

Cost Engineering Health Check - a limited survey

Prepared by QinetiQ

**For Society for Cost Analysis and Forecasting
(SCAF)**

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0 - DOCUMENT CONTROL PAGE

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1 – EXECUTIVE SUMMARY

At the Society for Cost Analysis and Forecasting (SCAF) Workshop meeting held on the 27th November, QinetiQ conducted a cost engineering survey with the objective of improve cost engineering capability by helping the SCAF chairman and membership identify areas of weakness that SCAF can focus upon at future workshops and conferences.

The short survey was based on QinetiQ's Cost Engineering Health Check (CEHC) and comprised 11 of the total set of 60 multiple choice questions that QinetiQ use as indicators of best practice in the cost engineering domain. The CEHC is based upon QinetiQ's philosophy of Knowledge Based Estimating (KBE), with the questions covering the cost engineering building blocks of Data, Tools, People and Processes. Each attendee responded to the questions electronically, using e-voting handsets, from the perspective of their experience in the cost engineering domain. As a result the outputs represented a consensus view of the attendee at this SCAF meeting.

This report provides the SCAF members with an analysis and interpretation of the e-voting from that day. The questions have been repeated and a graphical presentation of the results provided. To put the results into context a narrative of the answers has been given and further questions considered.

At the end of the report recommendations have been made regarding topic areas that the SCAF workshop should study in more depth in future to assist the cost engineering community in maturing their costing capability. In brief the areas identified for improvement are:

- Technical data gathering;
- Risk and uncertainty best practice [1.];
- Risk management and analysis tools [1.];
- Software estimating models [3.];
- Through Life Cost;
- Management engagement;
- Terms of Reference (TOR) for cost estimators [2.];
- Application of multiple estimating techniques.

Some of these topic areas will be covered in the forthcoming SCAF workshop programme including:

- [1.] 4th June 2013 “Quantitative cost and schedule risk analysis”, Preston
- [2.] 17th September 2013 “Cost Matters”, Bristol
- [3.] 19 November 2013 “Vendor Day”, Bristol

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2 - INTRODUCTION

A paper summarising the findings of a Cost Engineering maturity survey conducted at the November 2012 SCAF Workshop.

At the November 2012 SCAF Workshop QinetiQ conducted an electronic voting (e-voting) assessment of the attendees to identify areas that the SCAF community may consider worthy of attention during future workshops, with the ultimate aim being to draw out and mature the overall costing community as a whole.

The assessment used a number of structured multiple choice questions which formed a subset of QinetiQ's Cost Engineering Health Check (CEHC). QinetiQ's CEHC is a standardised competency assessment tool based on QinetiQ's long established, tried and tested, Knowledge Based Estimating (KBE) philosophy. The CEHC comprises 60 questions that can be answered on a graduated multiple choice scale of 5 options, where 5 is considered best in class and 1 is considered weak, and each answer is characterised by indicators that help identify the appropriate assessment.

For the purposes of this assessment only 12 questions from the total of 60 from the CEHC were considered. These questions span the four building blocks that form the foundation of this philosophy are Data, Tools, People and Processes. The remainder of this paper presents the results of the questions that were posed to the SCAF attendees. Stemming from the answers received to each of the questions asked, a number of additional discussion points have been identified that could help provide direction as to the content of future sessions.



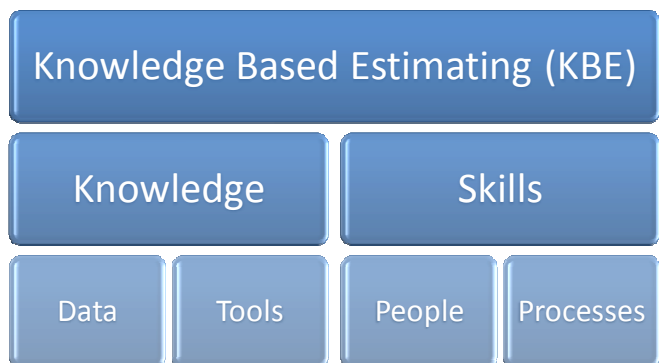
Assessment Context

The CEHC is usually conducted within a project, organisation or function. In the context of the Society for Cost Analysis and Forecasting (SCAF) the attendees were asked to consider their experience when answering the questions rather than focusing upon a particular organisational entity. Therefore the results need to be considered as a consensus of the cost engineers present at this SCAF meeting.

Knowledge Based Estimating (KBE)

QinetiQ cost forecasts and estimates are underpinned by its philosophy of Knowledge Based Estimating (KBE). This promotes the application of knowledge and understanding as the basis of all credible and justifiable costs. The building blocks that form the foundation of this philosophy are Data, Tools, People and Processes.

Within the context of QinetiQ's KBE philosophy Data is defined as any information, both cost and technical, concerning historical projects that will be used as the basis for future estimates, whilst also



extending out to information in relation to the technical or programme characteristics of future projects or services. Tools are defined as the software systems that help cost engineers to interpret historical data, such as statistical tools, that can be used to create cost estimating relationships (CER), or other tools that allow the application of such relationships to generate estimates.

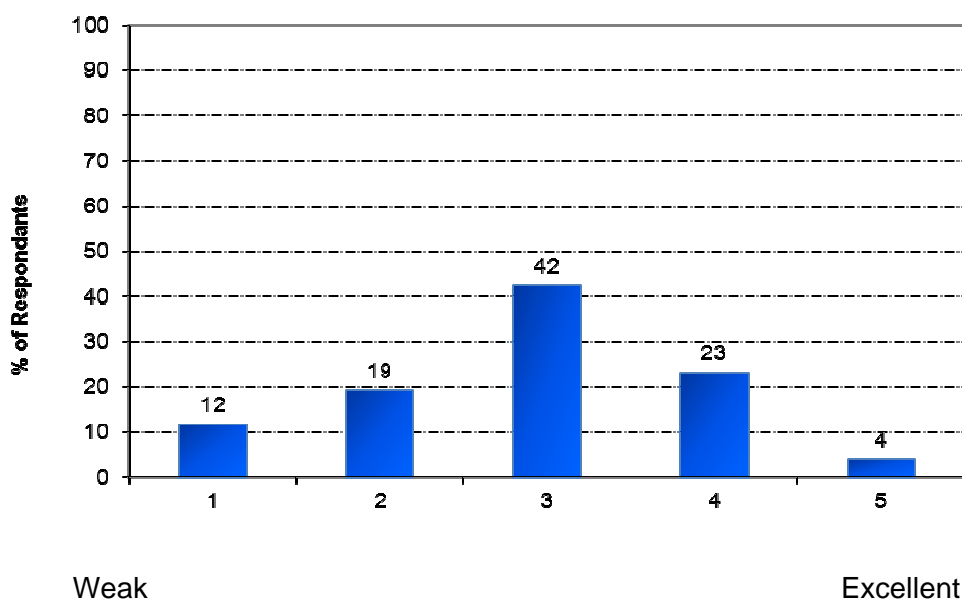
People within KBE are recognised as being needed to interpret historical data and predict the concepts for the new projects and services that will satisfy the perceived capability or requirements. Cost engineers need the qualifications to justify their professionalism and skills to elicit the data from finance, project staff and customers. Finally, processes are necessary so that that people conduct an estimate in a rational, repeatable way, ensuring that the outputs are traceable to source data and assumptions.

