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SOLUTIONS

The skills profile of the Engineering Construction Industry

ECITB

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1 Executive summary

In this extended summary we draw out the key conclusions, results and recommendations from the main body of the report. It can be read as a stand-alone document but will require reference to the main text and appendices.

1.1 What is this report

This report contains the results of a major study into skills in the Engineering Construction Sector. It includes:

Information on the views of clients and contractors of the engineering construction sector. This qualitative survey of customer and supplier views shows a major disconnect between these two stakeholders.

A survey of skills in the sector. The skills study reveals the relative strength of the industry in thirty-three skills that both clients and contractors identify as critical to future productivity.

A skills analysis. This analysis sets benchmarks for the sector that reveal where employers, government and the ECITB should focus their skills investment.

A workforce development strategy. This interpretation of skills gaps and skills shortages suggests a skills action plan for the industry, ECITB and government.

1.2 General conclusions and recommendations

The skills where we found greatest levels of competence in the respondents relate to skills in the traditional approach to contracting of getting a contract and delivering it; managing variations and supervising the workforce. This is accepted as a strength by both clients and contractors alike.

Conversely the areas where we found the weakest competence are in the areas where clients see the future.

- ➔ In the group of skills we call Client Relationship Management the weakest competence is in client understanding, contract management and communication.
- ➔ In the group of skills we call Design Technology, the weakest competence is in design for safe operation, client technology, process optimisation, process technology and process control.
- ➔ In project management the weakest competence is in integrating work with client production and cost reduction

Our focus groups of clients and contractors suggest that the change that is most required is for contractors to focus on the external pressures and technologies of the client industry and to provide a service that pre-empts

The areas we found the highest proportion of competent employees was in traditional contracting. Conversely, the weakest competence was in areas where the clients see the future.

client needs rather than reacting to them. This requires a better understanding of the client technology and business. We have evidence from the skills survey to suggest that contractors need a skills change to achieve this.

The future success lies in increasing the volumes of people capable of operating in a client environment and on client terms. Whilst strengths in getting the job done at a profit need preserving, new skills in process optimisation and project delivery are the future priorities.

Future success lies in increasing the volumes of people capable of operating in a client environment and on client terms

The disconnect we found between the client and contractor is reflected in the skills difference; where the disconnect is the greatest the skills are the weakest. This underlines the importance of skills in the future strategy for the industry; and we suggest that fixing the skills problem will allow contractors to move forward and reduce the apparent conflict between contractor and client.

1.2.1 Recommendations

The role of the ECITB

ECITB needs to raise awareness of the problem and use research driven strategies to stimulate both employers and training providers into taking action on the skills gaps and shortages and then secure funding to ensure this does not degrade the competitiveness of the sector.

The responsibility of employers

Employers need to make a structured analysis of their workforce and, as a result of this, undertake the training to improve the overall competence of their workforce.

The responsibility of government

Government should continue to work to bring clients and contractors closer together. They should support forums that encourage constructive dialogue and stimulate education and training funding at the “pinch points” identified through ECITB research.

1.3 The context for change

In setting the skills agenda we have taken account of the views of clients and contractors and more importantly the differences between them.

The description of the industry from the two perspectives of client and contractor differ significantly illustrating a major disconnection. We (MRM) can only conclude that what the clients say they want forms the future for the industry and indicates the direction it must take to break out of the current situation of distrust and disconnect.

1.3.1 The clients' view

The client industries served by the UK engineering construction sector represent at least 9% of the UK economy and probably nearer 20%. If

these industries cannot source the right level of expertise and labour in the UK then they will move operations overseas causing significant damage to the UK economy. Meeting their requirements for far greater overall productivity is a challenge to all with a stake in engineering construction.

“The client of today and the future will want to work with highly productive, safety conscious organisations that will deliver capital productivity that way outstrips inflation. Professionalism and innovation will be key. Making money from the contract should come from performance and nothing else.” - *International Chemical Company*

The key demands (and concerns) of clients emerging from our consultation are for:

1. A greater focus on client business objectives by contractors.
2. A supply of better, work ready and highly skilled people.
3. A new approach to and incentives for multi-skilling.
4. An equitable sharing of risk and rewards.
5. Greater investment in the workforce.

1.3.2 The contractors view

The contractors appear to operate in an environment where contract variations are common, the avoidance of blame is key and reducing cost is more important than innovation.

What the contractors are saying about client practice varies significantly from the direction given by the clients themselves. Contractors report a major difference between what the clients say and what they do.

The contractors appear to operate in an environment where contract variations are common, the avoidance of blame is key and reducing cost is more important than innovation.

Contractors report that they are unable to apply their full range of capability because the operational style adopted by many clients constrains innovation and sustains conflict; blind bidding and unequal sharing of risk degrades trust. Few of the warm words spoken about partnership appear to translate into operating contracts. Price and value are the only real drivers in the sector.

1.4 The survey of skills

Against the backdrop of such disconnect we measure the competence in a range of skills that are required by contractors and clients alike. Our selection criteria is that each skill must be:

1. Relevant to both client requirements and contractor ambitions.
2. Entirely relevant to the engineering contractors within the scope of the ECITB.

- Part of the ECITB framework of national occupational standards, recognised by OSCEng or universally required by the industry (many fell into all three categories).

The result was thirty-three distinct skills that fall into the five processes undertaken by most contractors, namely Project Management, Business Management, Design Technology, Design Management and Client Relationship Management. We report the competence levels in each skill showing the proportion of the respondents using the skill that regard themselves as either competent, able to lead others or expert.

The skills league table

Skills gaps and shortages reduce the ability of contractors to undertake a range of activities for their clients that include developing innovative plant through to maintaining client operations during work.

Top six skills	Bottom six skills
Skills where the highest proportion of user responses are in the competent category	The skills where the lowest proportion of user responses are in the competent category
Site management (90% of respondents of user responses are in the competent category)	Client technology (47%)
Employee relations (90%)	Process optimisation (46%)
Site supervision (88%)	Process technology (45%)
Managing project quality (85%)	Maintenance planning (40%)
Project evaluation (83%)	Process control (34%)
Progress control/lead time (83%)	Dealing with legislation (30%)

Note the competence figures relate only to those respondents who use the skills; so of those who do Process Control only 34% of their responses are in the competent category.

1.5 The skills analysis

The analysis has identified areas where there are skills shortages – too few people do the job and of those that do, too few are competent; and skills gaps – too few of those that do the job are competent.

Skills shortages and their implications

Skills shortages in ...	reduces the ability to...
Process control Process optimisation	Develop effective plant.
Managing supplier quality Procuring materials and services Modular design	Integrate supply chains and move to modular design and construction.
Safety management Design for safe operation	Improve the accident rate on site and amongst operators.

Skills gaps and their implication

Skills gaps in...	reduces the sector’s ability to...
Client technology Client understanding Process technology	Innovate in a way that reflects future client needs.
Deal with legislation Personnel development Protect the environment	Maintain client operations during build and maintenance.
Communication Stakeholder management Option appraisal	Engage the supply chain and client in alternative approaches.

1.6 A workforce development strategy

The ECITB has, as a result of this project, the infrastructure and tools to implement a fact driven strategy for addressing the skills issues in the sector.

The priorities that flow from this work are to

1. **Close the skills gaps in the existing workforce.** Those doing a task should be competent and the first priority is to increase the competence of the work force in the roles that they perform. The challenge here is to employers who need to identify their own skills gaps and re-train their staff accordingly.
2. **Address the critical skills shortages.** Many people in the industry require new skills. The second priority is to increase the pool of labour with these skills. The challenge here is to ECITB to create a pool of employees with these skills by stimulating both the training market to supply and employers to buy suitable courses.
3. **Address the general skills shortages.** The third priority is to increase the pool of labour in the skills where some but too few are competent. The challenge here is to ECITB and employers to identify the need within the workforce and stimulate the training of the workforce.
4. The ECITB is at the centre of delivering these recommendations. Below we set out the elements of a seven-point plan to deliver them.
 - I. Highlight the situation and provide the evidence to justify action.
 - II. Inform training providers of the precise nature of skills gaps in the workforce.
 - III. Stimulate the training providers to develop appropriate training “quick fix” training modules. These are likely to be short courses that employers can use to *inject* skills quickly into those found to need them.
 - IV. Develop, with universities and other training providers, the infrastructure to turn out large numbers of people with the skills identified as being low in both volume and competence.

- V. Stimulate employers to select and re-train individuals who are doing roles without the necessary competence.
- VI. Stimulate employers to invest in longer-term workforce development to address the skills where there are shortages of both competence and volumes of people.
- VII. Work with the Learning and Skills Councils to secure support for work to close the gaps.

1.7 Applying the findings of this project

Each part of this plan requires evidence of the skills needs of the industry. This project has provided the ECITB with the mechanism to generate such evidence. The benchmarking tool with the associated workshops is an effective and efficient way of measuring skills. With the support of the ECITB regional training managers, companies could use the tool to benchmark and report on their own skills needs. This would compare each participant against a wider sample of similar individuals stored and maintained by the ECITB. Such data could stimulate training providers, inform bids to government and more generally measure the impact of the ECITB on skills issues. This fact-based approach to workforce development is entirely right, consistent with good management and within the requirements of the SSDA.

