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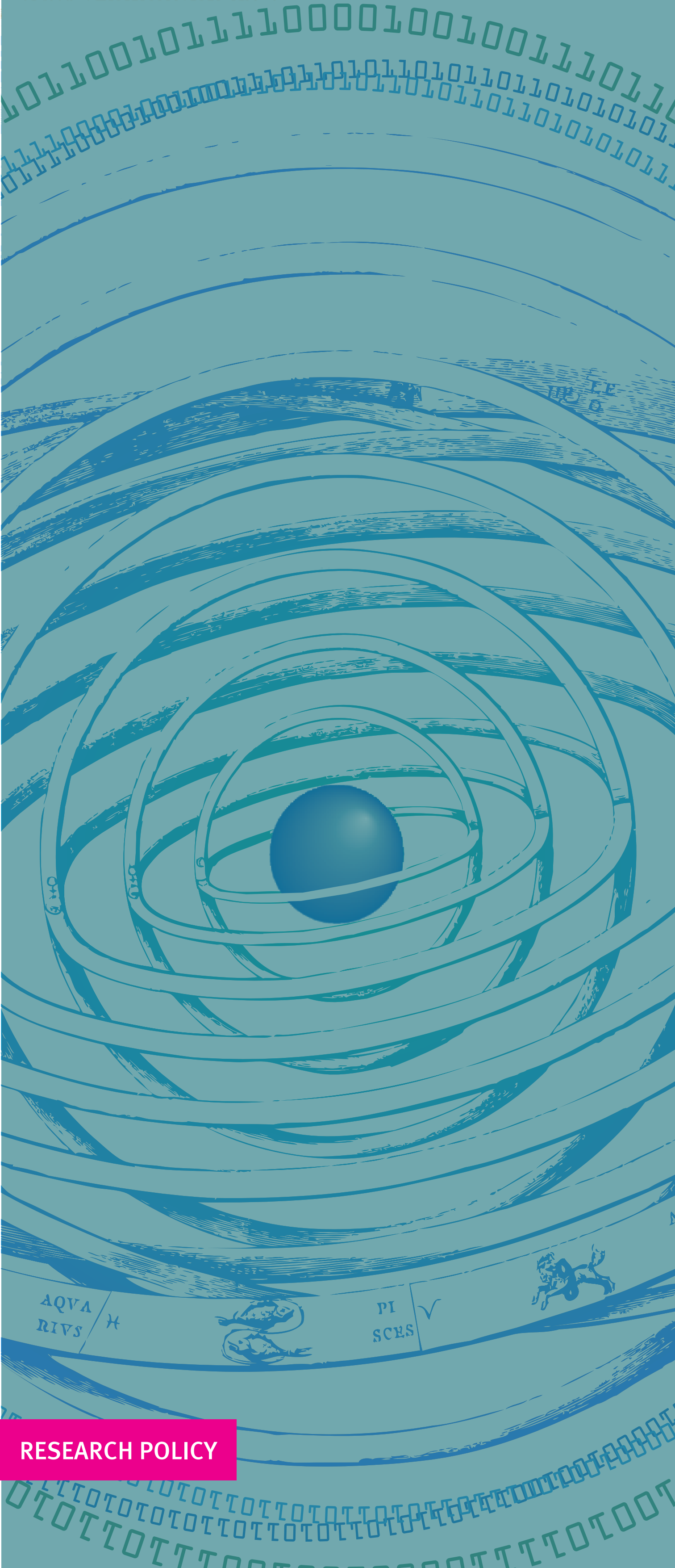

Cost control and management issues of global research infrastructures

Report of the European expert group on cost control and management issues of global research infrastructures

RESEARCH POLICY

European Commission

Directorate-General for Research
Directorate B – European Research Area: Research Programmes and Capacity
Unit B.3 Research Infrastructures

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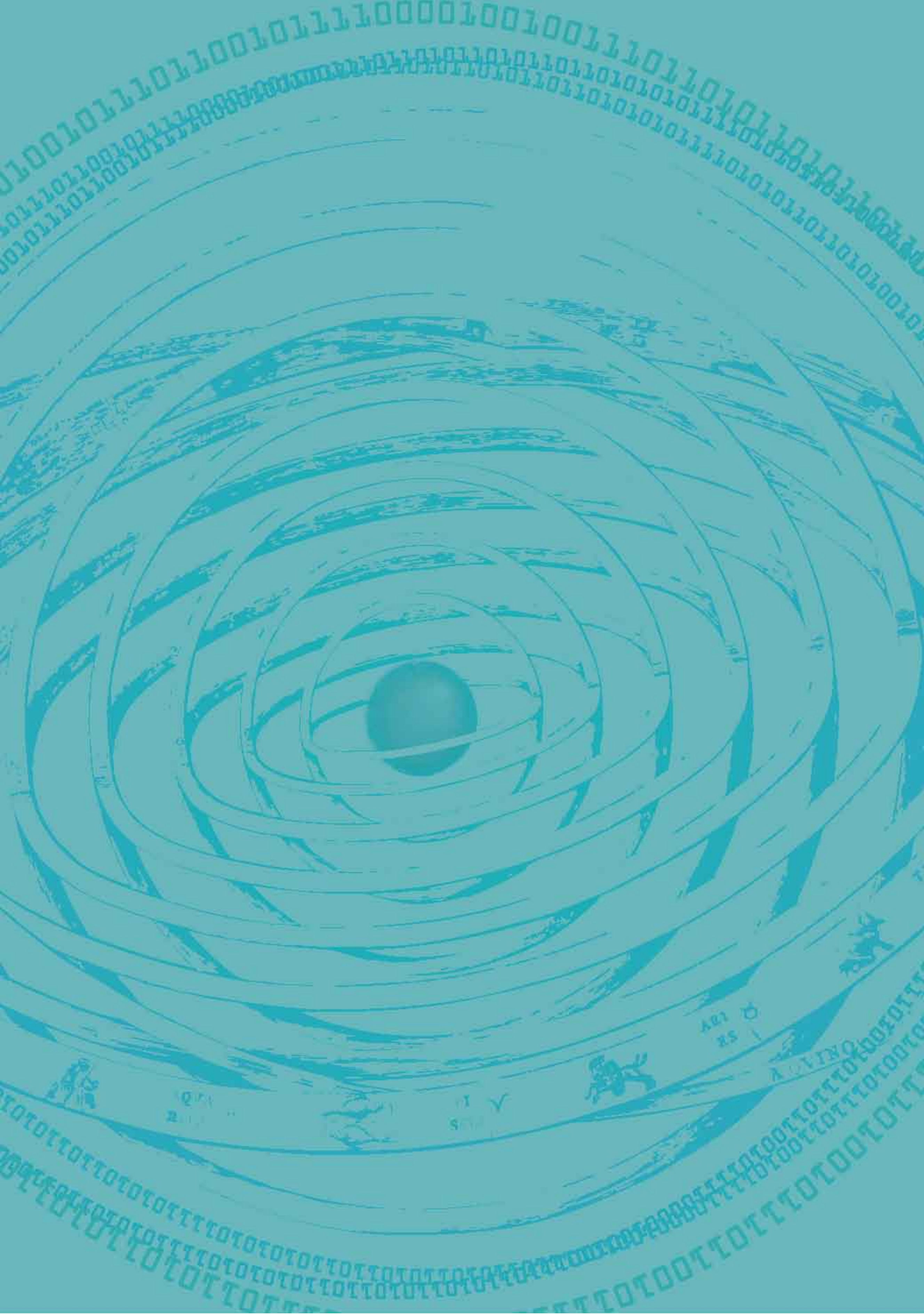
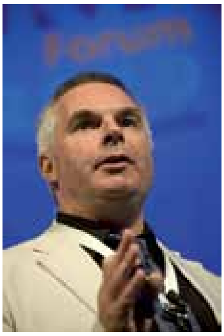