The CEHC has two additional outputs from the full assessment; Culture and Stakeholders. Information concerning both is inferred from the questions sees for Data, Tools People and Process as opposed being asked directly. Culture refers to the environment in which cost engineering is taking place. Stakeholders refer to anyone who has a vested interest in the cost inputs or outputs. The dataset for this survey was not suitably large to allow any inferences to be made.

3 - DATA

Question B1: Does the project gather historical financial data for cost estimating purposes?

More than 60% of the attendees surveyed thought that organisations do not have a recognised cost breakdown structure. Of these, 42% thought that some financial records have been stored for more than 5 years but are not necessarily in a consistent manner. 27% of the respondents believe that organisations store all financial records regularly and adhere to the organisations' default cost breakdown structure where a data dictionary is used to define cost element descriptions. Of these, only 4% of the respondents are confident that these financial records are stored for more than 5 years.

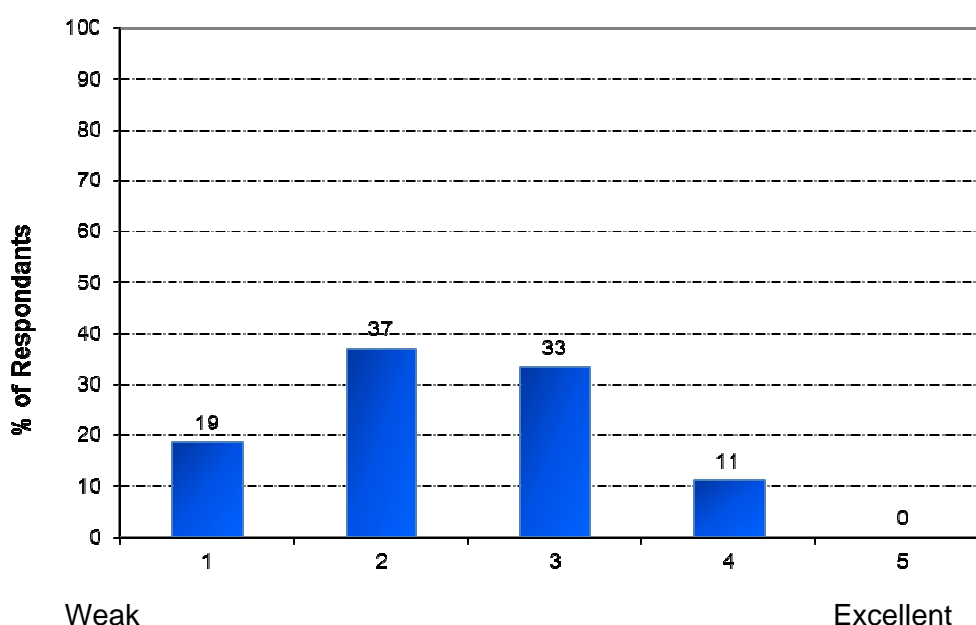


Further questions for consideration:

1. Is historic financial data important for the generation of the costs of future work?
2. If so, is it appropriate that almost half of the respondents indicated that financial data has been stored for less than 5 years without a clear definition of what the data relates to?
3. What can be done to improve upon this? Does the costing community have any ability influence this in the future?

Question B3: Does the project store technical information for the purposes of future cost estimates?

11% of the respondents thought that all technical characteristics of projects within organisations have been stored in a consistent manner adhering to the mandated corporate system, where none of these were for more than 5 years. 33% indicated that some technical characteristics of projects have been stored for more than 5 years but in an ad hoc inconsistent manner by individuals where technical attributes have various definitions. 37% thought that some, but not all, technical characteristics of projects have been stored for less than 5 years but in an ad hoc inconsistent manner by individuals. 19% suggested that ad hoc technical records have been stored through the initiative of individuals but not in a consistent manner and that organisations do not have a recognised need to store such data.



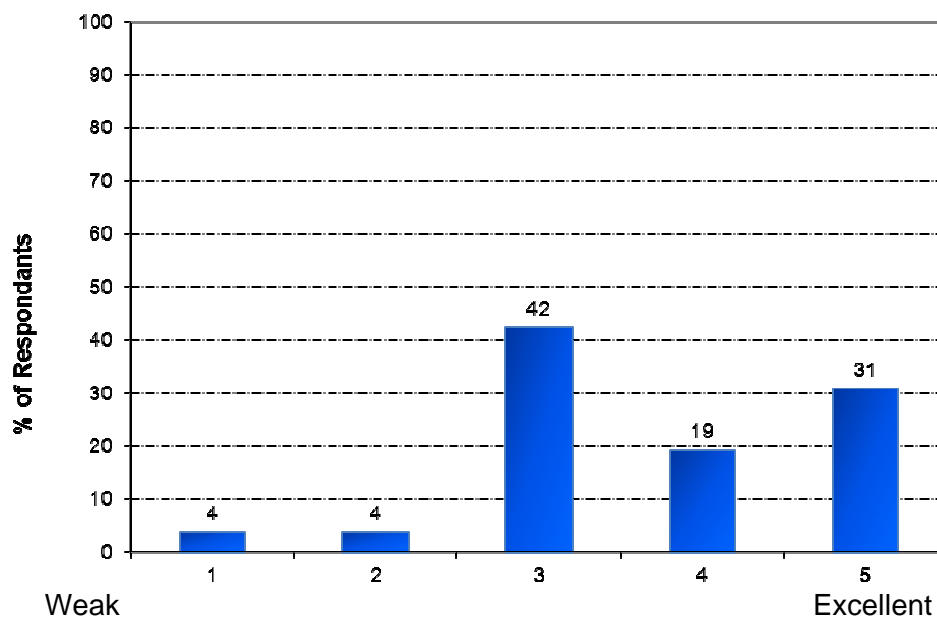
Further questions for consideration:

1. *Are technical characteristics of historic projects important for costing future projects?*
2. *If so, why are organisations not doing more to try to capture data in a fashion that it can be used for future estimates?*
3. *How can organisations better capture and store this data such that it can be used?*
4. *Is there technical data that is more worthy of capture (and hence investing in its capture) than other types?*

4 - TOOLS

Question C4: When producing an estimate does the cost engineer use risk analysis tools?

Half of those surveyed indicated that in their experience organisations conducted both cost risk and cost uncertainty analysis for the purpose of cost estimating, and that the output of schedule risk analysis was used to influence cost estimates. Of these, 31% of the respondents indicated that they had thought that this was being done for more than 5 years whilst the other 19% saying that they had been doing it for less than 5 years. 46% of those surveyed thought that cost engineers, whilst not having conducted both cost risk and cost uncertainty analysis, do consider 3 point estimating and have tools that enable them to produce uncertainty analysis or tolerances around an estimate when requested. Only 4% of these respondents believed that this was carried out for less than 5 years. The remaining 4% of the attendees surveyed indicated that cost engineers are not aware of risk or uncertainty analysis and do not see the requirement for such tools.

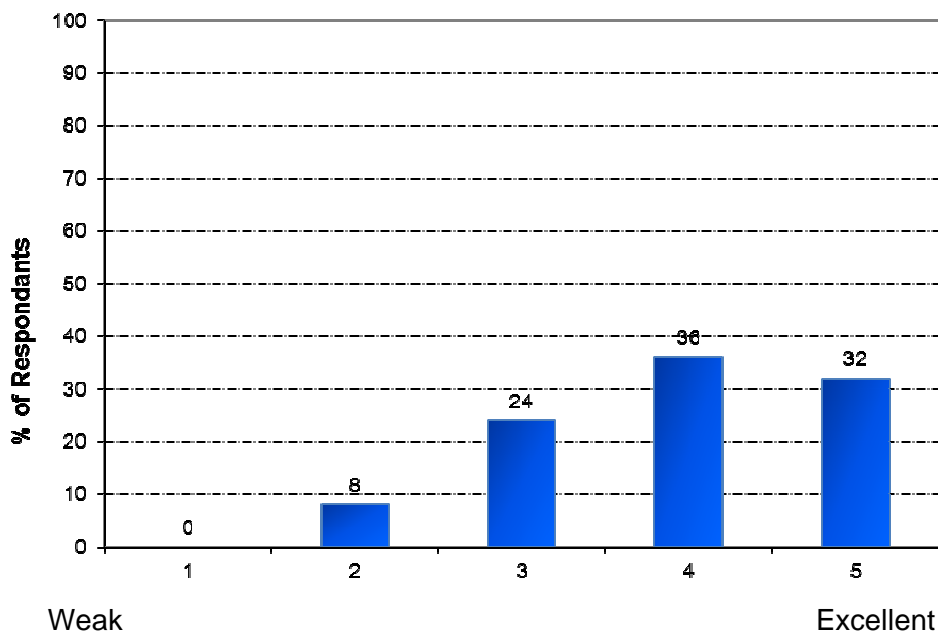


Further questions for consideration:

1. Is cost risk and cost uncertainty analysis really required to generate robust cost estimates? Are estimates any less useful if they aren't based on this type of analysis?
2. Do the advantages gained by cost risk and cost uncertainty modelling outweigh the investment required in order to be able to undertake it?
3. Is an organisations capability with respect to cost risk and cost uncertainty analysis a good measure of that organisation's costing capability?
4. Is conducting cost uncertainty analysis but not taking account of risk appropriate?
5. Should an organisation have a well defined standardised process for the application of cost risk and cost uncertainty analysis? What are the advantages and disadvantages of doing that?

Question C15: Does the cost engineering organisation have access to risk management tools?

68% of the attendees surveyed were confident that in their experience cost engineering departments had access to risk management tools and that staff were competent and trained in their use, and that these tools had some form of cost analysis functionality. 32% of the respondents thought that access to these tools and training was for more than 5 years, whilst 36% said that they had been used for less than 5 years. Remaining 32% of the respondents indicated that in their experience cost engineering organisation understood the relevance of risk management but there were no formal or standardised risk management tools in the organisation.