2 The context – what drives the skills agenda

The skills agenda for the engineering construction is set by a combination of supply side issues and demand side pressures. On the demand side, the clients seek more productive solutions at lower cost; on the supply side, skills shortages, pressure on margins and a changing domestic market dominate. In this section of our report we summarise the results of our discussions with clients¹ and contractors on these issues. Whilst many will be familiar with most of the issues we include it to set out the stark contrast between the clients and the contractors. These two views place into context the work on skills benchmarking that follows.

2.1 Client drivers

The client industries served by the UK engineering construction sector represent at least 9% of the UK economy and probably nearer 20%.

The key message from the clients

The client industries served by the UK engineering construction sector represent at least 9% of the UK economy and probably nearer 20%. If these industries cannot source the right level of expertise and labour in the UK then they may move operations overseas causing significant damage to the UK economy. Meeting their requirements for far greater overall productivity is a challenge to all with a stake in engineering construction.

To meet the challenge laid down by the clients, the UK requires contractors that can bring new levels of productivity required to compete in a global market. Clients want to move to output contracts where the contractor is using the minimum resources to attain maximum outputs; they do not want to pay for hours, - they want to pay for results. They are prepared to share risk but this must be equitable and the rewards well defined. The future described by clients in this consultation is not impossible but it does require new skills, structures and approaches to the delivery of engineering services.

The client of the future

All client sectors from oil through to pharmaceuticals are under competition from cheaper sources and require more productive plant for less capital costs. Without greater productivity, shareholders in the client companies will force them to produce outside of the UK.

“The client of today and the future will want to work with high productivity, safety conscious organisations that will deliver capital productivity that way outstrips inflation. Professionalism and innovation will be key. Making money from the contract should come from performance and nothing else.” - International Chemical Company

In our consultation, clients expressed concerns over the largely reactive nature of contractors. Clients seek to reduce their responsibility for contractors; they seek suppliers who can deliver without being given

¹ For a more detailed report on the Client of the Future contact ECITB and ask for “Engineering the Future – the Client Perspective”

detailed specifications and who require less project management. Clients want their contractors to deliver new technology and innovative processes to increase the productivity of plant.

In the future clients will seek labour that is multi-skilled and not restricted to a single trade. This need for multi-skilling is a drive to both increase productivity and to address skills shortages.

The challenges facing the sector

If the UK contracting sector is to maintain its capability of supporting the UK's process and power industries then it must radically change its working practices so that its productivity is increased and it can produce more and better outputs with fewer people and for less money.

It is unlikely that the Engineering Construction Industry will ever employ as many people as it does today. A falling entry of new labour and an increasing average age of the sector conspire to reduce the overall pool of labour available. Efforts to improve the image may slow this decline but it is unlikely that the Engineering Construction Industry can compete with other more popular sectors and attract large volumes of labour.

The future of the sector

The future will require:

- ➔ Greater productivity.
- ➔ More innovative and complete solutions.
- ➔ A better-managed and more flexible workforce.
- ➔ Greater service through commercial and technical flexibility.

To achieve this requires both changes in the nature and structure of the skills employed in the sector. It requires multi-skilling across all types of employee; it requires new construction methods; it requires new types of contracts and relationships with clients; it requires new skills in management, technology and construction. Above all it requires change from all stakeholders in the sector.

The actions required to fix the future

Whilst the remit of this report is the skills for the future it is clear that the actions required to address the challenges go beyond skills.

Amongst the key requirements that emerge from the consultation are:

- ➔ A greater focus on achieving the clients' business objectives by all in the supply chain; this will require more competent and knowledgeable professionals who are able to develop and transfer technology between companies.
- ➔ A supply of better, work ready and highly skilled graduates into design and management positions in contractors' organisations that are able to understand client issues and employ new technology and methods to increase the performance of both contracting and client sectors.

- A new approach to and incentives for multi-skilling of the workforce that will lead to an increase in output per employee; such an increase may not cut costs but will counteract the shrinking of the labour pool.
- An equitable sharing of risks and rewards at all levels of the supply chain to enable longer-term investment in technology and skills.
- Greater security of employment and investment in the workforce.

2.2 Contractor drivers

The contractors appear to operate in an environment where contract variations are common, the avoidance of blame is key and reducing cost is more important than innovation.

The key message from contractors

What the contractors are saying about client practice varies significantly from the stated opinions of the clients themselves. While this project has set out to understand the gaps between what the contractors deliver and what clients expect, it does not address the obverse; i.e. are client expectations realistic, and are clients fulfilling their own responsibilities fully? We (MRM) can only conclude that what the clients say they want forms the future the industry must head towards in order to break out of the current situation of distrust and disconnect.

The contractors appear to operate in an environment where contract variations are common, the avoidance of blame is key and reducing cost is more important than innovation.

Contractors report that they are unable to apply their full range of capability because the operational style adopted by many clients constrains innovation and sustains conflict; blind bidding and unequal sharing of risk degrades trust. Few of the warm words spoken about partnership appear to translate into operating contracts. Price and value are the only real drivers in the sector.

On partnerships, tendering and outsourcing

Customers maintain a distance from suppliers. Contractors profiled described instances of blind bidding, where they and their competitors were given insufficient access to the client site and operational data, yet were expected to provide accurate prices or commit to year on year savings. When price is the only real criterion for awarding a contract, it is probable that the cheapest bid will be from the contractor who has least understanding of the requirement.

Partnering is by no means the universal approach to contracting, with some contractors reporting that clients prefer either the adversarial approach to fixed price work or “body-shopping” where they hire resources at the lowest price. Contractors report that partnerships are uneven and risk is transferred to them without the associated opportunities for profit and reward.

The contractors we spoke with questioned the quality and quantity of engineering staff employed by their clients. At one extreme a client will have almost no permanent engineering staff and hire specialist contractors to manage other contractors. At the other extreme there is an

insistence on a semi-integrated team where responsibility and risk become unclear, leading to confusion and blame.

The balance between minimising operational costs or capital costs is still firmly in the favour of capital costs. One contractor questioned what clients say about plant efficiency: ***“many clients seek low cost plant rather than highly efficient plant”***.

Innovation,

Contractors question whether they are encouraged or even allowed to innovate, one reported:

“the clients put the handcuffs on you and shout at you to innovate”

This comment referred to the detailed specifications often put out by clients that state not only what is required but also how it must be delivered. As this specification is often lacking the detail required, contractors find they are bidding against moving targets.

If the clients buy on price then the contractor that has invested in research and innovation will rarely win, as he will regularly be the most expensive.

The lack of engineering skill within the client often blocks innovation. If the client team is unable to understand a more innovative solution then they are unlikely to purchase it. Where innovation is understood, the client will typically enforce confidentiality clauses and claim intellectual property to prevent technology transfer.

Innovation is difficult in a cost driven market (unless that innovation actually reduces purchase cost). If the clients buy on price then the contractor that has invested in research and innovation will rarely win, as that contractor will regularly be the most expensive.

On IT and communication

There is widespread use of IT in the sector.

The evolution in IT has been client driven; clients have dictated their requirements and suppliers have followed. This has improved communications and much management, technical and project information is exchanged via the internet. Contractors see this trend continuing with greater use of telemetry, simulation and modelling.

Global competition, global workforce

The international market, where contracts are plentiful and labour cheap, is an attractive option for the larger UK contractors.

For the larger companies the UK is only a part of the market and an increasingly insignificant one. The decline of the UK heavy manufacturing sector is reducing the flow of both contracts and people into the engineering construction industry. This is forcing contractors to look abroad for both work and the labour to deliver that work. One example is China where the quantity of work and the quantity of labour is a major focus for both clients and contractors.

The ability to source labour and work from anywhere in the world is a key competence for global contracting companies.

Workforce development

Two things stand in the way of developing the workforce; insufficient new entrants and lack of money for investment.

Contractors feel that the downturn in the number of people entering the sector is reducing the pool of labour available to them. The clients' apparent unwillingness to share the cost of training and accreditation is a further pressure on the margins of contractors who have no choice but to either invest in training or reduce in size. Contractors report that clients are unwilling to take the risk and cost of trainees on site; this reduces the opportunity to gain essential on-the-job experience.

3 The skills critical to the industry

3.1 Selecting the skills

Against the backdrop of such disconnect between clients and contractors we set out to select a range of skills that are required by contractors and clients alike. Our selection criteria was that each skill must be:

1. Relevant to both client requirements and contractor ambitions.
2. Entirely relevant to the engineering contractors within the scope of the ECITB.
3. Part of the ECITB framework of national occupational standards, recognised by OSCEng or universally required by the industry (many fell into all three categories).

The result was 33 distinct skills ranging from Site Supervision through to Client Understanding. For reporting we grouped these into five processes undertaken by most contractors. The table below shows the skills measured and their groupings. Full definitions appear in the appendix to this report.