Foreword



Internationalisation of large-scale Research Infrastructure (RI) projects has evolved to meet the scientific demand for facilities that are beyond the capability of individual countries or institutions in scope, cost and complexity. Increasingly, such RIs require the pooling of scientific expertise and funding on a global scale. This is proving to be the only way to address very large scale research challenges, although the management of such projects is extremely demanding and in the past has led to some well-publicised problems.

The Carnegie Group of G8+O5 Science Advisers recognised the potential for cooperation on issues related to global research infrastructures. They established a Group of Senior Officials on Global Research Infrastructures to look at possible standardisation of approaches to construction, operation and decommissioning costs, including contingencies; and at issues of cost and schedule containment during construction.

In order to adequately prepare the EU's input to this Group of Senior Officials, the Commission set up a European Expert Group on Cost Control and Management Issues of Global Research Infrastructures.

The Expert Group considered the essential cost elements which need to be taken into account in the planning phase of large scale RIs, compared the approaches taken on this issue by both major projects in Europe and global projects with significant European participation, identified key management issues for cost and schedule control, and drew lessons from present and past experience. The Expert Group has drawn on the broad experience of its members and also organised, with the support of the Commission, a one day International Workshop on 29 June 2010, with the participation of invited international experts.

This report is targeted at policy and decision-makers, and includes recommendations for issues to be addressed on the occasion of the 38th meeting of the Carnegie Group of Science Advisors, to be held during the Canadian Presidency of the G8 in November 2010.

John Womersley
October 2010

Executive Summary

The key recommendations of the expert group are listed below. They address the major issues in the realization and management of large scale infrastructures, especially those requiring global collaboration. Together they form a concise summary of our report.

1. At the start of a research infrastructure (RI) initiative, the political stakeholders must agree upon a shared understanding of the foreseen scope, schedule and cost, addressing inherent uncertainties and any external constraints, and describing what must be done if deviations occur during the following phases. This understanding should include awareness of potential cultural differences between the different partners, and should be encapsulated in a comprehensive, formal founding document.

2. Where decisions are inspired by political and financial considerations, rather than scientific and technical requirements, the RI management must ensure that the political stakeholders are made explicitly and fully aware of the consequences of these choices.

3. The governance, management, and supervisory structures must have clearly defined and differentiated authority and responsibilities. They must be able to immediately impact the project and to quickly resolve conflicts.

4. A clear and structured organisation is necessary, with direct, transparent reporting lines and the full use of management and project control tools.

5. Independent scientific and technical evaluation and external professional auditing of financial and management performance must be carried out and acted upon.

6. To harmonise expectations and reduce risk, a standardised, stepwise, and phased approach to the preparation and approval of an RI project is necessary.

7

The management must be chosen on the basis of clearly specified competencies, including project management and technical skills. Within its remit, management at all levels must be given full independence, responsibility and accountability for its specific budget.

8

Up-to-date, bottom-up planning, control and reporting systems based on work breakdown structures and financial management tools covering technical, financial and schedule issues, are mandatory. Management at all levels must have full responsibility and be accountable for their specific budget.

9

Best-practice systems for project control and risk management have to be fully embedded in the project management, covering technical, financial and schedule issues, together with mitigating measures in case of deviations.

10

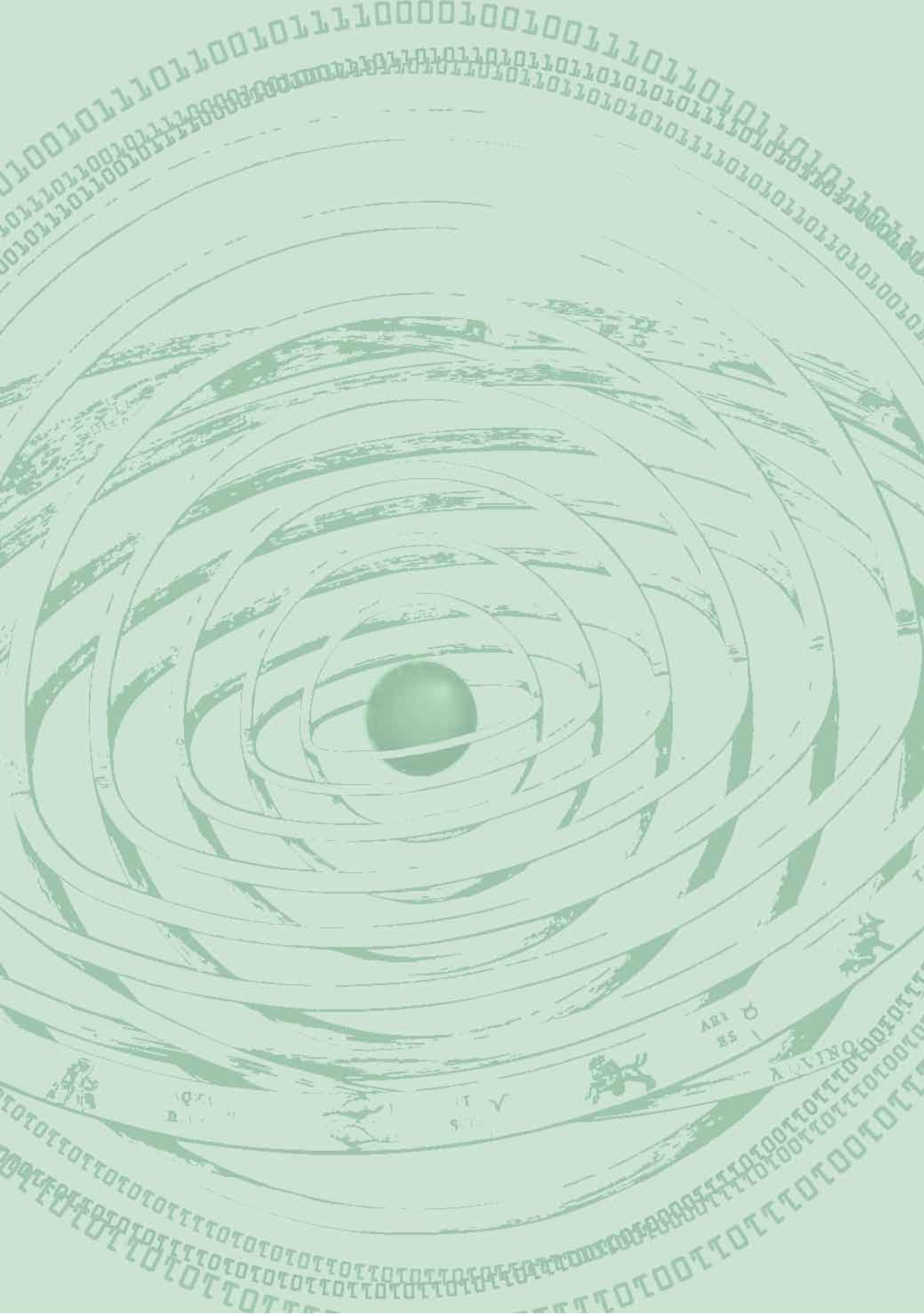
The procurement process should make best use of the internal and external technical expertise, and of appropriate negotiation procedures according to the technical demands of the procurement.

