantified basis for defining the CER validity range.

Parametric models respond to a wide variety of parameters that fall into two main categories:

- Size (e.g. weight, number of lines of code, man-months)
- Performances (e.g. pointing accuracy, antenna gain)

Parameters from the two categories are eventually used in the same model when their independence can be established.

Parametric models are often refined, completing them with adjustment factors that allow accounting for secondary qualitative or quantitative parameters. These parameters are usually defined by studying the residual errors of the data points versus the mathematical expression of the regression or by detecting families of data points on a graph.

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<sup>2</sup> The normalization consists in analysing the cost data in relation to all technical, programmatic and contractual aspects in such a way that the retained cost for each data point corresponds to a common and well identified set of underlying hypothesis. The quality of the normalization process depends of the level of knowledge that the analyst have of these parameters.



Parametric estimating is usually faster to perform than bottom-up methods but it is only accurate if the correct model or CER is used in the appropriate manner. For doing so it asks for an expert judgment, participation to the model development and a regular use of it.

Last but not least, commercial parametric models are available on the market. They are consisting in a non-opened bundled set of algorithms that need a calibration process before being used in the particular context.

Calibration is done by using existing data points applied to the reverse mode of the model. The advantage compared with developing CERs is that less data points are needed for reaching a good calibration. These models also assume adequate training and experience prior allow committing on produced figures.

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## Annex R (informative)

# Determination of the appropriate WBS level of detail

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The main challenge associated with developing the Work Breakdown Structure (WBS) is to determine the balancing between the project definition aspects of the WBS and the requirements for data collecting and reporting. One have to keep in mind that the WBS is a tool designed to assist the project manager when decomposing the project only to the levels necessary to meet the needs of the project, the nature of the work, and the confidence of the team.

An excessive WBS levels can lead to unrealistic levels of maintenance and reporting, and consequently to an inefficient and over costly project. The theory that more management data equates to better management control has been proven false many times over in the last decades when assessing systems' performance. On the other hand, if not detailed enough it makes the element difficult to manage or the risk unacceptable.

Among the different questions arising when developing a WBS, an important one is: Should the WBS be decomposed further?

To help answering this question, we propose the following list of questions. If most of the questions can be answered YES, then the WBS element analysed should be decomposed. On the contrary, if most of the questions can be answered NO, then this is not necessary. If the answers are approximately 50/50, then additional judgment is needed.

- Is there a need to improve the assessment of the cost estimates or progress measuring of the WBS element?
- Is there more than one individual responsible for the WBS element? Often a variety of resources are assigned to a WBS element, a unique individual is assigned the overall responsibility for the deliverable created during the completion of the WBS element.
- Does the WBS element content include more than one type of work process or produces more than one deliverable at completion?
- Is there a need to assess the timing of work processes that are internal to the WBS element?
- Is there a need to assess the cost of work processes or deliverables that are internal to the WBS element?
- Are there interactions between deliverables within a WBS element to another WBS element?
- Are there significant time gaps in the execution of the work processes that are internal to the WBS element?
- Do resource requirements change over time within a WBS element?
- Are there acceptance criteria, leading to intermediate deliverable(s), applicable before the completion of the entire WBS element?
- Are there identified risks that require specific attention to a subset of the WBS element?
- Can a subset of the work to be performed within the WBS element be organized as a separate unit?

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## Annex S (informative)

# Inventory Control

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The following non-exhaustive property item categories can be considered when defining the item classification in the Inventory Record:

- EEE Parts
- Consumable Items: Parts, materials, supplies, components, modules, assemblies, units, subsystems and minor expendable tools which through the production process lose their identity and are absorbed directly or indirectly by the system/product (e.g. satellite) that are provided according to the business agreement.  
Consumable Items are in principle not capitalized; however, before consumption they are identified as assets of the customer under the collective term "Inventory".
- Capital Items/Production Support Equipment and Tools: Jigs, fixtures, devices, apparatuses, instruments, machines, installations, technical facilities, patents, computer programs, documents, models, samples or any other items which, after their use in or in conjunction with the production process under the business agreement, are expected to have a residual utility or other value for the customer.  
Production Support Equipment and Tools which the Supplier acquires on his own account primarily for the purpose of the business agreement and charges the Customer for amortization are, as long as the Customer retains the option to buy such items from the Supplier, treated as far as property control is concerned as Customer's Property.  
Capital items have normally a useful life of more than one year and are identified individually as customer's assets.
- Customer Furnished Items: Items furnished by the Customer free of charge.
- Supplier's Acquired Items: Items procured or manufactured in house by the Supplier.
- Standard Equipment: this includes
  - All customer owned items procured in the frame of the project.
  - Equipment purchased specifically for the project.
  - Equipment not purchased specifically for the project but used exclusively or mainly for the project.
  - Equipment or supplies of the customer made available to the supplier or its lower tier suppliers free of charge.
- Residuals/Residual Equipment: this includes
  - Residual raw material, components, and parts remaining after completion of the Deliverable End Items or at the cancellation of a part of the project;
  - Residual deliverable items resulting from a reduction in business agreement requirements or other reasons. (in term of number of items to be delivered).
- Attractive items: items that lend themselves by their nature to unauthorized private use or unauthorized removal from the supplier's premises.

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## Bibliography

ECSS-E-10 Part 1B	Space engineering – System engineering - Part 1: Requirements and process
ECSS-E-10 Part 8 <sup>3</sup>	Space engineering – Value analysis
ECSS-M-30	Space project management – Project phasing and planning
ECSS-M-30-01	Space project management – Organization and conduct of reviews
ECSS-Q-20B	Space product assurance – Quality assurance
IEC 50:1992	International Electro-technical Dictionary
ESA PSS-A2 form	Company Price Breakdown
ESA PSS-A8 form	Manpower & Price Summary at Work Package Level
ESA PSS-A10 form	Work Package Manpower & Cost Plan

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<sup>3</sup> To be published.

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## ECSS Change Request / Document Improvement Proposal

A Change Request / Document Improvement Proposal for an ECSS Standard may be submitted to the ECSS Secretariat at any time after the standard's publication using the form presented below.

This form can be downloaded in MS Word format from the ECSS Website (www.ecss.nl, in the menus: Standards - ECSS forms).



## ECSS Change Request / Document Improvement Proposal

<b>1. Originator's name:</b> <b>Organization:</b> <b>e-mail:</b>		<b>2. ECSS Document number:</b> <b>3. Date:</b>		
4. Number.	5. Location of deficiency <small>Clause    page (e.g. 3.1    14)</small>	6. Changes	7. Justification	8. Disposition

**Filling instructions:**

1. **Originator's name** - Insert the originator's name and address
2. **ECSS document number** - Insert the complete ECSS reference number (e.g. ECSS-M-00B)
3. **Date** - Insert current date
4. **Number** - Insert originator's numbering of CR/DIP (*optional*)
5. **Location** - Insert clause, table or figure number and page number where deficiency has been identified
6. **Changes** - Identify any improvement proposed, giving as much detail as possible
7. **Justification** - Describe the purpose, reasons and benefits of the proposed change
8. **Disposition** - not to be filled in (*entered by relevant ECSS Panel*)

**Once completed, please send the CR/DIP by e-mail to: [ecss-secretariat@esa.int](mailto:ecss-secretariat@esa.int)**

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