Project management	Business management	Design Technology	Design management	CRM ²
Site management	Employee relations	Applying engineering	Progress control	Managing project variations
Site supervision	Personnel recruitment	Modular design	Project planning	Communication
Managing project quality	Safety management	Protecting the environment	Option appraisal	Stakeholder management
Project evaluation	Industrial relations	Designing for safe operation	Financial	Contract management
Programme management	Personnel development	Client technology	Maintenance planning	Client understanding
Managing supplier quality	Dealing with legislation	Process optimisation		
Procuring materials and services		Process technology		
Integrating work with client production		Process control		
Cost management/reduction				

² CRM is Client Relationship Management

3.2 Defining the skills

For each selected skill we drew on the occupational standards to define a sample of actions that would evidence whether someone had a degree of competence in that skill. Two examples are:

Skill: Project planning
Assess the project objectives to accurately determine their resource requirements
Identify the resources and time scales required to achieve each of the project task outcomes
Identify the relationship and dependencies between each project task
Establish the optimum sequence for the completion of the project tasks
Skill: Protect the environment
Identify perceived sources of hazard to the environment arising from activities, and relevant areas of risk
Monitor the impact of activities on the environment and ensure that affects are within planned parameters
Identify, understand and exceed the relevant environmental legislation and regulatory requirements
Understand the implications of a failure in systems and have procedures in place for a worst case scenario.

For a full definition of all the skills measured please refer to appendix 1.

The relevance of the skills definitions and evidence statements

We are confident in the basis of the skills and evidence statements because they were:

1. Selected because the clients referred to them as important.
2. Based on the national standards which themselves are subject to rigorous review by industry practitioners.
3. Verified by four different groups of employees from within the industry.

3.3 Measuring skills

The measurement had two stages:

1. The candidates were asked to select which of the 33 skills they used and
2. To rate their ability in this skill as one of the following:
 - i. I am an expert at this
 - ii. I help others to do this
 - iii. I do this

- iv. I can do this with help
- v. I cannot do this

This method ensures that the skills data collected relates only to skills that a particular candidate uses; he or she will not rate their ability against a skill they do not use. This means that only people who are responsible for project planning provide the data on project planning skills.

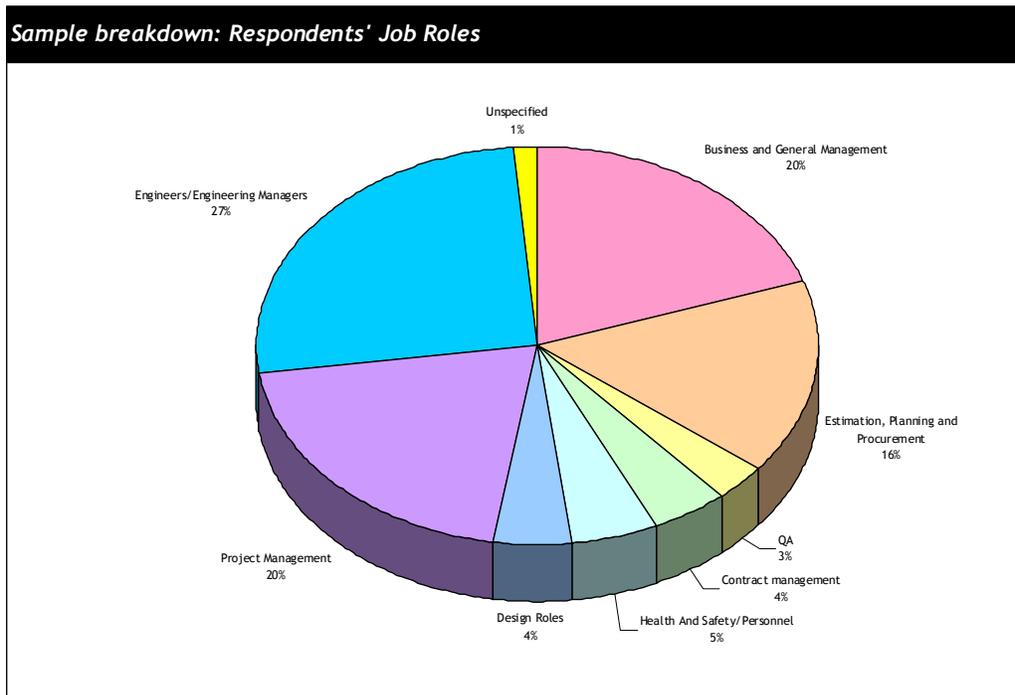
4 The skills profile of the industry

In this section of the report we present and discuss the results from the sample data that we collected.

4.1 The sample

The data we report is based on the answers to our skills questionnaire given by 160 professionals from the industry selected from the workforce of four employers. The four employers are regarded as market leaders in their own respective fields; they are typically large companies with a focus on management contracting. It is our view that this stratified (as opposed to random) sample will, if anything pick up the more skilled workers and thus overstate the level of competence.

Those responding spanned a range of technical and managerial roles as demonstrated in the pie chart above. In the appendix we include the job roles of those responding.



By selecting such a wide range of job titles (over 100 different roles) we would expect at least half of them to have and use each of the thirty-three skills that we measured.

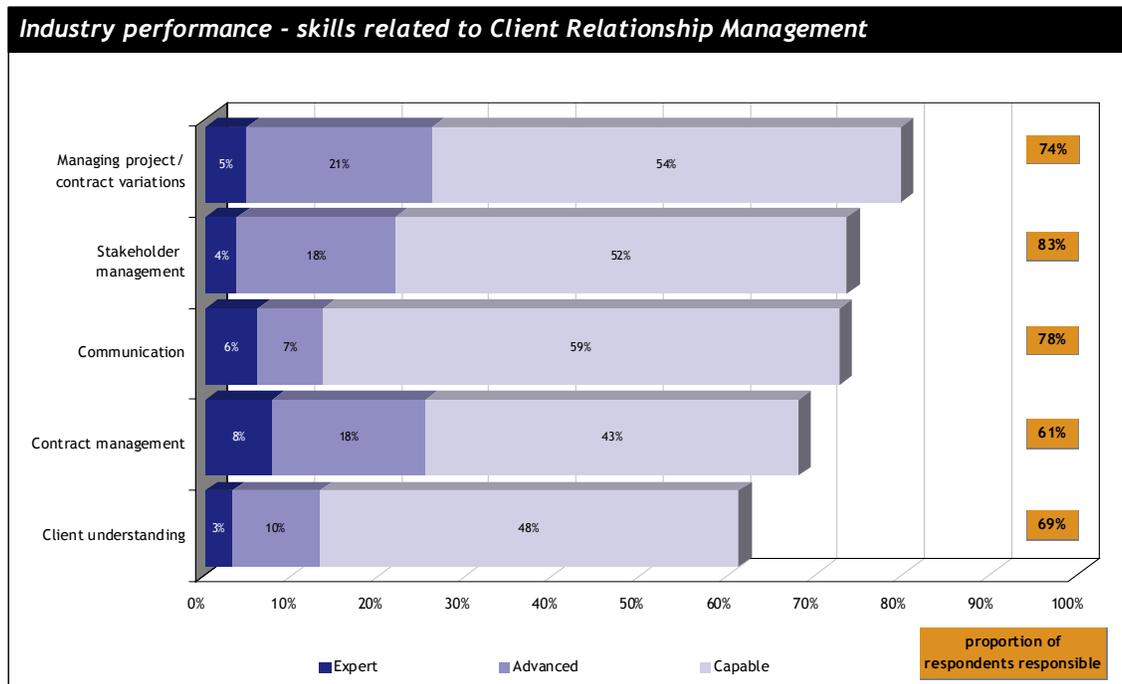
4.2 Skills in client relationship management

Client relationship management is the generic term for dealing with customers; it applies to both business development and contract delivery.

4.2.1 The skills within client relationship management

Skill name	Answered by those who are required to...
Managing projects/contract variations	...identify, communicate and manage changes
Stakeholder management	...develop relationships with clients, contractors and suppliers
Communication	...exchange information with clients, suppliers, contractors, colleagues and other stakeholders
Contract management	... be aware of and apply standard forms of contract
Client understanding	...understand the client's business

4.2.2 The level of skill found



4.2.3 Understanding the chart

This shows the results for five skills with each bar showing the following for each skill:

- ➔ The proportion of responses from the sample in the competent category – the longer the line the greater the overall competence. For example 69% of responses in the contract management category are capable or better.

- The degrees of competence reported by the sample, the greater the dark blue proportion of the line the greater the proportion of responses in the expert category. For example 8% of responses from those responsible for contract management are in the expert category.
- The proportion of respondents who are responsible for each task; the greater the number the higher degree of pervasiveness of this skill in the industry. For example 61% of the overall sample undertook contract management.

4.2.4 Our observations relating to these results

The highs and lows

The lowest competence is in the proactive skills of client understanding and contract management. The highest competence is in the reactive skills of stakeholder management, communication and managing variations.

Contractors place greater emphasis on the reactive skills than the proactive skills evidenced by the larger proportion of the respondents that were responsible for the top three reactive skills than the bottom two proactive skills.

What does it suggest...

The two skills where the competence is lowest are those that are required to get the job right first time.