11

The responsibilities of all suppliers for deliverables must be contractually fixed in a thorough way based on detailed specifications and drawings. The project must have full daily access to all relevant information (technical, financial and schedule related).

12

Costs must be clearly defined and spending must be realistically planned, including in-kind contributions. Costs should be estimated with appropriate precision according to the different approval stages, and contingencies must be provided. The costs must be controlled by always current bottom-up best-practice systems.



1. Political Issues

Increasingly, large-scale Research Infrastructure (RI) projects require the pooling of scientific expertise and funding on a global scale. The political and financial will of interested countries together with the scientists' readiness to create a multi-stakeholder RI are prerequisites to allow the creation of a consortium in which the different scientific, political, financial and cultural expectations come together.

It is essential that all of the stakeholders align their expectations regarding scope, schedule and cost, on the assumption of scientific excellence. Often the political stakeholders wish to achieve other, or additional, objectives, such as obtaining industrial benefit from their investment through the determination of in-kind contributions for the new RI, obtaining special know-how development for strategic components, or a variety of other political compromises.

If the political will and the project's technical requirements out of alignment, industrial return considerations and in-kind contributions can lead to less than optimal technical decisions, unnecessary interfaces and fragmentation of both the RI's systems and their technical or technological design, and as a result to higher costs and time delays.

At the start of a RI project, the political stakeholders must agree upon a formal founding document which fixes and records a shared understanding of the agreed scope, schedule and cost of the complete undertaking from the initial phase to the end; specifies the individual contributions; and sets a framework for the conduct of the project. The agreement should also take into consideration *a priori* constraints. It must explicitly cover the inherent uncertainties in this early project phase and describe the processes to be followed throughout the development of the project, including what must be done if deviations occur during the following phases and dispute resolution processes.

The agreement should address the possibility and consequences of the project's failure or of a situation arising where continued investments in the project no longer make sense (at least for individual partners). Rules and procedures should be put in place at the start to allow such partners an "exit clause" and a route to disengagement while protecting the interests of partners wishing to remain involved in the delivery of the project.

When decisions are inspired by political considerations, rather than the project's technical necessities, then the RI's management must ensure that the funders and the political stakeholders are explicitly informed of the consequences of these choices and that these are covered by the resources available to the project.

The RI's cost book must be agreed between partners at the beginning of the project. The methodology for (a) assigning values to in-kind contributions, and (b) making subsequent adjustments if necessary, should also be determined in advance. It should take account of the perceived value to the project.

Additionally, the construction proposal should expressly state the shared understanding of the necessary size, purpose and terms of release of a management reserve or contingency, namely to provide for unexpected events that could arise during the different phases of any first-of-its-kind project.

The policy on industrial return and the means of monitoring, accounting and adjusting the balance should also be determined at the outset. It should provide for the continuous monitoring of the delivered industrial return. This enables short term imbalances to be identified and rectified, thus maintaining long term financial stability, while taking due account of the partners' technical capabilities.

An adequate balance between cash- and in-kind contributions has to be agreed and clearly stated in the founding documents. This gives necessary flexibility, when unexpected costs have to be financed by the project.

Key Recommendations:

1 At the start of a RI initiative, the political stakeholders must agree upon a shared understanding of the foreseen scope, schedule and cost, addressing inherent uncertainties and any external constraints, and describing what must be done if deviations occur during the following phases. This understanding should include awareness of potential cultural differences between the different partners, and should be encapsulated in a comprehensive, formal founding document.

2 Where decisions are inspired by political and financial considerations, rather than scientific and technical requirements, the RI management must ensure that the stakeholders are made explicitly and fully aware of the consequences of these choices.

2. Governance

Good professional governance requires the exercise of clear authority to provide the RI's management with firm direction in the sound and responsible use of institutional resources to achieve the commonly agreed goals.

The governance model should be chosen to ensure that the RI can achieve its goals in the optimum way. The principles of good governance must be contained in the RI's founding document, providing a robust framework while allowing scope for future structural, political and possible financial changes or upgrades in response to the scientific development, and the organisational, procedural and operational needs of the project. Procedures for dispute resolution and changing the composition of the consortium should also be addressed in the founding document, so that they are established well before there is any real case to be resolved.

It is imperative to determine a sound governance structure from the start with clear and unambiguous lines of authority and responsibility. This must be well communicated such that each level of the organisational structure acts with certainty within the parameters of their function, knowing what their duties are and the limits of their decision making powers. There must be clear differentiation of authority and responsibilities between the supervisory and managerial activities of the project, for example. The supervisory board's role is to advise senior management, and to make strategic decisions as quickly as needed; whereas management deals with day-to-day operations, making decisions in conformity with the determined strategy, and aware that decisions need to be taken in a timely fashion on a transparent, fact-oriented basis.

The stakeholders, supervisory body and management need to have written agreement on the principles for receiving and managing in-kind contributions, from the outset.

They should include statements on:
(a) how non-cash contributions are to be valued,
(b) the expected balance between these contributions and cash receipts,
(c) the in-kind supply schedule and how delivery is to be monitored against the specification and schedule of the project and
d) the explicit responsibilities (and rights) of the contributors.
Procedures to facilitate the finding of technically satisfactory solutions in the event of conflicts or unforeseen technical problems should be specified and documented: the supervisory body must take explicit responsibility for resolving such

difficulties. This documentation should be well disseminated within the project.

