Developments in programme management

D C Ferns

In the context of projects and business management, the word 'programme' is rarely well defined. Variants of programmes include large (macro-) projects, 'groups of related projects', and 'all the projects undertaken by an organization' (multiproject environments). The paper offers a definition of a 'programme', and defines three models of programme design that between them encompass most business uses of the word. Each of the three programme-design models are described, as are their attributes and an example case study.

The benefits of managing projects within a programme framework are highlighted. A method of programme design is defined that helps to maximize the benefits delivered by the programme to the organization and to the business.

Keywords: programme management, multiproject, portfolio of projects, management process models, programme manager attributes, benefits analysis

FUNDAMENTALS OF PROGRAMME MANAGEMENT

Introduction

The word 'programme', or 'program' (US spelling), has many synonyms that have been used over the past 20 years, including

- multiproject,
- portfolio of projects,
- macroproject,
- project (typically large projects),
- complex change.

All the above terms are in common use, but precise definitions would be inconsistent with the loose way in which the words are used. The loose definition of the term 'programme' has contributed to a general lack of understanding of the benefits that programme management can provide. The common theme of programme management can be identified as the 'co-ordination of projects' to gain benefits that it would not be possible to obtain were the projects managed independently. In practice, however, the manner in which programme management is implemented, and the resulting benefits, are extremely variable.

This paper provides generic models that encompass most, if not all, of the current interpretations of programme management that have been implemented in organizations in almost all business sectors, private and public. The models serve two functions, first, the clarification of the understanding of the process of programme management, and, second, the encouragement of the design of programmes by the grouping of projects to maximize the benefits to the organization.

Definitions

Despite the loose definitions mentioned above, it is generally agreed that programmes are composed of projects, and it is, therefore, useful to consider how a 'project' is defined. 'Projects' are difficult to define. Harris 1 has collated 17 definitions, and others abound. Confusion is reduced by the separation of the definitions of 'project' and 'project management'. First,

'A project is a group of related tasks (or activities) which together satisfy one or more objectives'. (House 2, 1988)

Second,
'Project management is the planning, directing and controlling of tasks or activities and resources with the objective of completing a specific project with predetermined parameters of quality, time and money.' (UK Association of Project Managers, 1984)

A 'programme' and 'programme management' can now be defined:

A programme is a group of projects that are managed in a coordinated way to gain benefits that would not be possible were the projects to be managed independently.

Programme management is the coordinated support, planning, prioritization and monitoring of projects to meet changing business needs.

Need for programme management

Many projects fail to be successful because they do not deliver the expected results, or they overrun and overspend. Morris and Hough provide a good summary of preconditions of success and failure in very large projects, citing examples such as Concorde, the Channel Tunnel and the Giotto spacecraft. Some of the reasons for the failure of smaller projects, in technology, engineering, administration and IT, are the same as those for larger projects, for example:

- lack of objective evaluation,
- lack of clear and agreed objectives,
- poor leadership and teamwork,
- lack of risk management,
- contractual disputes,
- organizational and political issues.

Smaller projects, however, also fail for their own reasons, which, from the author's experience, are of major importance. These include:

- poor visibility of projects by senior management, owing to weak reporting,
- lack of prioritization, both within and between projects,
- inefficient use of resources,
- projects led by technology, rather than user needs,
- development of backlogs of work,
- lack of recognition and understanding of dependencies, both within and between projects,
- reengineering, owing to lack of attention to interfaces with other projects, systems and procedures.

These problems are evidenced in the real world by projects frequently being delivered behind schedule and over budget, and thus failing to provide the benefits that were expected by business managers. The reasons for failure listed above often only become apparent following some internal audit analysis. This analysis can confirm the degree to which projects are effectively coordinated, and assess the inefficiency from which the organization suffers owing to the poor performance of all project-related activities. In some cases, the causes of failure can be identified, and corrective action can be taken to prevent similar failures happening in the future.

Programme management, when understood and professionally implemented, provides a framework to help project managers 'get it right first time' within the business-strategy framework, and hence address current problems in projects.

Principles of programme implementation

The establishment of a programme within an organization requires executive-level support, usually from the Chief Executive or Chairman. Without this support, the programme manager does not have the position, respect and 'weight' to exercise the necessary control over project managers. A 3-phase process for implementing programme management is suggested (this has been proven in a variety of organizations):

- preparatory phase,
- programme establishment,
- programme management

Each phase is outlined below.