The analysis suggests the industry has the skills set to “get it right next time”. The highest competences found are those required to manage contract variations as opposed to understanding clients and setting up contracts.

The two skills where the competence is lowest are those that are required to get the job right first time. This links closely with what clients said – they told us that “the engineering construction industry reacted to client needs rather than pre-empting them” and they asked that “the industry spent more time understanding clients’ business and technology”. Such a demand will be difficult to meet if the skills are not present in the sector. There is further evidence to support this finding in the sections on design technology and project management where the skills relating to client technology, process optimisation and integrating with client production are lower than more reactive skills.

The client view that contractors do what they are told, rather than understanding and responding to the business, is verified by this finding.

Actions arising

Greater efforts should be focussed on the right first time skills of client understanding and contract management.

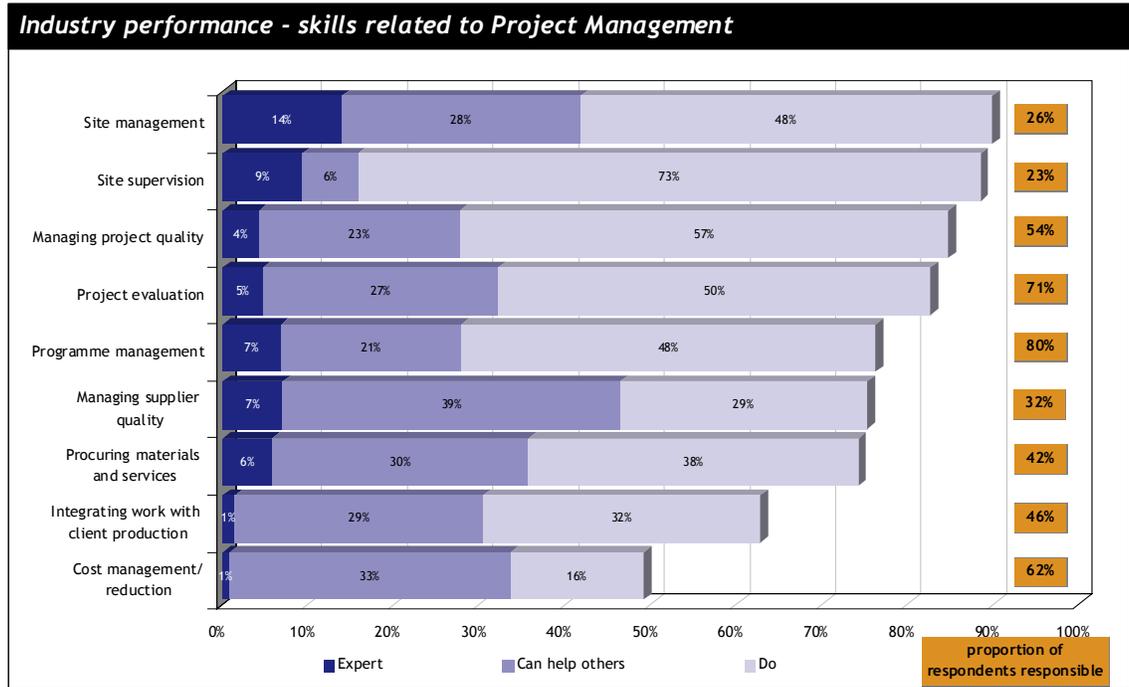
4.3 Skills in project management

Project management is the generic term for delivering the project; it spans planning, procurement, quality control, site management and evaluation.

4.3.1 The skills within project management

Skill name	Answered by those who are required to...
Site management	... manage individuals working on site,
Site supervision	... manage greenfield and brownfield sites
Managing project quality	... manage the quality of outputs and deliverables,
Project evaluation	... review the effectiveness of a project as it progresses.
Programme management	... understand project requirements, specifications and milestones.
Managing supplier quality	... manage the quality of bought in goods, plant and services.
Procuring materials and services	... procure goods, plant and services.
Integrating work with client production	... manage projects to maintain the productivity of the plant.
Cost management/reduction	... manage projects to reduce the out turn cost

4.3.2 The skills profile found



The highs and lows

Site work is a particular strength of contractors; nearly 90% of responses by those responsible for site management, supervision, project quality and project evaluation were in the competent or better categories.

Cost management, integration with client production and procurement are three skill areas undertaken by people who feel they are less competent. Fewer than half of those responsible for cost management and reduction reported that they were competent.

What does it suggest

The competitiveness of UK contractors depends on their ability to deliver to specification at the lowest possible cost in the shortest possible time. Our analysis of project management skills suggests that the skills to do this are in need of focus.

The four highest scoring skills in project management are critical to getting the job done – something that the clients praised the industry for. This suggests that when left to do the job contractors have the skills to make the project work.

Cost management is a key to the clients; 62% of the respondents were responsible for this however less than 50% of their responses were classifiable as competent.

Three of the five skills with results less than 80% are in the areas that impact on the cost performance of the work and the remaining two affect lead time.

Actions arising

Training for existing teams is required in the area of cost management, how to integrate with clients and procurement in its widest sense.

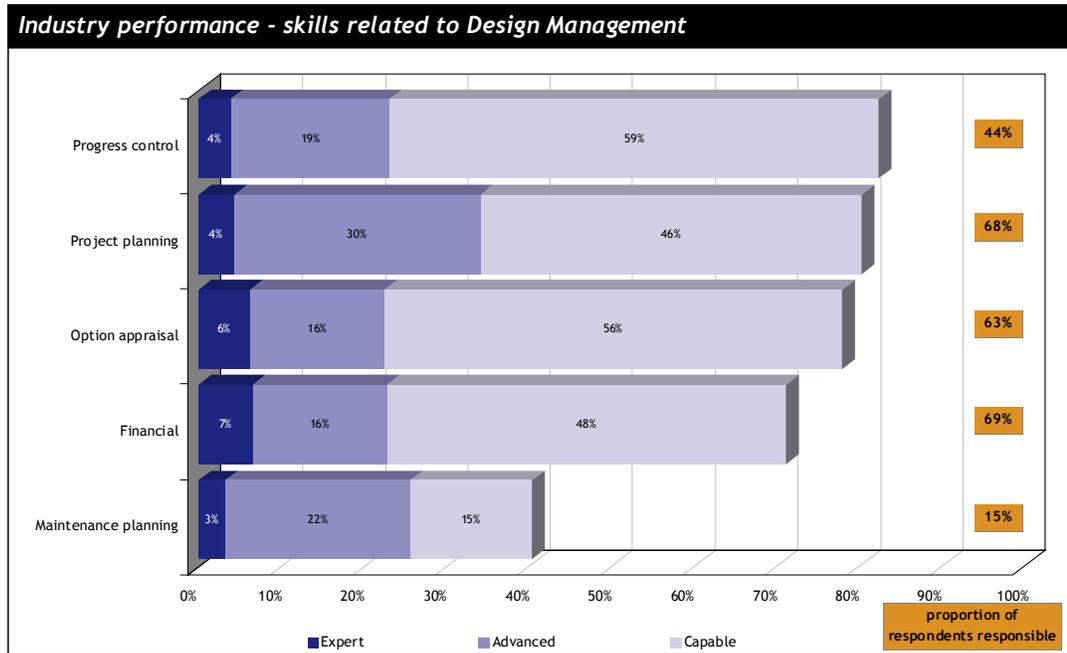
4.4 Skills in design management

Design management is the generic title under which we have categorised skills relating to progress control (reducing build time), project planning option appraisal, financial control and maintenance planning.

4.4.1 The skills within design management

Skill name	Answered by those who are required to...
Progress control	...reduce build time by monitoring progress against plan and re-assigning resources.
Project planning	... plan the implementation of a project.
Option appraisal	... think differently and develop alternative methods.
Financial control	...monitor, against the estimate, individual cost centres to predict potential overspends.
Maintenance planning	...apply technology to create plant and equipment that is more productive, runs for longer, requires less maintenance and/or is cheaper than existing plant to operate.

4.4.2 The level of skill found



4.4.3 Our observations relating to these results

The highs and lows

Only one skill, progress control, in this area is above the 80% level. Project planning is a close second. Very few people do maintenance planning (just 15%) and the majority of their responses are in the not competent category.

What does it suggest

Contractors are skilled in managing a sequence of tasks and allocating resources to ensure the task is completed on time. Two areas of importance to clients are reducing cost and innovation; again these are two skill areas where more than a quarter of responses by those doing the tasks were less than competent.

Actions arising

As with other areas, a change of skills focus towards the client requirements for cost savings and a range of options are required. Whether this fits with the client practice of issuing tight specifications is questionable. Perhaps the reason why clients specify so tightly is the lower skills of contractors to develop and appraise options.