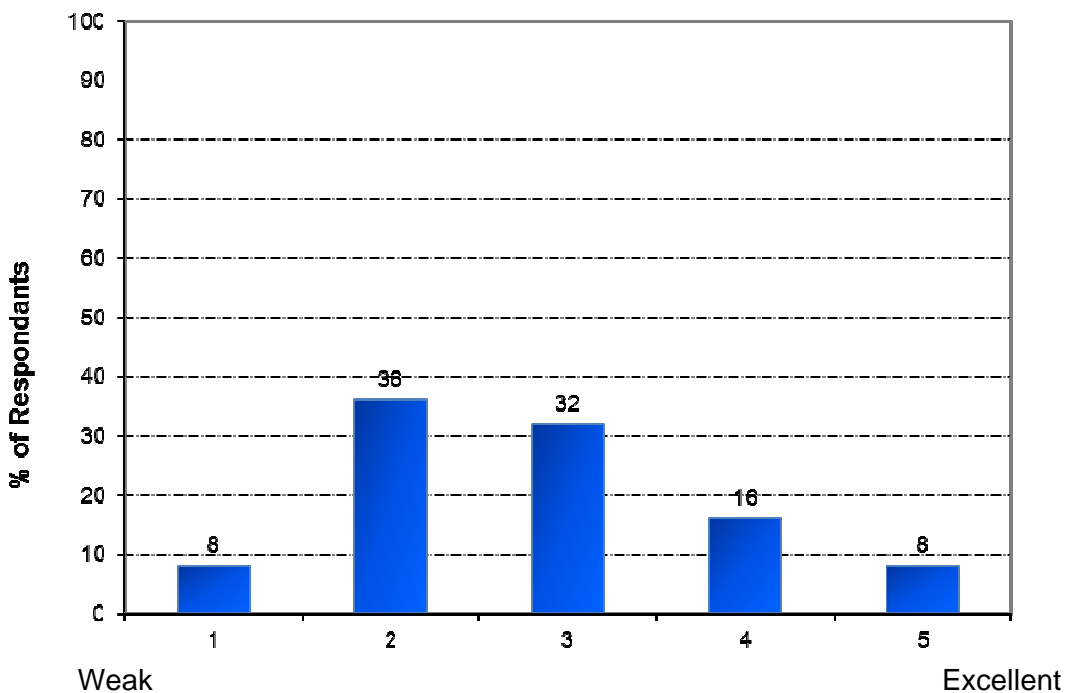


Further questions for consideration:

1. *Is risk information important to the cost management and analysis process?*
2. *Are formal risk management and analysis tools important for effective management of risk?*
3. *In the absence of formal management tools could the credibility of risk data feeding into the cost analysis process be considered questionable?*
4. *Is there anything an organisation could do to minimise the level of investment in formal risk management tools in order to secure the credibility of risk data for its cost analysis processes?*

Question C5: Does the project consider software estimating tools necessary?

Almost a quarter of the attendees surveyed thought that to estimate the cost of software, organisations typically use software cost estimating models such as COCOMO, and that there is the realisation that sizing software is critical to a good estimate. 8% indicated that they have been using these tools for more than 5 years, whilst 16% have been using them for less than 5 years. 68% of the respondents suggested that the importance of effective software estimating and software models is recognised by cost engineers but that in their experience they did not use software cost models and that estimates were conducted by subject matter experts and as such remained effectively unchallenged. Of these, 32% thought that software estimating have been recognised by their cost engineers for more than 5 years. The remaining 8% of the attendees surveyed indicated that in their experience cost engineering functions do not think software estimating to be worthy of consideration.



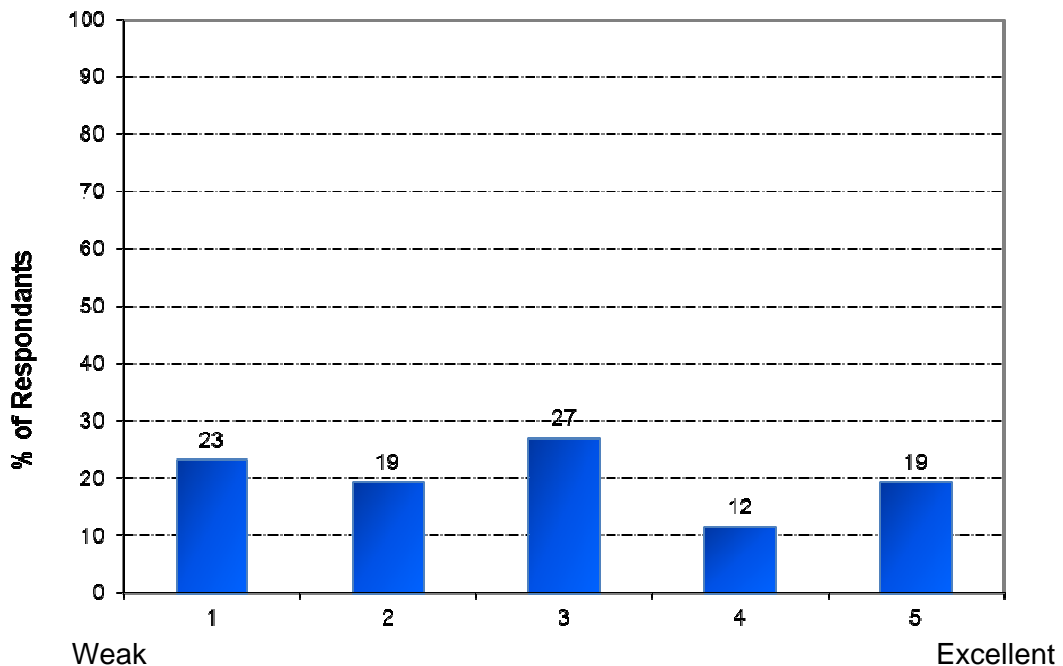
Further questions for consideration:

- 1. Are software cost estimates developed by commercial software estimating models accurate? Are they readily applicable in all instances?*
- 2. Is it appropriate that 68% of the respondents said that software cost estimates are arrived at through SME judgement as opposed any specific models? Could SME knowledge be used to generate organisation specific software models? Are these of greater value than commercial models?*
- 3. What are the business advantages to challenging commercial software models? Do these outweigh the investment required?*

Question C16: When producing a schedule estimate, does the cost engineer use schedule risk analysis tools?

31% of those surveyed indicated that in their experience organisations conducted both schedule risk and schedule uncertainty analysis for the purpose of schedule estimating, and that the output

of schedule risk analysis was used to influence schedule estimates. Of these, only 19% of the respondents indicated that they had thought that this was being done for more than 5 years. Almost half of those surveyed thought that cost engineers, whilst not having conducted both schedule risk and uncertainty analysis, do consider 3 point estimating and have tools that enable them to produce uncertainty analysis or tolerances around an estimate when requested. 19% of these respondents believed that this was carried out for less than 5 years. Almost a quarter of the attendees surveyed indicated that their engineers are not aware of schedule risk or uncertainty analysis and do not see the requirement for such tools.