The preparatory phase requires the appreciation of the programme concept by senior management, and the realization of the benefits and savings that the implementation of programme management is likely to deliver. The committed senior managers, who recognize the potential benefits of the programme, typically group to form a programme-steering executive (PSE). The PSE is usually responsible for establishing the programme and monitoring programme policy. In many organizations, the PSE evolves from an existing committee, such as a 'projects-investment approval board' or a 'projects-evaluation panel'. In such cases, the terms of reference of the committee must be broadened from financial approval to include the monitoring of project progress and the interactions between projects. The PSE should then appoint a programme manager (and programme-control support staff as necessary), who defines the policy and management procedures, and establishes common project-support tools to serve the projects within the programme.

The second phase, programme establishment, involves the confirmation of the projects that comprise the programme, through the prioritization of projects and the gaining of the commitment of project sponsors. The project interrelationships should then be analysed by the programme manager. These include the identification of interfaces, potential savings from commonality between projects, and project interdependencies. The confirmed programme of projects can then be agreed and communicated, and the projects can then be planned in more detail.

The third phase of implementation is the programme-management activity itself. Programme management includes planning, logistics and change control functions, but should also encompass the human-resource management of project managers and directors, which requires good interpersonal-communication and conflict-resolution skills. The programme manager may research and implement the tools and procedures to support project managers within the programme, and thereafter manage training for project managers and their teams. As the projects become established, the programme manager focuses on monitoring change within projects. This involves reassessing whether or
not projects are continuing to meet business objectives and use resources efficiently. The external influences on projects, such as changes in demand forecasts, are also regularly reassessed by the programme manager, and, where appropriate, projects are reprioritized within the programme.

Programme-organization relationships

A programme manager typically has project managers reporting to him/her, and reports upwards to the programme steering executive or alternative executive body. Examples of how programme managers fit into matrix and hierarchical organizational structures are shown in Figure 1. These reporting levels have been proved to be successful, as they bridge the gap between project managers and executives responsible for business and financial performance. If the programme manager reports in at a level too low in the organization, he/she does not have the authority to make the strategic decisions that are part of his/her role, and neither does he/she gain the respect of senior project managers.

Figure 1 illustrates the ideal reporting positions in matrix and hierarchical organizations. The programme manager often has the same status or reporting line as the other directors. As more organizations realize the benefits of becoming more ‘project oriented’, there is likely to be an increasing number of ‘programme directors’ taking their places on the board or executive.

Programmes should be designed to serve a range of business objectives or business areas within an organization, and hence an organization may have several programmes. A very large organization could have several concurrent programmes. Programme management can either be adopted locally within a part of an organization, or corporately across an organization. Some may consider that an organization should contain only one programme to manage change through projects, and, indeed, for small- and medium-sized organizations, this may well be a sound and practicable solution. For larger organizations, however, the author trusts that the following sections of this paper demonstrate the additional benefits to an organization of designing several programmes by well considered groupings of projects.

The scope of implementation is likely to be chosen by the PSE, and it will depend on the funds available and the degree of commitment to change in different parts of the organization.

A large organization may choose to have a pilot implementation of programme management that meets the needs of a business area or satisfies the scope of a business objective. The business area for the pilot implementation is typically that with the greatest need, where projects have a poor record of delivering business benefits, and hence there is a substantial potential for an early payback on the costs of programme-management implementation.

Need for development

The many definitions and interpretations of ‘programme’ almost all have some degree of validity, as there is no dictionary definition of ‘programme’ within the context of project and business management. The author and his colleagues therefore sought to develop generic models that encompassed their experiences of how organizations define and practice programme management. Their experiences have been gathered in a wide variety of industry sectors, including IT, telecommunications, construction, aerospace and manufacturing, in the UK and overseas.

The detailed analysis has resulted in the development of three ‘programme’ models that are

- strategic,
- business-cycle,
- single-objective.

Each model is described below, with example case studies.

PROGRAMME MODELS

The three models of programme design are detailed with the associated attributes necessary for the effective management of the programmes. In many organizations, it is clear which programme model is adopted, but the poor quality of programme management results in some of the advantageous attributes being neglected.