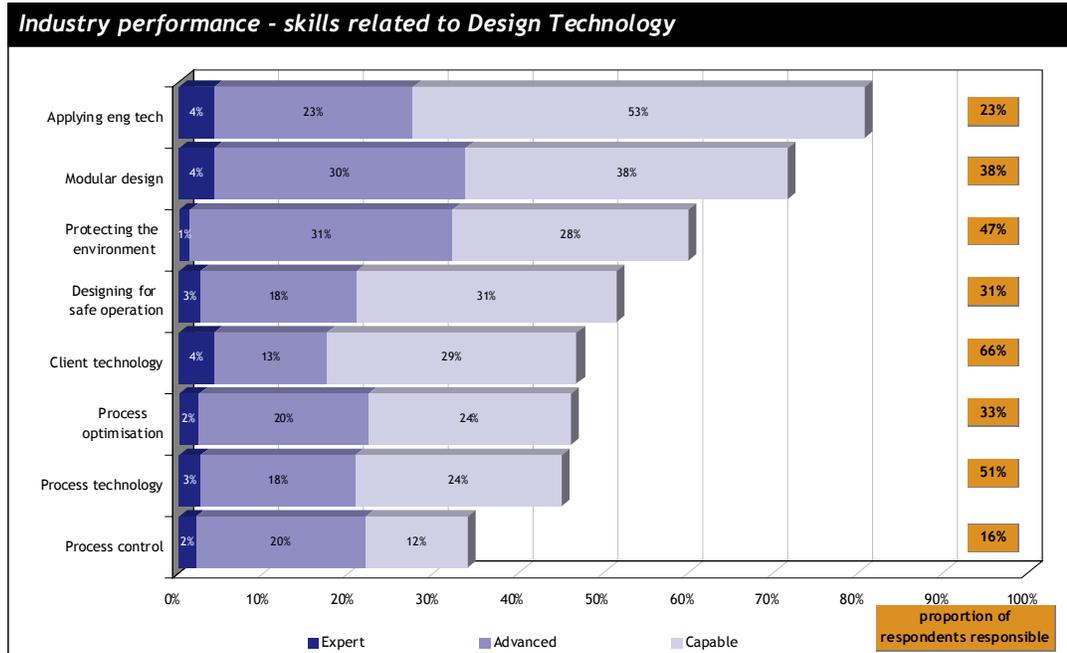
4.5 Skills within design technology

The eight skills that we place inside the wrapper of design technology are those skills required to develop safe, optimum processes using modular designs that comprise of the best available technology.

4.5.1 The skills within design technology

Skill name	Answered by those who are required to...
Applying engineering technology	...manage complicated construction programmes using new technologies in adverse environments.
Modular design	...use and develop standardised equipment and processes to improve productivity and profitability.
Protecting the environment	... design solutions within environmental constraints.
Designing for safe operation	... managing the safety of the design.
Client technology	...understand the technology and operations of the clients' business.
Process optimisation	... apply technology to create plant and equipment that is more productive, runs for longer, requires less maintenance and/or is cheaper than existing plant to operate.
Process technology	... understand the operation of the plant and the commercial performance required.
Process control	... bring technical skills to monitoring and controlling the plant.

4.5.2 The skills profile



4.5.3 Our observations relating to these results

The highs and lows

With the exception of applying technology all the skills in this group fall below the 80% ceiling.

With the exception of applying technology all the skills in this group fall below the 80% ceiling.

A large proportion of people are responsible for understanding the clients' business (66%) yet only 46% of their responses are in the competent category.

What does this suggest

The skills that best reflect innovation (process control, process technology, process optimisation, understand clients' business) sit largely at the bottom end of the competence league table. Conversely innovation is high up the client agenda.

In an industry with such a potentially high impact on the environment we were surprised to see that only 47% of people thought they were responsible for this and of those only 60% of their responses were in the competent category.

Actions arising

For such a technology-led industry this surprising result needs further investigation and, if confirmed, work to rapidly address its consequences is required. **The client drive for innovation was clear from their statements during the consultation. Equally market forces suggest that the UK contracting industry is unlikely to compete successfully**

on price. Technology is a key area for differentiation yet the skills in it are low.

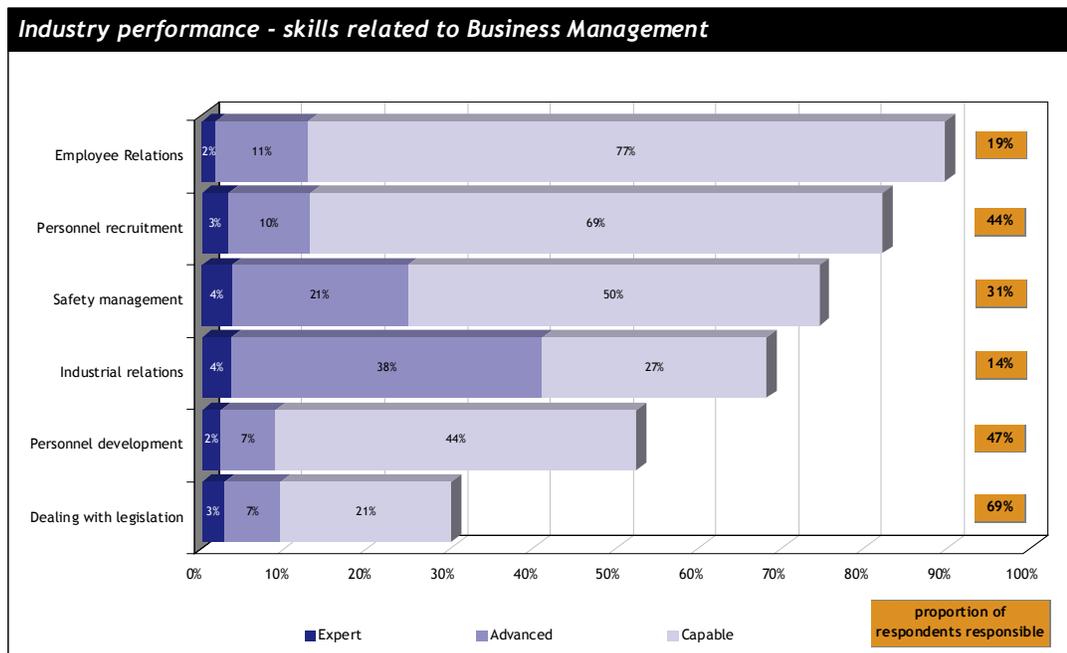
4.6 Skills within business management

The skills that we report in this area fall under the general categories of employee development, industrial relations, safety management and legislation management.

4.6.1 The skills within business management

Skill name	Answered by those who are required to...
Employee relations	... improve industrial relations.
Personnel recruitment	...attract and retain people in the company.
Safety management	...manage occupational safety.
Industrial relations	... develop and implement an industrial relations strategy.
Personnel development	...develop a multi-skilled and flexible workforce.
Dealing with legislation	... understanding your role and legal responsibilities.

4.6.2 The level of skill found



4.6.3 Our observations relating to these results

The highs and the lows

Employee relations and recruitment are the only two skills to break the 80% line, suggesting that the companies know how to recruit people and deal with problems.

Industrial relations, personnel development and legislation are all low areas, suggesting that the general competence in skills that retain the workforce are low.

Those that are good at team building make up less than 20% of the sample. There are a few specialists in industrial relations.

Both clients and contractors all stated the importance of safety yet only a third of the sample claimed responsibility for it.

What these results might mean

A key area of concern of clients was the supervision of the workforce covered by skills in Employee Relations and Industrial Relations; we were surprised that the numbers involved in these two activities were low. In an industry that is so heavily influenced by working agreements and with a unionised workforce we would expect more people to be expert in dealing with employee and industrial relations. Our survey found that there are a small number of highly competent experts who deal with this.

Skills in dealing with legislation appears a major problem, many people do this (69%), but less than 30% of their responses fell in the competent category.

Actions suggested

The overall focus on skills in good business management needs expanding to a greater proportion of the workforce. The reliance on a few highly capable experts will ultimately mean that the message is neither understood nor acted upon.