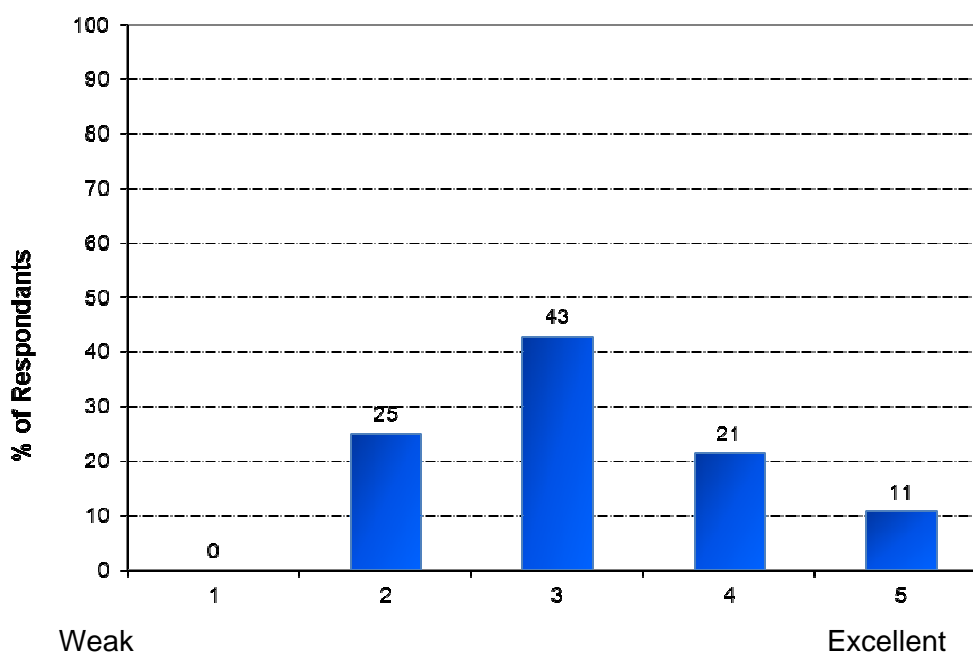
Further questions for consideration:

1. *Is schedule risk and schedule uncertainty analysis really required to generate robust estimates? Are estimates any less useful if they aren't based on this type of analysis?*
2. *Is conducting schedule uncertainty analysis but not taking account of risk appropriate?*
3. *Should an organisation have a well-defined standardised process for the application of schedule risk and schedule uncertainty analysis? What are the advantages and disadvantages of doing that?*

5 – PEOPLE

Question A5: How well does the cost engineer understand their project and the way that it functions?

Of the attendees surveyed 43% thought that in their experience cost engineers had a full appreciation of their projects, the domain in which those projects sat, including all the associated engineering, and of how costs were incurred through the complete lifecycle of the project. 36% of the attendees felt that their engineers had limited understanding of the project and/or the engineering, and had limited understanding of the associated through life costs. The remaining 21% of those surveyed indicated that that they thought that whilst the engineer fully appreciated, the project, the domain and the associated engineering they did not have a full grasp of costs through the complete lifecycle of the project.

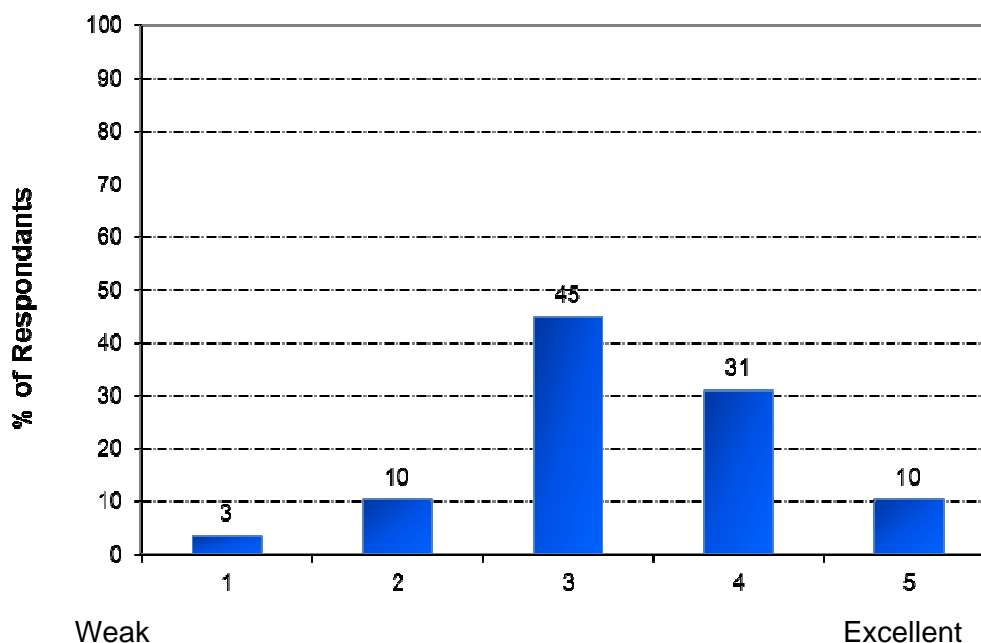


Further questions for consideration:

1. Do cost engineers need to have full knowledge of the complete through life costing aspects of the projects in which they are involved to create credible estimates?
2. What can the industry do in order to help cost engineers appreciate the life cycle?
3. Is it appropriate that almost 70% of those surveyed thought that their cost engineers did not have full understanding of the project, and/or it's engineering?

Question A1: What is the nature of the senior management's involvement in cost engineering?

Almost half of the respondents thought that, in their experience, a written policy on cost engineering exists in organisations, but practice on projects may be, to some extent, at variance with this. 31% think that organisation's senior management may have initiated some actions concerning cost engineering but do not yet make full use of the capability. 10% of those surveyed are confident that in their experience organisation's management has approved a written policy on cost engineering and that the project's methodologies, cost-related decisions making, and reporting processes are fully consistent with the policy. However, the remaining 13% of the respondents thought that although there will typical be a cost engineering organisation, senior management makes little or no use of the project's cost engineering capability or even acknowledge it.