Strategic programme model

Many organizations recognize strategic decision points when business objectives and missions are reorientated.
Typical examples of strategic organizational change are privatization, reorganization following mergers, and diversification into new businesses. Strategic decisions typically result in a number of parallel projects to implement new organizational structures, systems, marketing strategies, personnel policies etc. Together, these projects comprise a programme. The key features of this category of programme are

- stimulus from a change in business mission or objectives,
- projects defined ‘top down’ by the executive, with minimal input to project definition from management,
- diverse, crossdepartmental and multidisciplinary projects within the programme,
- a primary common theme between projects of orientation towards meeting the new business objectives.

The model for the development of a strategic programme is outlined in Figure 2.

Useful examples of the strategic programme model resulted from the decision of the UK Government in 1989 to privatize the electricity industry. The government directive resulted in a revised mission for the UK Central Electricity Generating Board (CEGB), which involved the rapid establishment of component companies, namely National Power, Powergen, National Grid and 14 distribution companies (DISCOS). Nuclear Electric was devolved later from National Power. Each of these new companies inherited the staff and assets of a part of CEGB, and, from this base, each new company developed a business strategy, including a mission statement and goals. In addition to satisfying the long-standing technical needs, the companies then had to compete against each other, and satisfy shareholders, new government legislation and the new government-appointed industry regulator. The new strategy for each company resulted in the definition of development projects, which were managed as programmes by directors of the respective companies.

**Business-cycle programme model**

Organizations undergo continuous change. Projects provide a mechanism for managing these changes in a stepwise, controlled manner. The requirements for change come ‘top down’ from the executive, and ‘bottom up’ from management. For example, the executive may request a short-term performance-improvement project, or research for a new suite of products to add to their existing range. Bottom-up projects requested by management may, for example, relate to improvements to customer services, or enhancements to existing computer systems to improve efficiency and service levels. Irrespective of the origination of the projects, all projects within an organization deliver changes that affect the overall business performance of the organization.

The values of changes that are delivered from projects to the business are greatest when the projects are coordinated and prioritized across the organization. Such a series of coordinated projects represents the second category of programme, which is often synonymous with 'multiproject management' or a 'portfolio of projects', which typically has the following attributes:

- projects come top-down from the executive and bottom-up from management,
- projects are linked to planning and budget cycles within the organization,
- the authorization and prioritization of projects is a major function,
- programmes may be established in a range of business areas within an organization.

Figure 3 outlines the model for the business-cycle programme.

The example taken is that of a major financial-services company that has an annual programme derived from procedures that are integrally related to the annual budget cycle. The programme is designed in a 3-stage process. First, management are asked to present proposals for projects to the programme controller. This is the ‘bottom up’ process at work. The programme controller, working closely with the finance department, determines which projects can be afforded within the budget. Those that are below the funding line are shelved or rejected. The list of affordable projects is then passed to a panel of corporate business strategists, who provide further funding for key strategic projects, often generated ‘top-down’ from the executive. The final list of projects is the ‘annual corporate
programme', which the programme controller then manages. The programme controller is responsible for managing changes to the programme during the year, including the introduction of new projects and resource prioritization.

**Single-objective programme model**

Programmes with a single objective are often called macroprojects, or simply projects. What differentiates them from other projects is their size. Examples might be the Channel Tunnel, the establishment of the First Direct bank in the UK, and aircraft and satellite programmes. These programmes are of such magnitude that they consist of a large number of projects (often several hundred), many of which run concurrently and can benefit from programme-management techniques.

These programmes often employ large numbers of contractors, and many are multinational programmes. The typical features of this category of programme are that they

- are 'easy to label' and visualize,
- often involve new initiatives and greenfield sites,
- are important enough to the business for there to be direct reporting to the Chief Executive or directors,
- are often managed outside normal functions, by a specially established company, consortium or independent business unit,
- require phased development and implementation,
- require tightly coupled technical interfaces between projects.

The establishment of a new single-objective programme usually requires a strategic organizational decision on how the programme should be managed (see Figure 4). Three major options are available, and hybrid combinations of options can be considered, as discussed below.

**Establish a new company**

The option of establishing a new company is favoured by many groups of companies, whose members each provide staff to the new company or consortium on long-term secondment. This option can help to isolate the risk of the new venture for the sponsoring organizations. One example of this is Panavia, a company formed by a consortium of British Aerospace, Dornier (now Deutsch Aerospace) and Fokker to manufacture the Tornado aircraft.