5 Turning research into action

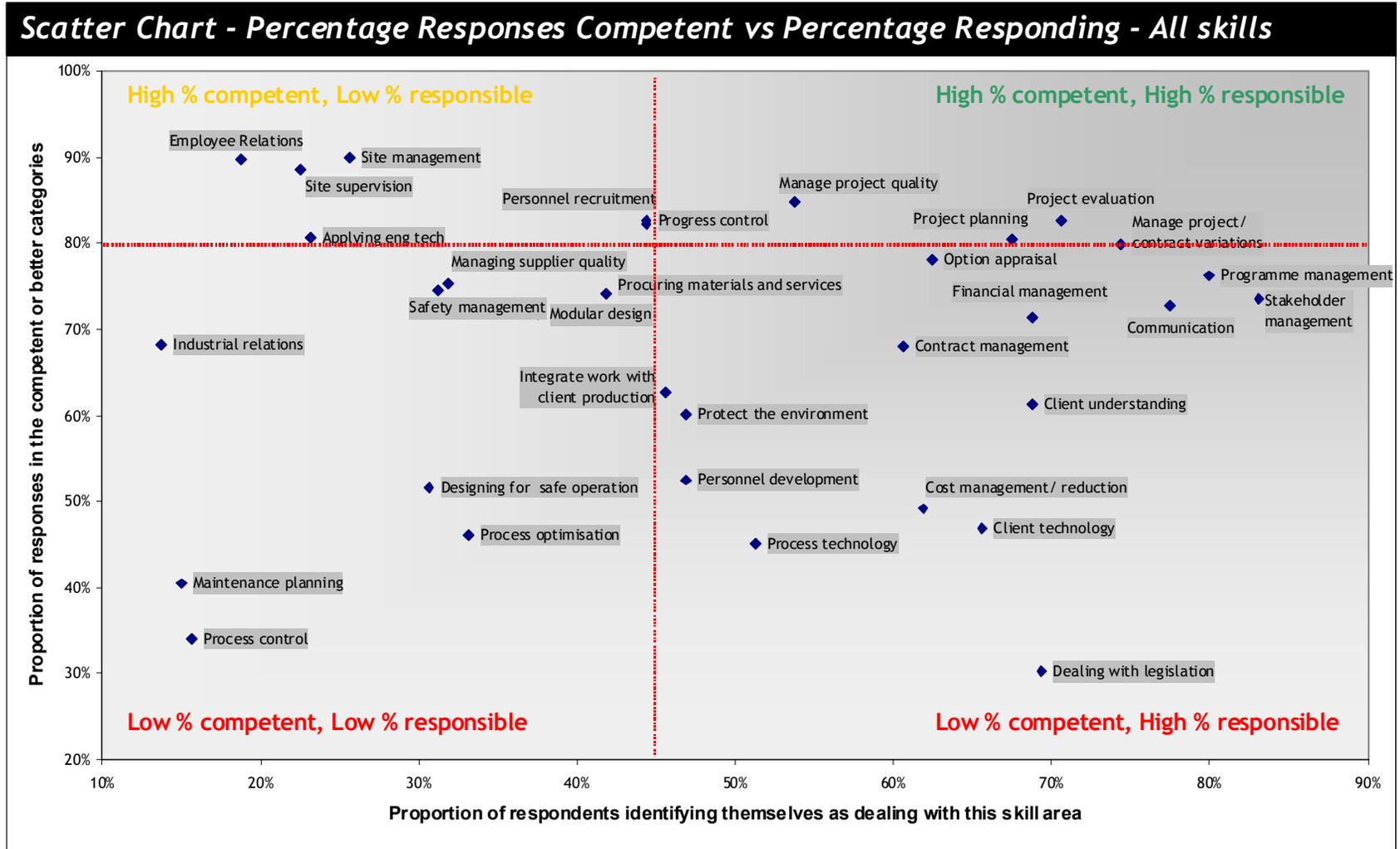
In this section of our report we take the messages from the skills survey and use it to answer two questions:

1. Does the industry have the right numbers of people in the right areas to address client concerns – (are there skills shortages)?
2. Are the people in role sufficiently skilled (are there skills gaps)?

5.1 The analysis

In the survey we collect two measures – the proportion of the whole sample that have and use each skill, and their competence in that skill. By looking at the overall sample we can see the proportion of the sample that are responsible for say Site Supervision and then see what proportion of those people are competent. The two measures are combined on a two by two matrix as below:

5.2 The skills mapped



5.3 Our observations relating to these results

We have set the vertical dividing line at 50% implying that half of the people in the industry should have each skills and the horizontal line at 80% implying that four fifths of those using each skill should be competent.

The medical analogy is that half of all medical practitioners should be surgeons and that eighty percent of the surgeons should be competent.

The 50% limit is arbitrary; the 80% is based on the high scoring skills in the sample and represents the upper quartile of skills results.

5.3.1 Skills where the results suggest the industry is OK

The skills in the top right hand box are:

- Managing project quality
- Project planning
- Project evaluation
- Managing project/contract variations

These are the skills used by a large volume of the workforce and over 80% of responses were classified as competent..

They reflect the strengths in getting the job done in a changing environment. It is this area where the only action is for companies and the ECITB to ensure that the levels are maintained.

5.3.2 Skills shortages

We define skills shortages as those skills where the results suggest the industry has insufficient people but those they have are skilled

The top left hand box comprises skills that are possessed by less than 50% of the respondents but over 80% of people that use those skills are competent. They include:

- Employee relations
- Site management
- Site supervision
- Applying engineering technology
- Progress control

This reflects the industry's overall strength in managing a technical workforce in a project based sector. Again these were areas where the client groups reported some satisfaction.

This reflects the industry’s overall strength in managing a technical workforce in a project based sector. Again these were areas where the client groups reported some satisfaction.

The action on employers is to increase the numbers of people with these skills so that more of the industry is competent in people management in a technology sector.

5.3.3 Critical skills shortages

We define critical skills shortages as where the results suggest the industry has insufficient people and those they have are insufficiently skilled

The lower left hand quadrant is an area of danger for the industry. The skills are important to both clients and contractors (else they would not be in the survey) but the sample of respondents contained less than 50% of people who use these skills and less than 80% of their responses were in the competent category. The skills list includes:

- Process control.
- Process optimisation.
- Maintenance planning.
- Design for safe operation.
- Industrial relations.
- Safety management.
- Modular design.
- Managing supplier quality.
- Procuring materials and services.

The likely impact on sector performance

The table below groups the skills in these areas and suggests the implications of them being both low volume and low competence.

Skills shortages in ...	reduces the ability to...
Process control Process optimisation	Develop effective plant. A key requirement of clients is for plant that is more productive. This requires specialist control and optimisation skills.
Managing supplier quality Procuring materials and services Modular design	Integrate supply chains and move to modular design and construction. A key requirement of contractors is to bring together specialists teams and manage the flow of systems and units that make up a plant.
Safety management Design for safe operation	Improve the accident rate on site and amongst operators. A key ambition of all in the industry is to improve the safety record. This ambition will be easier to achieve if more people are responsible for and competent in safety management and design.

5.3.4 Skills gaps in the workforce

We define skills gaps as those skills where the results suggest that the industry has sufficient people but those they do have are insufficiently competent.

The lower right hand quadrant is another area of danger for the industry. The sample of respondents contained more than 50% of people with these skills but less than 80% of their responses were in the competent category. This implies many people are using a skill in which they are not fully competent.

The skills list includes:

- Dealing with legislation.
- Process technology.
- Client technology.
- Cost management.
- Personnel development.
- Protect the environment.
- Client understanding.
- Contract management (dealing with different types of contract)
- Communication
- Stakeholder management
- Option appraisal
- Programme management.

The likely impact on sector performance

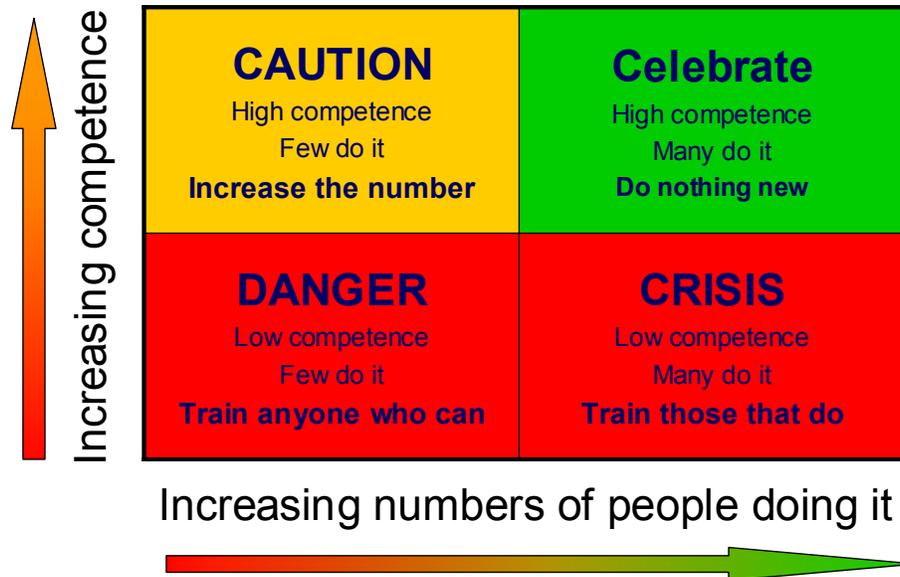
The most likely impact is the contractors will struggle to deliver in these areas and may under-perform client expectations. Some of this was reflected in the discussions with clients who were critical of the sector's ability to understand their processes and technology and reduce costs. Again we set out in the table below the likely implications of the skills gaps.

Skills gaps in...	reduces the sector's ability to...
Client technology Client understanding Process technology	Innovate in a way that reflects future client needs. Innovation is a key requirement of clients and was mentioned at both client and contractor workshops.
Deal with legislation Personnel development Protect the environment	Maintain operations. A key requirement given that legislation is continually tightening and of increasing significance to the way plants and sites are designed and operated.
Communication Stakeholder management Option appraisal	Engage the supply chain and client in alternative approaches. The need to develop options with different stakeholders, appraise them and sell them to a client is again something the clients felt the industry needed to improve.

6 Future opportunities – where next

The survey has revealed the skills gaps and skills shortages in the participants. Correlating these with the comments of clients and contractors suggests four areas of focus for developing the workforce in the sector that link with the four quadrants of the skills matrix.