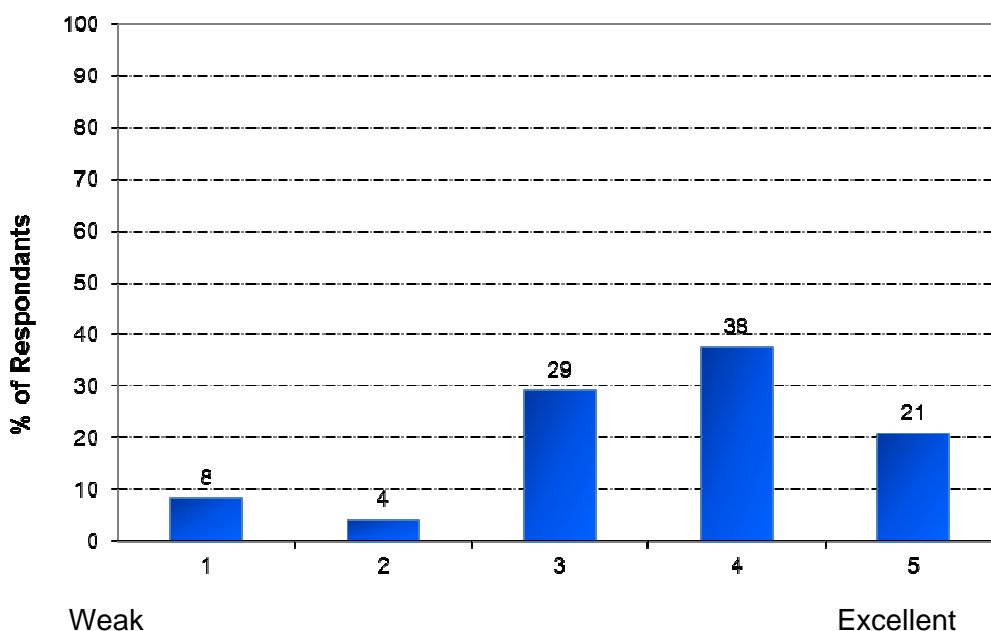


Further questions for consideration:

1. *Is it appropriate that more than 89% of those surveyed thought that their projects were either working at variance from the organisational mandated processes, or without specific organisational guidance in the generation of estimates that would be used to inform decision making?*

Question A15: Is the cost engineer motivated by the domain in which the projects reside?

21% of the attendees surveyed thought that in their experience cost engineers have a genuine interest in their project domains, and that this is underpinned by a comprehensive and long term understanding of the domain with more than 5 years experience. 38% suggested that cost engineers have an interest in the project domain, underpinned by a modest understanding with less than 5 years in domain. Both these groups indicated that the cost engineer acts to further their personal knowledge and skills through conducting research and reading books related to the domain. 29% thought that their project cost engineer, whilst having a long term understanding of more than 5 years working in the domain, lack the desire to maintain and progress their knowledge. The remaining 12% of the respondents indicated that although cost engineer had an interest in the project domains and that this was typically underpinned by a modest understanding with less than 5 years experience in the domain, they lacked the desire to maintain their knowledge.



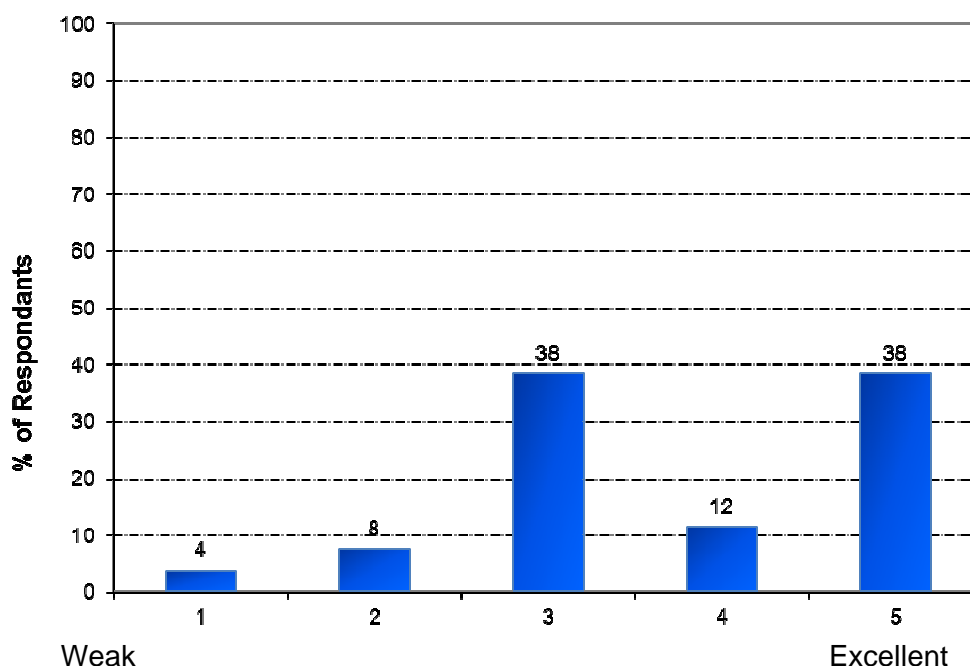
Further questions for consideration:

1. *Should the project cost engineer be motivated by the domain in which they are working or estimating?*
2. *Is it important that they have knowledge and experience of the domain? Does this impact upon the quality of the estimates generated?*
3. *Should management be interested in whether the people generating the estimates on which they base decisions have an understanding and knowledge of the domain?*
4. *What can an organisation do to help encourage this type of knowledge or interest?*
5. *Is an interest in the domain a measure of the professionalism of the estimator?*

6 - PROCESS

Question D6: How are cost engineering responsibilities carried out within the project team?

38% of the attendees surveyed thought that typical in their experience a cost engineer role is identified and endorsed within organisations, with clear empowering terms of reference (TOR) for the role, and that a suitably qualified individual has been allocated to the role who has accepted the responsibility to deliver the TOR. 12% suggested that although a cost engineer's role is typically endorsed within the organisation, and clear TOR have been identified, the individual allocated either is not suitably qualified or has not signed up to the TOR. 38% of the respondents indicated that a cost engineer role is identified and endorsed within organisations but clear TOR has not been established. The remaining 12% thought that not only is a cost engineer's role not identified and endorsed within the organisation, but the cost estimation/ management falls to someone within the project team whose primary role is something different. Of these, 4% thought that there are no cost engineer responsibilities.