The arrangements for in-kind contributions must give the management clear authority and responsibility for the whole manufacturing, delivery and installation process. The relationship of in-kind contributions to the critical path, the consequences for the project of any slippages in schedule or failure to meet specifications, and the available responses and procedures for invoking them, have to be clearly understood. Where appropriate, operational support agreements should be concluded prior to any commitment. For key critical components provided as in-kind contributions, the suppliers must adhere to technical decision factors provided by the management, who must be empowered to take any necessary corrective action. The division of financial responsibilities in such circumstances must be clearly specified from the outset.

Periodic project audits in relation to scientific, technical and management demands (organisation, processes and tools) need to be undertaken. To ensure that an objective evaluation is achieved, appropriate external and independent scientific, technical and project audits should be commissioned by the supervisory board. It is recommended that these audits/reviews should be carried out by appropriate and properly independent experts drawn from the same and other scientific and technological fields and from industrial and management companies.

Key Recommendations:

3 The governance, management, and supervisory structures must have clearly defined and differentiated authority and responsibilities. They must be able to immediately impact the project and to quickly resolve conflicts.

4 A clear and structured organisation is necessary, with direct, transparent reporting lines and the full use of management and project control tools.

5 Independent scientific and technical evaluation and external professional auditing of financial and management performance must be carried out and acted upon.

3. Project Approval

The approval (commitment for financing, construction, running and decommissioning) of a large RI project is a complex process with numerous participants and diverse interests. The innovative character of a new RI implies that many new technologies and components have to be developed in addition to using established and well-understood equipment, materials and technological processes. In order to mitigate risks and better understand the costs, a precise technical understanding of core components and their influence on the whole system and the critical path therefore is necessary in this phase. A substantial preparatory phase is necessary to deliver this understanding. Design changes can still be expected to occur, but it must be recognised that late design changes after approval have been the most significant reasons for cost increases and delays in RI projects in the past.

A clearly defined final design for construction has to be frozen at the appropriate point before the start of construction. Otherwise the stakeholders must accept the consequences on costs incurred and schedule disruption. A substantial investment in the preparatory phase of the project to test technical and manufacturing feasibility and mitigate risk should be recognised as a necessary and prudent precursor.

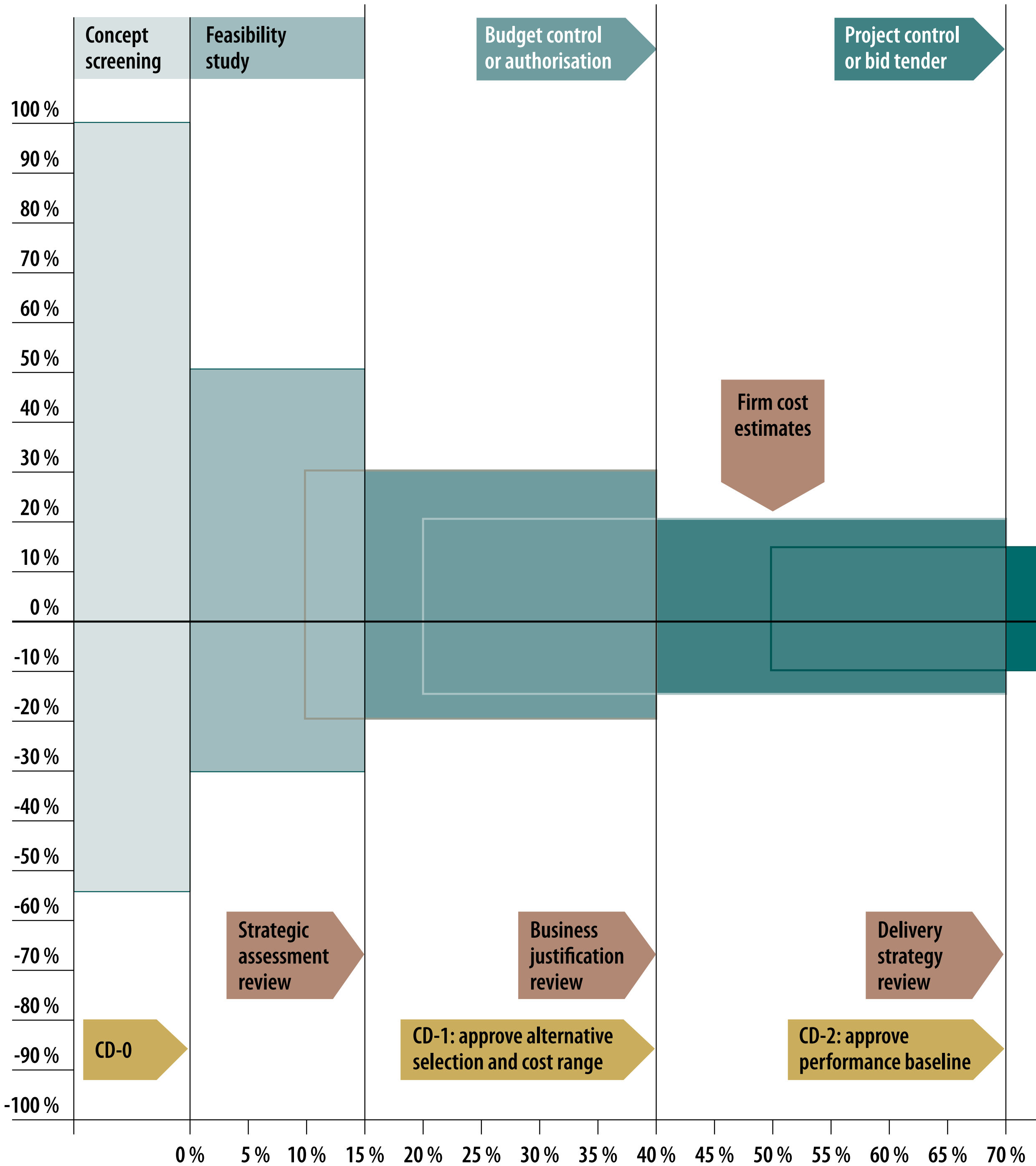
To harmonise expectations and to reduce inherent risks, a consistent, stepwise, and phase-oriented approach in relation to the project's maturity is necessary to approve the RI project. Such an approach is highlighted in Figure 1.

A framework of scope, schedule and cost should be developed from the outset. The inherent uncertainty in this early phase demands the application and provision of adequate working margins and contingencies, especially for time and cost, under realistic assumptions. The approval documents should clearly set out the boundary conditions and eligibility criteria for consideration of calls on the contingency.