**Manage without organizational constraints**

Some organizations recognize that their managerial structure and procedures might constrain the effectiveness of a large programme. A number of options are available:

- contract the whole programme to an external 'prime' contractor who is responsible for managing and conducting the work,
- use independent consultants and their procedures as managing contractors,
- establish the new programme 'off-site' in an independent location with minimal interfaces to the parent organization.

When the Midland Bank, UK, established the First Direct telephone banking service, they set themselves
tight schedules, and recognized the need to be unconstrained by traditional banking development methods. As a result, the establishment of the First Direct service was managed as a major programme, and located at an independent site with a selected team, including external consultants. The programme manager reported to the Midland Group Board, and all the technical interfaces to the Midland Bank were minimized. Indeed, for commercial reasons, it was important to minimize the relationship between the new service and the parent bank. The new banking service was successfully brought to schedule and to budget.

Management in the organization

The development of a large programme, either subcontracted to a prime contractor or managed internally, usually requires that a dedicated team of professionals be assigned to the programme. This demands some organizational restructuring, which may require the PSE to submit a case for the restructuring to the board.

It having been determined how the single-objective programme should be managed, the second major decision point in the design model for single-objective programmes focuses on how the programme should be structured. The structure is typically hierarchical, although there can, in some circumstances, be benefits from using a matrix structure.

Hierarchical programme

Most single-objective programmes have a hierarchical internal structure that is arranged either by functional projects, such as engineering subsystems, or by project responsibility, from prime contractors and subcontractors down to component suppliers. This is analogous to the division of a project into work packages.

Matrix programme

Some programmes have special requirements that are best addressed by grouping projects in a matrix structure. The matrix design of programmes is particularly useful for identifying commonality between projects at an early stage, and for producing detailed specifications for complex interfaces between projects.

The Columbus Programme, which is the European Space Agency's contribution to the NASA Freedom Space Station, was initiated in 1985, with a matrix structure, to explore the potential of common specifications for complex interfaces between projects.

Programme Design

Potential benefits of programme management

The models described above having been developed, the potential benefits that programme management can bring to an organization are considered below. The benefits fall into three major categories:

- meeting business needs,
- savings,
- reducing risk.

Meeting business needs

Projects do not always meet business needs. Projects are often established to implement changes that cannot be fully justified to the senior management of the organization. A sound 'business case' is not always developed to justify a project. In addition, projects tend to become more inward-looking as they develop, resulting in a drift away from the original business objectives. In projects in large organizations, it is common for insufficient attention to be paid to interfaces to other systems, both existing and planned. This results in the need for reengineering and major additional costs.

Well designed programmes, with strong programme managers, ensure that projects are aligned with each other, and are implemented with close regard to business strategy and priorities.

Savings

Tools, procedures and training

Many organizations allow each project manager a large degree of freedom in selecting tools and procedures for his/her project. This policy is attractive, in that it allows versatility, but, in management terms, it generates many hidden costs. For example, software support tools are often purchased for one project, and are not reused. In some cases, the selection and procurement of the support tools alone can take several man-weeks of the project resource. A greater cost to the organization is the training and retraining of all the staff involved in a project in different tools and procedures. Even if formal training is minimized, each individual on the project team wastes time in adapting to different tools and procedures when starting work on a new project.

The programme manager should be responsible for selecting a common set of tools and procedures that meets the needs of all the projects within the programme. This commonality not only saves direct costs, but also enables staff to transfer between projects within a programme without having to climb unnecessary learning curves for new procedures and tools.

The selection of tools and procedures by programme managers allows greater flexibility for the meeting of project needs than does, for example, the imposition of corporate standards for project-management tools and procedures. Corporate standards are rarely written to satisfy the diverse needs of all types of project. For example, different tools and procedures may be required for a programme of small IT projects than for a multimillion-pound building programme.

Staff resources

Projects typically require variable staffing-resource profiles, and it is the programme manager's task to ensure that the staff are used in the most effective way,
and are transferred between projects within a programme with the minimum of 'dead' time, subject, of course, to individuals being able to spend reasonable amounts of time on each project. Resource allocation between projects, and for the benefit of projects, is rarely paid sufficient attention by line managers. There are likely to be cost savings, owing to the more efficient use of resources by the programme managers.