6.1 The workforce development strategy



The priorities that flow from this work are to:

Close the skills gaps in the existing workforce (responsibilities in the lower right hand quadrant). Those doing a task should be competent and the first priority is to up skill the work force in the roles that they perform. The challenge here is to employers who need to identify their own skills gaps and re-train their staff accordingly.

Address the critical skills shortages (responsibilities in the lower left hand quadrant). Comparatively few people identify themselves as responsible in these categories. The second priority is where necessary to increase the pool of labour with these skills. It is the task of employers to assess whether the low pervasiveness of these skills is a problem, and seek to address them if it is. The challenge here is to ECITB to create a pool of employees with these skills by stimulating both the training market to supply and employers to buy suitable courses.

Address the general skills shortages (responsibilities in the upper left hand quadrant). Many people in the industry require these skills and a small proportion are already competent. The third priority is, where necessary, to increase the pool of labour in these skills. The challenge here is to ECITB and employers to identify the need within the workforce and stimulate the training of the workforce.

6.2 Addressing the priorities

The three stakeholders in addressing the priorities are employers, ECITB and government.

6.2.1 The role of the ECITB

Referring to the matrix above, the role is to increase the supply of skills that fall into the danger and crisis category. The recommendation flowing from this work is that ECITB needs to stimulate both employers and training providers into taking action on the skills gaps and shortages and then secure funding to ensure this does not degrade the competitiveness of the sector.

6.2.2 The responsibility of employers

Referring to the matrix above, the role of employers is to increase the proportion of the workforce that have skills that fall into the caution box. The recommendation flowing from this work is that employers take a structured analysis of their workforce and, as a result of this, undertake the training to improve the overall competence of their workforce.

6.2.3 The responsibility of government

The recommendation flowing from this work is that government continues to work to bring clients and contractors closer together. They should support forums that encourage constructive dialogue and direct education and training funding at the “pinch points” identified through ECITB research.

6.3 A plan for the ECITB

The ECITB has, as a result of this project, the infrastructure and tools to implement a fact driven strategy for addressing the skills issues in the sector.

The ECITB is at the centre of delivering these recommendations. Below we set out the elements of a seven-point plan to deliver them.

- ➔ Highlight the situation and provide the evidence to justify action.
- ➔ Inform training providers of the precise nature of skills gaps in the workforce.
- ➔ Stimulate the training providers to develop appropriate training “quick fix” training modules. These are likely to be short courses that employers can use to *inject* skills quickly into those found to need them.
- ➔ Develop, with universities and other training providers, the infrastructure to turn out large numbers of people with the skills identified as being low in both volume and competence.
- ➔ Stimulate employers to select and re-train individuals who are doing roles without the necessary competence.

- Stimulate employers to invest in longer-term workforce development to address the skills where there are shortages of both competence and volumes of people.
- Working with the Learning and Skills Councils to secure support for work to close the gaps.

6.4 Applying the findings of this project

Each part of this plan requires evidence of the skills needs of the industry. This project has provided the ECITB with the mechanism to generate such evidence. The benchmarking tool developed is an effective and efficient way of measuring skills. With the support of the regional training managers companies could use the tool to benchmark and report on their own skills needs. This would compare each participant against a wider sample of similar individuals. If all the results were fed back to the ECITB then the training board would have a continual, current profile of skills in the sector based on real individuals. Such data could stimulate training providers, inform bids to government and more generally measure the impact of the ECITB on skills issues. This fact-based approach to workforce development is entirely consistent with the requirements of the SSDA.

7 Appendix 1 – the skills map

	Code	Name	When you...	Rate your skills to...
Client Relationship Management	M5.1	Communication	Exchange information with clients, suppliers, contractors, colleagues and other stakeholders	Produce structured, written reports using media and language appropriate to the audience
	M5.2			Give presentations to audiences of clients, colleagues or suppliers , using language and media appropriate to the audience
	M5.3			Listen to and question clients and secure all the information required to proceed
	M5.4			Use advanced groupware or extranets to communicate with project stakeholders
	S1.1	Contract management	Be aware of and apply standard forms of contract	When negotiating contracts, ensure that contractual obligations are reasonably attainable by both parties
	S1.2			When fulfilling contracts, ensure compliance with your contractual obligations throughout the lifetime of the project
	S1.3			When managing contractors, monitor progress to ensure that any departures from the contract are identified and appropriately remedied
	S1.4			Wherever possible, resolve contractual disputes through negotiation rather than litigation
	S2.1	Manage project/contract variations	Identify, communicate and manage changes	Monitor and review emerging and previously identified risks and opportunities, in line with procedures
	S2.2			Ensure sufficient, timely and appropriate information and advice is exchanged with clients and contractors throughout the project
	S2.3			If problems arise, analyse the available information from the perspectives of all major stakeholders, identifying and prioritising all known factors according to the project objectives, scope and definition
	S2.4			Make adjustments to activities, resources and plans with the knowledge and agreement of team members and stakeholders, and ensure adjustments are accurately recorded and securely stored
	S3.1	Stakeholder management	Develop relationships with clients, contractors and suppliers	When preparing a project brief, clearly delineate the boundaries and deliverables of the project so that they are understood by the stakeholders and are useful to other activities
	S3.2			Clearly define the authority and responsibilities for all activities in the project, and agree the relationships with employees, clients, contractors.

	Code	Name	When you...	Rate your skills to...	
	S3.3			Establish arrangements for achieving effective communications between all parties during the development and execution of the project	
	S3.4			If disputes arise, endeavor to resolve them fairly and amicably	
	S4.1	Client understanding	Understanding the client's business	Understand the client's structure, culture, market and commercial drivers, and act appropriately	
	S4.2			Evaluate and secure feedback from clients on your organisation's input to a project throughout it and on completion.	
	S4.3			Build an integrated project team, incorporating relevant members of client, contractor and subcontractor staff.	
	S4.4			Encourage openness between team members, and promote an environment where stakeholders can propose refinements to processes and new technologies	
	Design	I1.1	Understand clients' business	Understanding the technology and operations of the clients' business	Analyse and understand the customer's business.
		I1.2			Use your knowledge of the customer's business to build the business case for the project
		I1.3			Analyse and understand the technology underlying the customer's business
		I1.4			Suggest potential refinements to technology and identify processes which will best deliver client requirements
I2.1		Process technology	Understanding the operation of the plant and the commercial performance required	Analyse and understand the operation of the plant and its processes	
I2.2				Design plant or components for lowest cost operation particularly reducing man-power requirements	
I2.3				Design and/or implement plant components in the most efficient manner	
I2.4				Plan and execute maintenance in a manner that minimises impact on the operation of the plant.	
I3.1		Process optimisation	Applying technology to create plant and equipment that is more productive, runs for longer, requires less maintenance and/or is cheaper than existing plant to operate	Design and/or implement projects for efficient ongoing maintenance	
I3.2				Use computer modelling to predict and optimise processes	
I3.3				Perform computer simulations of lifetime costing and output of plant	
I3.4				Apply value engineering techniques to meet client objectives or improve design solutions	
I5.1			Bringing technical skills to monitoring and	Understand and appropriately apply computer diagnosis systems.	

	Code	Name	When you...	Rate your skills to...
	I5.2	Process control	controlling the plant	Identify opportunities for process improvement through use of system optimization software.
	I7.1	Modular design	Use and develop standardised equipment and processes to improve productivity and profitability	Where possible, use standard designs for plant, equipment and procedures
	I7.2			Modify standard designs to meet the client's or project's requirements
	I7.3			Record the changes made to standard designs and ensure that they have acceptable cost and safety implications
	I7.4			Continually improve and develop standard designs of plant, equipment and procedures
	M9.1	Designing for safe operation	Manage the safety of the design	Perform a risk analysis based on all plant variables and strongly developed process knowledge
	M9.2			Perform process simulation and develop operating scenarios for the plant
	M9.3			Understand and implement failsafe modes
	M9.4			Assess the design for safe construction
	P6.1	Apply engineering technology	Manage complicated construction programmes using new technologies in adverse environments	Develop expertise that is relevant to the activities being undertaken; developing an understanding of materials, methods, and environments.
	P6.2			Monitor technological developments within the engineering sector and your discipline area
	P6.3			Select the most effective production methods to achieve the project outcomes.
	P6.4			Possess the knowledge and ability to communicate your requirements effectively to suppliers and contractors.
	P7.1	Protect the environment	Protect the environment	Identify perceived sources of hazard to the environment arising from activities, and relevant areas of risk
	P7.2			Monitor the impact of activities on the environment and ensure that affects are within planned parameters
	P7.3			Identify, understand and exceed the relevant environmental legislation and regulatory requirements
	P7.4			Understand the implications of a failure in systems and have procedures in place for a worst case scenario.