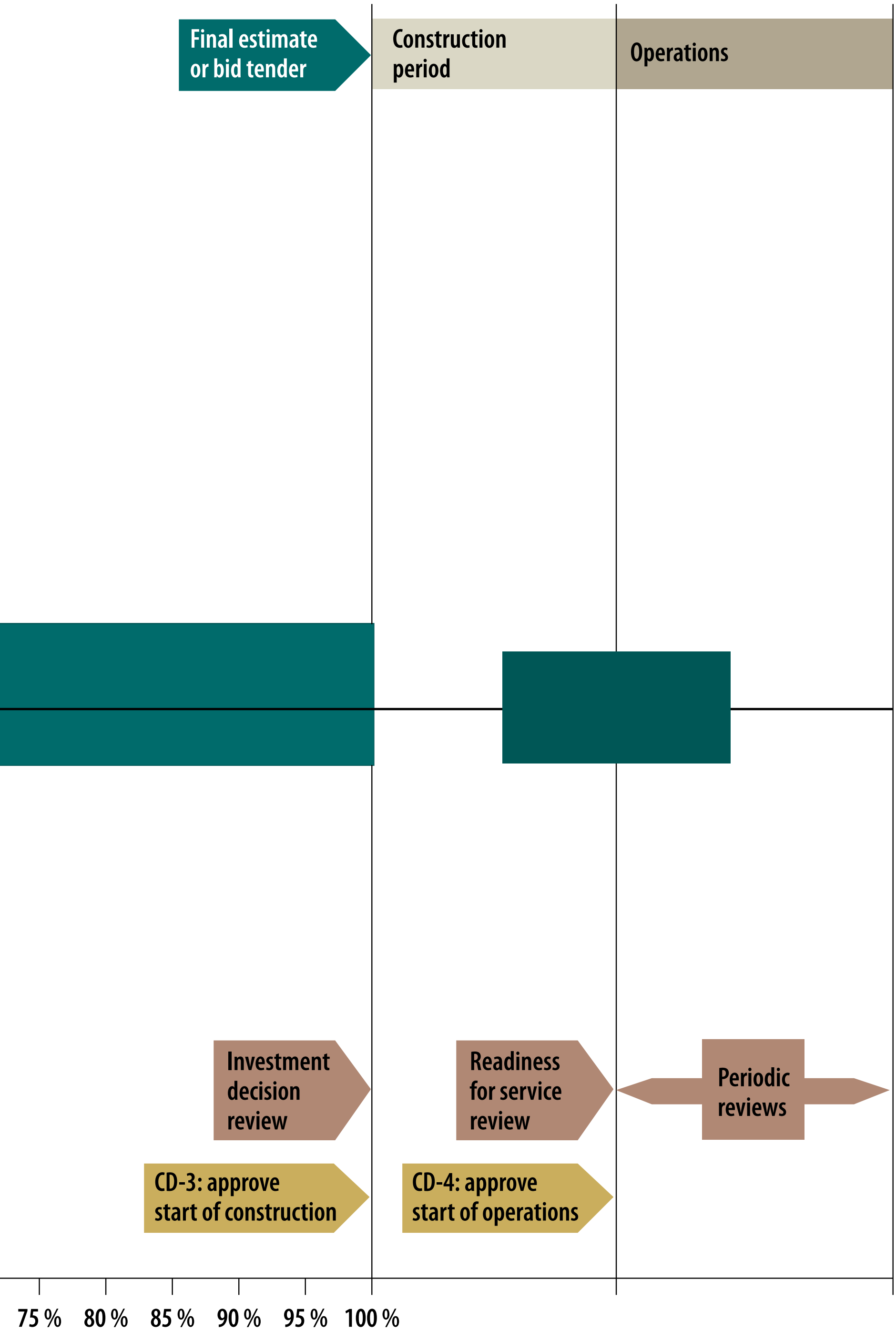
An independent audit of the project should be carried out on this first delivered framework. This must be based not only on scientific-technical aspects but also on the application of best practice management standards (methods and tools) including established confidence methods. These procedures must be iteratively applied in the different approval phases.

In every case, it is necessary that at each phase of the approval process the partners collectively achieve a clear understanding of scope, schedule and estimated costs; and that this is put on record. A scheme has to be in place to define the

Figure 1: Critical stages of project design and realisation



Illustrative example of cost evolution and approval stages following design evolution for a generic project.



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- Relevant References are: UK OGC gateway review process: http://www.ogc.gov.uk/what_is_ogc_gateway_review.asp
- DOE requirements for Project Management, DOE Order 413.3B
- Program and Project Management for the Acquisition of Capital Assets (Approved 11-29-2010) http://www.directives.doe.gov/directives/current-directives/413.3-BOrder-b/at_download/file
- AACEi Cost Estimating Classification Guidance: http://www.aacei.org/technical/rp.shtml#17R-97

In this graph, CD-0 to CD-4 refer to the US DOE Critical Decision Process, while the arrows above refer to the equivalent UK OGC Gateway Review Process. The division in critical stages (top of the graph) has been carried out following the AACEi Cost Estimating Classification Guidance.

priorities (scope, schedule or costs) and allow trade-offs to be assessed in the case of conflicts.

Before final approval, all critical aspects, activities and components should have a demonstrated maturity allowing assessment of the remaining risks to the project. Potentially significant R&D effort and detailed technical design studies (e.g. which may cost up to 10% of overall projected costs), together with precise cost estimates, should be mandatory for all critical aspects, activities and components. Where relevant, industrial production feasibility and capacity should be established and tested. The initial cost book must be prepared and agreed prior to the construction decision.

Key Recommendation:

6 To harmonise expectations and reduce risk, a standardised, stepwise, and phased approach to the preparation and approval of an RI project is necessary.

4. Management

Professional management of the RI project is the fundamental factor for success. While the top management of an RI project is often dominated by scientists from the research field of the RI, providing the scientific vision and motivation for the project, this must be combined with a very rigorous project and technical management approach and accepted by the whole project team if the project is to be successful. A crucial part of any innovative RI project is the development of new technical solutions. These can have far reaching consequences if they require changes to original, baseline plans.

The whole management at all levels must be chosen on the basis of clearly defined competencies to include the appropriate blend of project management, technical and financial competencies and scientific understanding.

The management must be given a high degree of independence and authority corresponding to their responsibility for managing the project. The management must:

- establish well defined authorities and responsibilities across and on every management level together with direct and transparent reporting lines and clear channels of communication, both internally and between the management and the governing bodies;
- be able to provide immediate and regular up-to-date and definitive information, and to report this on a regular basis together with recommendations for action to the governing bodies as necessary;
- enable the systematic observation and scrutiny of activity in order to rapidly detect and report deviation, and subsequently instigate remedial action;
- establish, implement and maintain a comprehensive monitoring and risk management and mitigation system that is understood and approved by the stakeholders.

From the outset the management must implement well functioning engineering structures, processes and systems to cope with emerging technical developments.

To avoid cost increases and delays, configuration management must be implemented in good time. It must identify, control, adapt, verify and finally document the system engineering output and compare the planned and as-built (meaning as really measured) configurations in all phases of the project, especially in integration and assembly phases. It must facilitate the identification of trade-offs that have to be made between performance and specification.