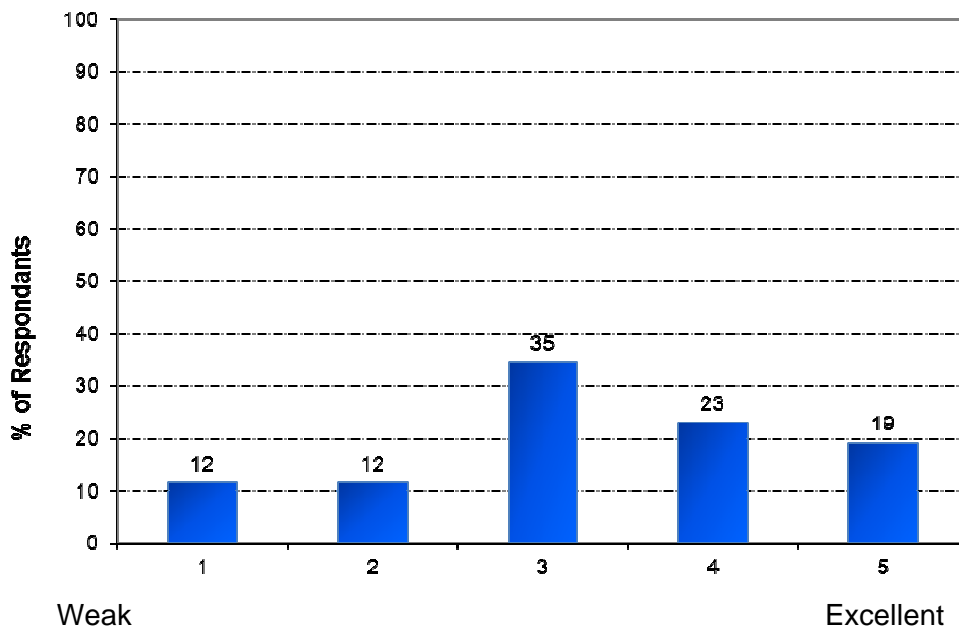
Further questions for consideration:

1. Is it appropriate that more than 60% of respondents indicated that cost engineering was being conducted by someone who either isn't a) suitably qualified to conduct cost estimation, or b) who has fully agreed to their responsibilities within that role, or that c) there is no specific cost engineering role? Should there be a dedicated cost engineering role?
2. Should this role have associated specialised training and terms of reference? What type of training would be appropriate?
3. What type of qualifications would be considered appropriate for such a role? What type of experience would be beneficial for someone within such a role?

4. *Who should they report to within the organisation? Should they ideally sit within a specific team or should they remain outside the team and be attached to the business?*

Question D3: How well is the cost engineering process planned and communicated?

19% of the respondents indicated that in their experience typically a Cost Management process exists, a Cost Management Plan has been developed, and this has been fully endorsed by all project stakeholders including independent scrutineers. 23% indicated that although a Cost Management plan and process exists, it wasn't fully endorsed by all project stakeholders. 35% suggested that a cost engineering process exists in their organisation and a Cost Management Plan has been developed but this has not been shared with stakeholders. The remaining 24% of the respondents indicated that a cost engineering process may exist but this is not documented. Of these, 12% thought that there is no cost engineering process.

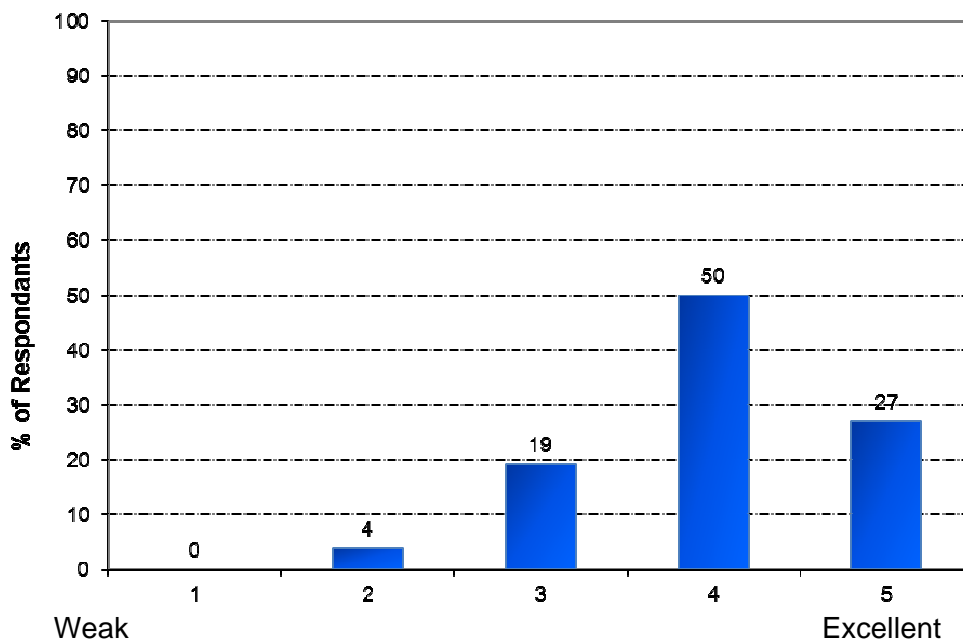


Further questions for consideration:

- 1. Is it important to have a clearly articulated organisational cost management process? If so why? What are the business advantages of doing this?*
- 2. Is it important to communicate this process around the business and have stakeholders bought into it? If so why?*
- 3. Is it important that all projects or teams adhere exactly to this process? Is there the case for tailor of the process to suit their needs? Does tailor the process diminish the credibility of the output being delivered to management? What impact could this have on its use in aiding management decision making?*

Question D13: Does the cost engineer make use of multiple estimation approaches to arrive at a suitable estimate (i.e. triangulation)?

27% of the attendees surveyed thought that typically a cost engineer will have knowledge of, and access to, a broad spectrum of estimating techniques and that for each estimation activity would down select those methodologies (i.e. parametric, analogy, analytical) that are most appropriate and use these to arrive at a triangulated value. Half of the respondents think that typically a cost engineer will have limited access to different estimating techniques. Consequently, the methodologies they use when estimating are limited to that which are available, with limited comparison of results between different approaches. 19% indicated that in their experience the cost engineer has knowledge of different estimating techniques, but does not apply them. The estimation methodology is limited to that which they are comfortable applying, with no comparison of results between different approaches. The remaining 4% of the respondents suggested that the engineer has limited knowledge of, and limited access to different estimating approaches so defaults to using one in all circumstances.