Commonality savings
The role of the programme manager should include the identification of common themes, in development and techniques, that can be applied to projects within the programme to minimize corporate spending. Examples include:

- the need for a detailed cost model on different projects,
- the need for common market research to support requirements for more than one project,
- the potential for developing modular software or engineering products that can be developed to common specifications, and reused in two or more projects,
- the potential for two or more projects to share computer systems (in development or operation),
- the likelihood of different projects using the same subcontractor – placing the organization in a stronger position to negotiate terms (for two or more contracts).

The assessment of commonality also helps to identify areas of technical overlap between projects, and 'underlap', such as, for example, missing functionality.

To realize the above benefits, the programme manager must have 'helicopter' skills, to 'hover' over project plans and observe, using some forethought, the potential for commonality. These skills are rare, and many programme managers fail to meet this requirement. The programme manager must also have a sound understanding of business and user needs, and the support facilities required. In some circumstances, political skills are also highly desirable.

The programme manager should then discuss these ideas with project managers, and they should decide whether or not, in their experience, savings due to commonality are likely to be greater than the management costs of introducing commonality between projects.

Reduced risk
The management of interfaces and dependencies between projects reduces the risk of projects developing their own inertia and boundary definitions. Hence, the risk of costly redirection and reengineering is reduced.

The understanding of the process of programme management by senior managers also has the positive effect of increasing awareness that projects are being assisted and coordinated.

The appointment of programme managers, and their activities in programme-planning control, contributes significantly to reductions in project overrun and overspend. The degree of payback depends, to a large extent, on the degree of current problems with delivering projects, the quality of the programme manager as an individual, and the effectiveness with which he or she integrates into the organization.

Realizing the benefits
Many organizations that have attempted to implement programme management, particularly across groups of small projects, have failed to be able to quantify the benefits to the organization. Often, the benefits are not optimized, because of the following reasons:

- programme managers are not strong enough as individual managers,
- programme managers report in at too low a level in the organization,
- projects are grouped in a random fashion, such that
  - skills are unique to projects, and are not transferrable to other projects in the programme,
  - there is no technical commonality between projects within the programme,
  - there are few technical or management interfaces between projects within the programme.

From the experience of the author and his colleagues in implementing programme management, the way in which these issues can be addressed is outlined below.

Selection of programme managers
The programme manager should typically be a director or delegate director. If this is not the case, the individual must have considerable personal 'weight' and persuasive qualities in relation to the directors. The manager should think strategically, but understand the tactical work of the projects. The ability to communicate and manage relationships with the executive and the project managers is essential. If the programme represents a macroproject, the programme manager must manage public relations with the outside world and financiers. He/she is likely to require a programme-support office that integrates plans prepared by project managers, provides procedures and tools for use by the project managers, and gives training and support to project managers as necessary. The personal goals of the programme manager are likely to be to:

- generate savings and maximize return by the coordination and effective management of projects,
- ensure that projects are delivered successfully, to predetermined scope, time, cost and quality,
- support project managers in their execution of projects,
- maintain project alignment with business objectives.

It is noteworthy that, while some project managers possess many of the above qualities, and could therefore be promoted to the role of programme manager, others do not. Take, for example, an effective, highly focused project manager who has always emphasized the team building skills, team spirit, and the defensive strategy of 'our project versus the rest of the organization'. He is unlikely to be able to maintain the strategic forethought and balanced, impartial relationships that put organizational needs before the needs of individual project managers.
Designing programmes to reap benefits

Many of the benefits of programme management can only be obtained if projects are grouped in certain ways. It is recommended that the programme design be optimized by the consideration of potential benefits to the organization at the earliest possible stage.

The first phase of programme design is to establish a matrix of all projects mapped against each other (see Figure 5). The matrix can be completed with interface and linkage information, which should be appropriately classified by the potential benefit of relating the projects together. For example, interfaces between projects may reap the following potential benefits:

- resource/skill sharing,
- engineering/software commonality,
- market-research commonality,
- contractor commonality.

The author and his colleagues have designed a database model to facilitate this exercise. The model can be used to develop the best grouping of projects, and list the benefits that that particular grouping of projects has the potential to deliver. A typical output is shown in Table 1.

For example, consider a company that has defined 60 new projects from its new strategy. The first stage would be to complete the programme-benefits matrix (an example is shown in Figure 5), by anticipating the potential linkages, interdependencies and commonalities between each of the 60 projects. The model then asks for the number of ‘programmes’ required. 60 projects would be unlikely to justify more than three or four programmes, and there may be advantages in keeping all the projects within one programme. The model can be run for any number of chosen programmes.