Key Recommendation:

7 The management must be chosen on the basis of clearly specified competencies, including project management and technical skills. Within its remit, management at all levels must be given full independence, responsibility and accountability for its specific budget.

5. Project Controlling and Culture

It is normal for difficulties to arise and delays to occur during a construction process lasting many years. Ensuring that efficient project control and reporting systems are in place, and that they are widely used, should help to manage difficulties and delays. But these systems will only be effective if there is a well-developed and appropriate project culture embedded in the project team.

From the outset the RI's management must implement integrated project planning, controlling and steering systems together with mitigating measures in case of deviations, both for long term and short term purposes. The importance that senior management places on this project planning must be clearly understood at all levels in the project team. The management must secure the commitment of the whole project team to it.

(a) For all important activities, detailed work breakdown structures with explicit operational milestones have to be applied. They must be used as the standard basis for a daily communication process.

(b) The detailed inputs for all the work packages should be provided by the responsible engineer or group leader, to ensure a bottom-up planning and information updating process.

(c) The operational work breakdown structures should be automatically combined with the financial management tools (in particular the financial accounting software system). Both parts have to be set up in a bottom-up/top-down process, where the assigned engineers or technical group leaders feed in technical information, which is then combined with the financial data and updated on a short time basis (e.g. weekly). This integrated tool must show the planned and actual, weekly updated data and any deviations. Finally these reports have to be approved by the upper management levels in the top-down process to ensure consistency across the whole project.

(d) All these data should be integrated and aggregated into a management information system, which provides the decision makers with up-to-the-minute data and comprehensive cost and risk information.

A culture of openness, transparency and trust, in which problems can be communicated as soon as possible without a rush to judgement, is essential. This should be accompanied by an attitude of developing and proposing countermeasures in parallel to the decision-making boards. For optimal outcomes a collaborative environment needs to be fostered, in which activity is directed towards achieving delivery on time, to required specifications and on budget.

This culture of openness should extend across the whole project and during all project phases, to the use, exchange and regular updating of all relevant data (planned and actual) on a detailed and timely basis.

Cultural differences between the different partners, in particular with respect to terminology, processes and practices, need to be identified and addressed from the outset with openness (and sensitivity) in order to minimise misunderstandings.

In collaborations with external industry the same transparent controlling and reporting systems must be applied as internally. The management must be able to get access to all relevant information whenever it appears necessary.

Key Recommendations:

8 Up-to-date bottom-up planning, control and reporting systems based on work breakdown structures and financial management tools covering technical, financial and schedule issues, are mandatory. Management at all levels must have full responsibility and be accountable for their specific budget.

9 Best-practice systems for project control and risk management have to be fully embedded in the project management, covering technical, financial and schedule issues, together with mitigating measures in case of deviations.

6. Procurement

The procurement for a large RI has to deal with a large range of supplies ranging from highly innovative ones to standard (off-the-shelf) components. These different types of supplies require somewhat different procurement approaches. Furthermore, it has become the practice for at least part of the contributions to be provided in-kind. These can serve a useful function but need special attention despite *the lack of price negotiations. Technical mismatches between the in-kind contributions and the whole system may lead to enormous configuration and change costs and delays during the implementation phase. This risk has to be taken into account in the contracts.*

In the case of highly innovative supplies, early advantage should be taken of the expertise and knowledge of industry. The management should involve industry in consultations at an early stage to ensure that clear, reasonable, unambiguous and realistic specifications are produced while counterbalancing technical ambition with industrial experience and technical capabilities. The final specification decisions must be made by the management, and due attention should be paid to intellectual property right (IPR) issues.

The procurement process should be clearly specified and appropriate to the nature of the items being procured. It should make optimal use of competitive dialogue and competitive tendering. For highly innovative tasks the bidding procedure should be based on negotiations challenging the technical expertise and the cost control of the potential suppliers; and should be carried out against specified technical quality and costs. Identical components may be sourced from several suppliers if this decreases the risk of delivery failures.

Classical competitive bidding procedures should be broadly applied for all standard orders (classical buildings, standard components and services).

Clear boundary conditions must be set for the content and scope of contract negotiations, including defining when the changes are such that a re-tendering is required. The negotiations should include:

- the costs, services, milestones,
- continuous control and reporting systems,
- access to all relevant information during the production, testing and delivery processes,
- the actual work breakdown structures and planned next steps,
- the terms and conditions under which the supplier is able to concede more flexibility, and
- penalty clauses, incentives, sanctions, etc. and the process for taking a decision to impose them (even a negative should be decided).

Any intellectual property issues relating to the procurement must also be clearly spelled out at the call for tender stage and be fixed in the contracts.

Full-time, on-site inspections at any time as part of the reporting system at all the production facilities should be foreseen and fixed in the procurement contracts.

Contracts related to industrial return requirements and in-kind contributions should be placed primarily on the basis of partners' technical competence, with the terms and conditions under which industrial return considerations are brought into play clearly defined. Orders for key critical components must be placed according to competition among the best (not necessarily the cheapest) suppliers (e.g. best value for money). In case of conflict, the management must inform the political stakeholders, who have the ultimate decision-making power in this regard.

While selection/definition of in-kind contributions may not follow the same selection process as other procurements, the same rules should apply for all deliverables in the construction process. The many interfaces of the in-kind contributions require the same detailed specifications, information exchange and precise supervision as the other supplies because of their potential technical, financial, logistical and schedule risks.

Care should be taken to ensure that any arrangements with industry, e.g. for development or consultancy, do not compromise the organisation's ability to carry out open and transparent competitive tendering processes or prejudice the results of tender exercises.

Key Recommendations:

10 The procurement process should make best use of the internal and external technical expertise, and of appropriate negotiation procedures according to the technical demands of the procurement.

11 The responsibilities of all suppliers for deliverables must be contractually fixed in a thorough way based on detailed specifications and drawings. The project must have full daily access to all relevant information (technical, financial and schedule related).

7. Costs

Costs have to be planned and instantly controlled across the whole project. The use of adequate cost frameworks and formal structures including all aspects of finance is essential to steer the project and to avoid cost increases, which are very common in the construction of most research infrastructures. The identification of cost risks, their management and mitigation is an essential duty. This demands the application of the best, benchmarked tools and procedures with respect to cost and schedule control. Two aspects have special importance: first the whole life cycle of the RI from the outset to the end (e.g. very early planning phase until redeployment or demolition of buildings no longer required) must be reflected; secondly, for every life cycle phase the same formal, comprehensive cost categorical system has to be applied.

Costs must be clearly defined and realistically planned for all project phases from the outset to include construction (design, preparatory phase, manufacturing, assembly/integration, configuration/change, testing, commissioning), operation, upgrades, refurbishing, decommissioning, and additional requirements (e.g. computing needs, e-infrastructures, staff training, knowledge sharing, hosting facilities). Furthermore, all the "exit costs" expected at the end of the project (e.g. handling of redundant buildings, sale of decontaminated land, equipment, etc.) should be included.