Further questions for consideration:

1. *Is it necessary for cost engineers to have knowledge of and access to different estimation methodologies? What are the advantages of having access to different approaches?*
2. *Should the business be concerned if their estimators are not regularly cross checking their estimates using multiple estimating approaches?*
3. *Does the cost associated with applying multiple estimating approaches outweigh the benefits?*
4. *Is it appropriate that half of respondents said that whilst the engineers had knowledge of different approaches that they have limited access to appropriate tools/data? What are the barriers that are preventing this? Time constraints? Lack of appropriate training? Estimator lethargy? What could the organisation do to counteract this?*

7 – RECOMMENDATIONS

SCAF areas to consider

The SCAF answers to the CEHC questions have been reviewed in the body of this document and a narrative provided as to the meaning.

When the cumulative results are combined on one graph the outcome can be seen in Figure 0-1. This graph should be interpreted from left to right to establish priority of action to be taken.

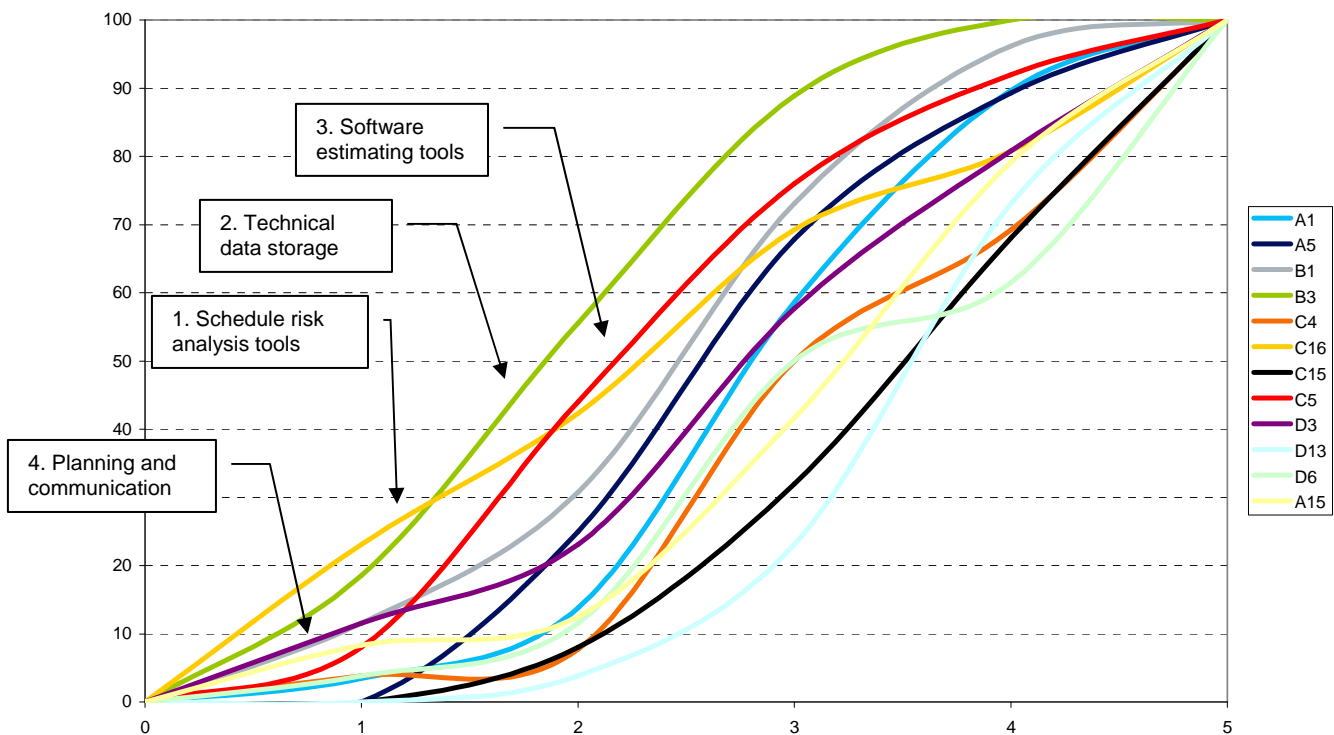


Figure 0-1 - Summary of results

As a result of this analysis it is possible to suggest the following topic areas for the SCAF community to study in future:

Recommendations

| | |
|---------|--|
| Data | <ul style="list-style-type: none"> • Exploration of what the costing community can do to ensure that both cost and technical data in relation to past projects is better recorded for use in generating future cost estimates [3.] |
| Tools | <ul style="list-style-type: none"> • An exploration of what best practice cost and schedule risk and uncertainty modelling is within the context of SCAF [1.] • An exploration in the trade-off between investment in risk management and analysis toolsets and the benefit achieved. • An exploration in the trade-off between investment in commercial software estimating models (or bespoke models) and the benefit achieved [3.] |
| People | <ul style="list-style-type: none"> • An exploration of the measures that could be undertaken to ensure that cost engineers have a better understanding of the through life costs of their projects • Exploration of the values of having management define a clear written policy on how costs should be estimated within the organisation and the measures required to ensure that this is adhered to. |
| Process | <ul style="list-style-type: none"> • An exploration of what an appropriate TOR look like for a cost engineering role [2.] • An exploration of what can be done to encourage the use of multiple estimating methodologies within an organisation. |

Notes - The SCAF committee has organised the following workshop which will address some areas:

- [1.] 4th June 2013 “Quantitative cost and schedule risk analysis”, Preston
- [2.] 17th September 2013 “Cost Matters”, Bristol
- [3.] 19 November 2013 “Vendor Day”, Bristol

CEHC is hosted in QinetiQ Commerce Decisions AWARD tool

Strategic procurements involve multiple stakeholders, significant budgets and have a big impact on business performance. They may represent only 5% of procurement transactions, but often account for 50% of annual spend and 90% of procurement risk. The issues faced by procurement professionals are common throughout the world.

QinetiQ Commerce Decisions delivers proven software - [AWARD](#), best practice knowledge and expert [services](#) to assist sourcing projects through-life; from preparation, qualification, evaluation, negotiation to continuous supplier performance review and contract compliance.

AWARD software provides a central web-based information and process & infrastructure enabling project teams to collaboratively make major contract decisions and monitor subsequent performance. AWARD delivers consistent repeatable processes for both project and organisational deployments. It is proven to significantly increase contract value and reduce risk and has been used on projects totalling well over £60 billion to date.

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AWARD is available in the UK via a number of routes, including GPS frameworks.