![Figure 5. Example of a programme-benefits matrix](image)

Table 1. Output of programme-benefits model

<table>
<thead>
<tr>
<th>Programme</th>
<th>Link</th>
<th>Programme</th>
<th>Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>B</td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>Projects 1, 2, 3, 5, 6</td>
<td>5</td>
<td>Projects 4, 7, 8</td>
<td>2</td>
</tr>
<tr>
<td>Resources</td>
<td>6</td>
<td>Engineering</td>
<td>2</td>
</tr>
<tr>
<td>Software</td>
<td>3</td>
<td>Contractors</td>
<td>3</td>
</tr>
<tr>
<td>Contractors</td>
<td>3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(* A measure of the strength of project relationships within a programme.)

A relative ‘link score’ is provided to assess whether or not the projects would, for example, be best grouped into two or three programmes. The link score also relates to the category of benefit that can be expected from that grouping of projects. For example, one programme might be justified on the basis of commonality savings related to resource management (involving staff transfer between projects) and coordinating plans. Another programme might be justified on the basis of managing organizational and management interfaces across the organization to meet a single business objective.

A future development of the model will involve the use of a clustering algorithm to determine the natural ‘best number’ of programme groupings for a given set of interrelated projects.

Having made the judgement that a programme is justified by a particular set of benefits, the programme manager should set, or have set for him or her, objectives that allow the measurement of tangible progress towards the achievement of the benefits.

The use of this simple method for grouping projects into programmes enables the benefits of programme management to be delivered.

CONCLUSIONS

Programme management is increasingly providing substantial benefits to a wide number of organizations. Although it is applied in different ways, the common theme of programme management is to ‘coordinate projects to gain benefits that would not be possible if the projects were managed independently’.

Almost all programmes can be categorized into one of the three models defined in this paper:

**Strategic programme**
A strategic programme is characterized by a group of projects that results from a change in the mission or objectives of an organization, for example privatization, reorganization following mergers, and diversification into new businesses.

**Business-cycle programme**
A business-cycle programme is characterized by a group of projects within a time-related business cycle, such as an annual budget.

**Single-objective programme (or macroproject)**
A single-objective programme (or macroproject) is characterized by a strategically important large ‘project’
(e.g. an aircraft, the Channel Tunnel) that owing to its size, is managed as a group of smaller projects.

The models described develop the understanding of the process of how programmes are defined. From a critical review of these processes, it was clear that, in the real world, little attention is paid to grouping projects to achieve maximum benefits. It is more usual for a programme to be defined from a strategy, and for projects to then be defined within the programme. Very often, this process yields programmes that are unable to deliver clear benefits, because the interdependencies between the projects are either not present, or are not strong enough to yield measurable benefits.

It has been demonstrated that programme management can achieve greater, and more controlled, benefits if the projects are defined prior to their grouping into programmes.

A model has been developed to facilitate the definition of interdependencies between projects. Projects are then grouped to maximize the benefits to the organization. The key advantage of the new model is that both the business and the programme managers can identify the specific objectives of each programme. The objectives of the programme manager are specifically defined to provide additional benefits through the coordination of projects that would not otherwise be delivered.

Organizations that practice programme management are likely to gain additional benefits through the use of the programme-benefits model described. Others can apply the model to projects within their organization. This ensures that, when programme management is implemented, it has the maximum impact on improvement of the business through the coordination, support and management of projects.

ACKNOWLEDGEMENTS

This paper was stimulated by colleagues in PA Consulting Group’s Project Management practice, in particular: David Wightman, Charles Evans, David Stupples, Jim Young and Steve Winslade. The author would also like to thank those named for their valuable comments on the manuscript.

REFERENCES

1 Harris, R ‘Definitions of project management’ Project Vol 2 No 7 (1990) p 18

Duncan Ferns is a client development manager with PA Consulting Group’s Project Management practice. He has advised and trained clients in the establishment of programme and project management in the aerospace, finance and energy sectors. Previously, Dr Ferns was a project manager of large space-system developments with Logica Space and Defence, UK, where he managed several projects within the international Columbus (space-station) programme. He holds a doctorate in remote sensing and image processing from Imperial College, University of London, UK.