These should be estimated with precision appropriate to the different approval stages, and with increasing certainty as the project progresses towards construction and project knowledge accumulates. The level of confidence in the estimates should be assessed and shared. In the case of e-infrastructures, it is vital that there is a dialogue with e-infrastructure providers to provide realistic estimates. It is essential for cost control to prevent the cost estimates becoming known to potential suppliers.

Appropriate and adequate contingency budgets, and the terms under which they can be released, should be agreed in advance for each time period. The management should have delegated authority to use a management reserve or contingency budget for e.g. for working steps that are not yet detailed or for mitigating defective supplies (including in-kind contributions) within pre-defined limits, as well as having the possibility to shift orders and money (at a reasonable level) between each year's tranches of budget and work according to the project's needs for cost and schedule control.

Independent verification of the cost estimates should be achieved through independent audits.

The basis for all aspects of cost control must be a sound financial management and acceptance of the necessity for appropriate systems to be funded, maintained and used rigorously. A holistic cost planning and accounting system based on a proper number of cost elements, cost objects and cost units, must be implemented and fed from the outset with the ability to grow with the project's complexity.

The costs must be monitored by an always up-to-date, bottom-up planning, controlling, reporting and steering system as described in chapter 5. Special attention should be given to the implementation of early-warning systems and tools for short-term reactions (normally monthly, in crisis times weekly). They should give instant indication of deviations in cost and schedule, demand rapid but considered counteractions and give quick feedback about their effectiveness.

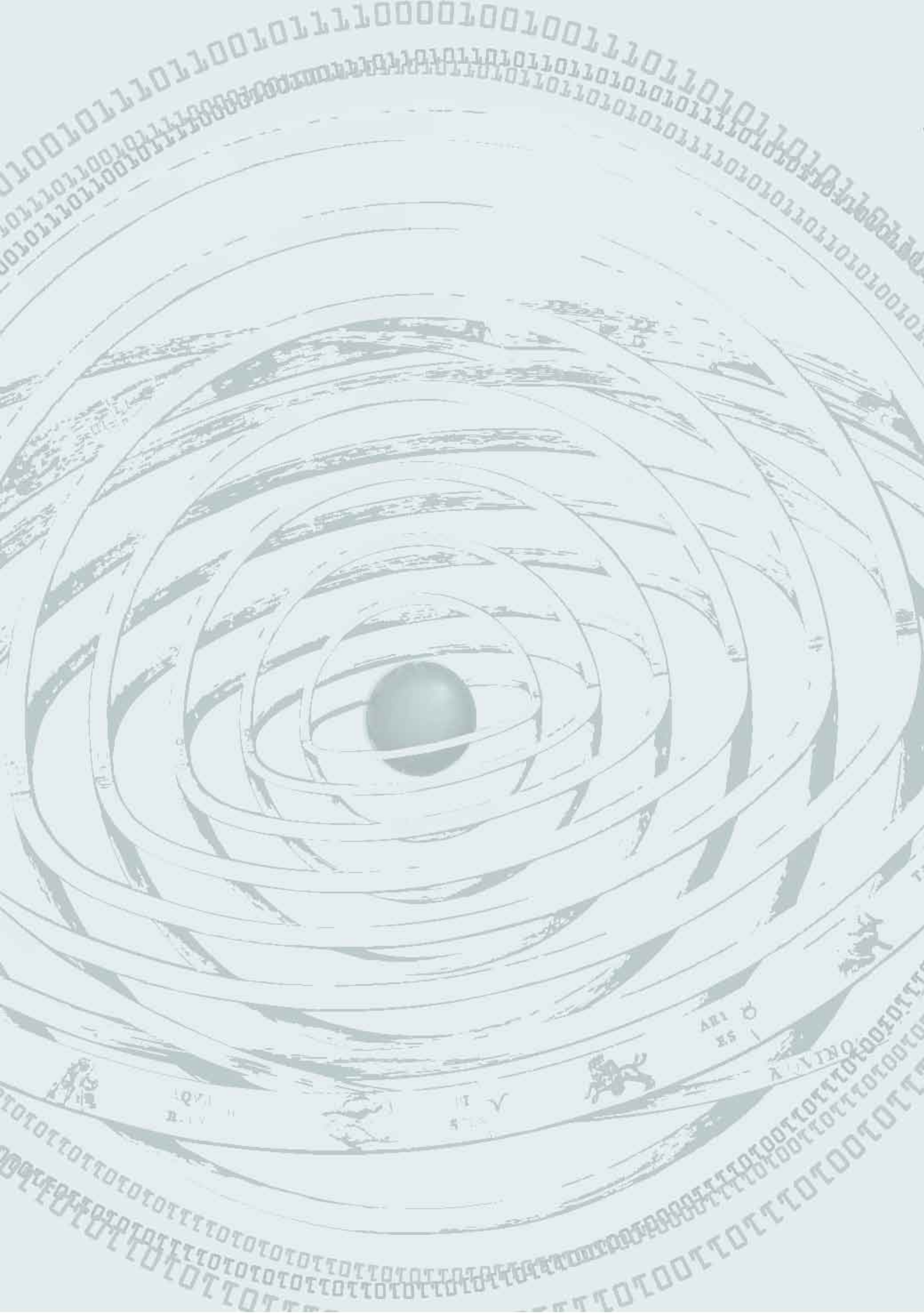
Key Recommendation:

12

Costs must be clearly defined and spending must be realistically planned, including in-kind contributions. Costs should be estimated with appropriate precision according to the different approval stages, and contingencies must be provided. The costs must be controlled by always current, bottom-up best-practice systems.

8. Forward look

As future Research Infrastructures become ever more complex and more expensive, it is increasingly important that the establishment of new world class RIs is executed in a comprehensive and highly professional way in order to avoid as far as possible the experienced pitfalls in the past, delays and cost over-runs. No single "best" solution for every RI is possible, simply because each RI has unique features demanding special models and practices. But the collective experience of international experts in this field demonstrates that there are clear underpinning principles and good practices that can make a major contribution to the success of RIs. It is hoped that the recommendations in this report, based on the collective experience and expertise of those operating in the field at a senior level, may provide a guideline in the demanding process of establishing and operating a RI.



Annex I: Members of the Expert Group, invited international Experts and Observers

European Expert Group on Cost Control and Management Issues of Global RIs

Chair

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Rapporteur

Dr. W. MEISSNER	Intech GmbH Industrie- und Technologie- Holding (DE)

Secretariat

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Mr. L. VIEHOFF	European Commission, DG RTD D.02
Dr. B. VIERKORN- RUDOLPH	Deputy Director General Federal Ministry of Education and Research (DE) and DE Senior Official
Prof. J. WOOD	Secretary-General Association of Commonwealth Universities

Invited International Experts

Prof. D. ADAMS	Chief Director, Research Infrastructures and Emerging Research Areas (ZA)
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Dr. D. DU TOIT	Minister Counsellor, South African Mission to the EU (ZA)
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Annex II: Terms of Reference given to the Expert Group

Terms of Reference for the European Expert Group on Cost Control and Management Issues of Global Research Infrastructures

BACKGROUND

The strong potential for cooperation on issues related to global research infrastructures was recognised in the meetings of the Carnegie Group of G8+O5 Science Advisers in their meetings since 2007. Consequently, at their first meeting the G8+05 Science Ministers decided to form a Group of Senior Officials on Global Research Infrastructures. This Group was originally mandated to look at the general situation regarding global research infrastructures, their inter-dependencies and specific issues such as:

1) State of play of national roadmaps and priority setting;

2) Overview of existing global projects and their issues;

3) Identification of possible new areas of cooperation ("gap analysis");

4) Promotion of mutual use of existing research infrastructures.

Since then it has become clear that countries estimate construction and operation costs in different ways, and not all relevant figures are included, including contingencies and inflation costs. This leads to lengthy negotiations, misunderstandings and almost inevitable cost over-runs once construction starts.

At their last meeting, (Kazan, Russia, 29-30 October 2009) the Carnegie Group welcomed Commissioner Potočnik's proposal to hold the first meeting of the Group of Senior Officials on Global Research Infrastructures in Brussels in spring 2010. During this meeting, it was also agreed that the mandate of the Group should be broadened to look at:

Reaching a common understanding regarding standardisation of construction, operation and decommissioning costs, including contingencies;

Cost and schedule containment during construction.

OBJECTIVES

In order to adequately prepare the EU's input to the first meeting of the Group of Senior Officials (tentatively to take place on 29-30 June 2010) and its follow-up, the Commission decided to set up a **European Expert Group** on **Cost Control and Management Issues of Global Research Infrastructures.**

With the assistance of the European Commission (which will provide the Secretariat), the Expert Group will:

Prepare a one day International Workshop to be held tentatively on 29 June 2010, [with the participation of the Senior Officials and invited experts], on **"Cost Control and Management in the Construction of Global Research Infrastructures"**.

Prepare the European input for the meeting of the Group of Senior Officials, currently scheduled for 30 June 2010.

Prepare the European input for a follow-up Workshop to be held in 2011.

WORKING APPROACH

In order to fulfil the above objectives, the expert Group is expected to:

Identify the **key cost elements** (from design to decommissioning) which need to be taken into account in the planning phase of large scale research infrastructures.

Compare the **approaches** taken on this issue by major construction projects in Europe and in global projects with significant European participation.

Identify **key management issues** for **cost and schedule control**, including risk management and risk mitigation.

Draw **lessons** from both present and past experience.

Make proposals for a possible **standardisation** of **methods** and of the related **project management process** for the construction of truly Global Research Infrastructures.

The Expert Group is expected to produce three sets of deliverables:

Prepare the key briefing points for the European Members of the Group of Senior Officials, in view of their first meeting, currently scheduled on 30 June 2010.

A **draft agenda**, a **discussion paper** and a list of tentative **invited speakers** for the Workshop of 29 June 2010.

A **consolidated report**([1]) by the end of 2010, targeted at policy and decision-makers, taking into account the outcome of the Workshop. The Report will include recommendations for issues to be tackled in a second Workshop to be held on the occasion of the second meeting of the Group of Senior Officials in 2011.

([1]) A possible outline of the report could be: 1) Executive Summary, 2) Introduction, 3) Review of good practice in project management and cost control, 4) areas with perceived problems, 5) Recommendations, 6) Annexes

Three physical meetings of the Expert Group are planned:

One on 20 May 2010

One on 29th June 2010

A third one in fall 2010

In addition, the members of the Expert Group will exchange documents by e-mail and may hold telephone conferences, as appropriate.

The Expert Group will elect its Chairperson and will develop its own working method. It may constitute sub-groups to tackle specific issues.

A member of the Expert Group will be designated as **Rapporteur**, and will be responsible for putting together the written deliverables mentioned above.

COMPOSITION

The Group will consist of **Heads**, or their designated **Representatives**, of European intergovernmental research infrastructures, of major facilities of pan-European relevance and of research infrastructure related programmes in Europe.

There will be up to 18 members.

They will all participate in a personal capacity

They will be appointed by the Commission according the usual procedures for Expert Groups.

The Group will elect a Chair and designate a Rapporteur.

RESOURCES

The **Commission** will provide **logistical support and the Secretariat of the Group**.

Costs for the participation in the physical meetings will be reimbursed by the Commission according to the standard rules.

Additional compensation for the work to be furnished in the context of these terms of Reference will be provided by the Commission to the Chair and the **Rapporteur**.

Annex III: Meetings of the Panel

First Meeting:	May 20, 2010
Second Meeting:	June 29, 2010
Third Meeting:	September 23, 2010

All meetings took place at the European Commission's Premises in Brussels.

Annex IV: Reference Documents

The following documents have been circulated in advance of the International Workshop on 29 June 2010:

EUROPEAN SPACE AGENCY COUNCIL, *Cost and Calendar of ESA Projects,* ESA/C(2010)20.

CERN Finance Committee, *Earned Value Management Status Report of the LHC Project on 2nd June 2008*, CERN/FC/5257.

Council Working Group on the Scientific and Geographical Enlargement of CERN, *Global Accelerator Projects and their Governance*, CERN/SPC/942/Rev. CERN/2898/Rev.

Ph. Lebrun (CERN) and P.H. Garbincius (Fermilab), *Assessing Risk in Costing High-Energy Accelerators: from Existing Projects to the Future Linear Collider,* Proc. 1st International Particle Accelerator Conference, Kyoto, 23-28 May 2010.

CERN, The LHC Project, *Configuration Management – Change Process and Control,* LHC-PM-QA-304.00 rev 1.1.

European Expert Group on Cost Control and Management Issues of Global Research Infrastructures, *Discussion Paper for the Expert Group Meeting on 29th June 2010.*

International Workshop on Cost Control and Management Issues of Large Scale RIs, *Outline paper for structuring the discussion during the Workshop on 29th June 2010.*

European Commission

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Internationalisation of large-scale research infrastructure projects has evolved to meet the scientific demand for facilities that are beyond the capability of individual countries or institutions in scope, cost and complexity. The management of such projects is extremely demanding.

In order to adequately prepare the European Union's input at international level on these issues, the Commission set up a European Expert Group on Cost Control and Management Issues of Global Research Infrastructures. In this report, the Expert Group considered the essential cost elements which need to be taken into account in the planning phase of large scale research infrastructures, compared the approaches taken on this issue by both major projects in Europe and global projects with significant European participation, identified key management issues for cost and schedule control, and drew lessons from present and past experience.

Further information is available at:
http://ec.europa.eu/research/infrastructures/

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