	Code	Name	When you...	Rate your skills to...
Design Management	I4.1	Maintenance planning	Predicting and planning maintenance in a way that has least disruption on the production cycle or life of the plant	Plan maintenance of any given component in a manner compatible with the commercial concerns and the maintenance requirements of other components
	I4.2			Base maintenance planning around dynamic predictions of the condition of plant and its components.
	I4.3			Utilise plant monitoring systems and non-destructive testing to support maintenance activities
	I4.4			Ensure that the implementation of maintenance methods and procedures complies with all relevant regulations and guidelines
	I6.1	Option appraisal	Think differently and develop alternative methods	Define the activity, the current method of execution and take into account the customer requirements
	I6.2			Think laterally and develop alternative methods
	I6.3			Analyse the alternatives using appropriate value engineering techniques, against the requirements and identify the best option
	I6.4			Communicate the benefits of the new method, where appropriate, to colleagues and the client
	P1.1	Project planning	Plan the implementation of a project	Assess the project objectives to accurately determine their resource requirements
	P1.2			Identify the resources and time scales required to achieve each of the project task outcomes
	P1.3			Identify the relationship and dependencies between each project task
	P1.4			Establish the optimum sequence for the completion of the project tasks
	S5.1	Financial management	Controlling and reducing cost	Monitor, against the estimate, individual cost centres to predict potential overspends
	S5.2			Take remedial action to recover overspends by creating new solutions (rather than taking legal action)
	S5.3			Negotiate alternate approaches with the client and or sub-contractors
	S5.4			Question and challenge designs that appear over complicated and expensive
S6.1			Monitor, against the plan, individual tasks to identify time savings	

	Code	Name	When you...	Rate your skills to...
	S6.2	Progress control		Optimise the size of the team for the work to be completed
	S6.3			Take remedial action to recover project overruns
	S6.4			Question and challenge schedules that appear over generous
Management	M1.1	Personnel development	Develop a multi-skilled and flexible workforce	Before proceeding with an individual's personal development, complete a training needs analysis.
	M1.2			Manage teams in a way that provides people with planned opportunities to develop their career and apply their skills
	M1.3			Evaluate the effects of training upon the individual and the organisation
	M1.4			When specifying the requirements for new staff, review the skills implications of emerging technology
	M10.1	Safety management	Manage occupational safety	Audit potential hazards arising from activities, and relevant areas of risk, including consequential hazards arising from a combination of events
	M10.2			Identify, understand and meet the relevant Health and Safety legislation and regulatory requirements
	M10.3			Review previous accidents and incidents to ensure that relevant experience has been considered and included in the assessment of hazards and operations
	M10.4			Continually develop and recommend actions for reducing hazards to staff and third parties a level of acceptability
	M2.1	Personnel recruitment	Attract and retain people in the company	Identify and clearly state the technical and personal skills required by a given job
	M2.2			Interview to against accepted objectives, in a structured manner as described in the job description.
	M2.3			Maintain and/or apply a clearly stated equal opportunities policy.
	M2.4			Represent the industry and its activities fairly and positively to outsiders
	M3.1	Team building	Improve industrial relations	Give opportunities to team members to contribute to the planning and organisation of their work
	M3.2			In cases of disagreement with or between staff/contractors, negotiate a fair and mutually acceptable solution.
	M3.3			Provide opportunities for the team and individuals to monitor and assess their own performance against objectives and work plans

	Code	Name	When you...	Rate your skills to...	
	M3.4			Provide feedback to teams and individuals in a situation and in a form and manner most likely to maintain and improve their performance	
	M6.1	Industrial relations	Develop and implement an industrial relations strategy	Identify the requirements of the project and the areas of activities	
	M6.2			Negotiate and devise a project specific site agreement with trade unions, working on an open book policy	
	M6.3			Instigate and promote team building exercises for both management and contractors	
	M6.4			Work with clients to obtain a commitment to Industrial Relations Strategy and team building.	
	M8.1	Dealing with legislation	Understand your legal role and responsibilities	Understand where employment law impacts on your day to day processes	
	M8.2			Monitor emerging legislation and identify relevant changes	
	M8.3			Instigate procedural change where necessary to meet legal obligations	
	M8.4			Record the results of training in legal matters.	
	Project Management	M4.1	Site management and supervision	Site management	Select the most appropriate individuals for each task
		M4.2			Issue clear instructions
		M4.3			Monitor and manage performance of individuals and teams
		M4.4			Resolve disputes
M7.1		Project management	Understand project requirements, specifications and milestones	Assess the manpower and resources available	
M7.2				Communicate with individuals in other disciplines, regarding the on-site requirements of plant and equipment	
M7.3				Plan procurement milestones for plant, equipment and materials	
M7.4				Ensure that milestones are met and that appropriate remedial actions are taken when they are not	
P10.1		Site supervision	Manage greenfield and brownfield sites	Effectively manage sub-contractors	
P10.2				Effectively manage your own workforce	
P10.3				Work to agreed programmes and costs	
P10.4				Assess and report on the progress of work	

	Code	Name	When you...	Rate your skills to...
	P2.1	Project evaluation	Review the effectiveness of a project as it progresses	Obtain accurate information on the project activities being undertaken
	P2.2			Control the use of project resources to achieve the most effective results
	P2.3			Confirm that the materials and approaches used during the project are appropriate
	P2.4			Contribute to the contract review and make suggestions for improving the processes undertaken within the context of the project and for future projects
	P3.1	Procure materials and services	Procure materials, equipment and services	Assess the installation requirements and any factors that could affect their achievement
	P3.2			Review the options for fulfilling the brief, and make an informed choice, appropriately balancing quality, time and cost considerations
	P3.3			Identify and specify appropriate pre-engineered solution rather than designing everything from scratch.
	P3.4			Specify clearly the resources required to implement the agreed installation methods and procedures
	P4.1	Manage supplier quality	Manage the quality of bought in goods, plant and services	Understand the nature and quality of materials necessary to deliver appropriate quality in the outputs, and specify accordingly during the purchasing process.
	P4.2			Work with supplier companies to improve the quality of materials and take advantage of technological advances.
	P4.3			Monitor/inspect the quality of purchased materials and ensure that they meet the quality specified
	P4.4			Work with suppliers to initiate effective remedial action to correct the causes of non-conformance and limit their effect
P5.1	Manage project quality	Manage the quality of outputs and deliverables	Ensure that a commitment to quality assurance procedures is obtained from those responsible for applying them	
P5.2			Assess the outcomes and performance against specified or expected targets or milestones	

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	Code	Name	When you...	Rate your skills to...
	P5.3			Identify areas of non-conformance promptly and report them clearly to those who need to know
	P5.4			Initiate effective remedial action to correct the causes of non-conformance and limit their effect
	P8.1	Integrate work with client production	Manage projects to maintain productivity	Assess the existing production cycles and methods
	P8.2			Identify and plan access points that cause minimum disruption
	P8.3			Develop and agree build/maintenance schedules with on-site production staff
	P8.4			Agree and communicate access schedules and routes
	P9.1	Cost management/reduction	Manage to reduce cost	Assess and optimise materials flows and storage
	P9.2			Monitor and manage waste
	P9.3			Measure and optimise utilisation of construction plant
	P9.4			Measure and optimise utilisation of construction labour

8 Appendix 2 – the job roles of the respondents

The table below shows the unique job titles of those responding.

Assistant Engineer	Principal Planning Engineer
Business Development Manager	Principal Process Engineer
Business Manager	Process Engineer
Chief Civil / Structural Engineer	Process Engineer
Chief Engineer - Process & Design HSE	Process Manager Engineering Process Project Manager (Principal Process Design Engineer)
Chief Packaged Equipment Engineer	Procurement Leader
Chief Process Engineer	Procurement Manager, Teesside Operations
Civil/Structural Designer	Project Engineer
Commercial Manager	Project Accountant
Commercial Manager, Procurement	Project Commercial Manager
Construction Manager	Project Control Manager
Contracts Manager	Project Director
Design Manager	Project Engineer
Design Safety Engineer	Project Estimating Engineer
Director	Project Manager
Divisional Director, Commercial & Legal	Project Manager
E&I Manager	Project Process Manager
Employee Relations Adviser	Proposals Manager
Engineering Manager	Quality Manager
Estimating Manager	Quality Systems Engineer
Financial Accountant	Quantity Surveyor
Graduate Engineer	Regional Director
Graduate Process Engineer	Regional Manager
Head of SHE	Safety Officer
HSE Manager	Sales and Marketing Director
Inspection Manager	Senior Buyer
Instrument Designer	Senior Construction Manager
Lead Planning Engineer	Senior Cost Engineer
Manager Construction Contracts	Senior Design Engineer
Manager of Project Controls	Senior Electrical Engineer
Manager Special Projects	Senior Estimator
Manager, Business Development	Senior Process Engineer
Manager, Procurement Managers	Senior Project Manager
Managing Estimator	Senior Project Manager
Managing Quantity Surveyor	Senior Project Procurement Manager
Mgr Construction HSE and IR	Senior Proposals Co-ordinator
Operations Manager	Senior Vessel Engineer
Operations Manager Projects	Senior Electrical Estimator
Personnel Manager	Senior Process Engineer
Piping Designer	SHE Advisor
Planning Engineer	Site Based Planning Engineer
Planning Manager	Site Superintendent
Principal Cad Designer	Technical Support and
Principal Civil Engineer	

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Principal Construction Engineer	Development
Principal Consultant Process Engineer	Technology Development
Principal Cost Engineer	Manager
Principal Engineer (Civil/Structural)	Technology Manager
Principal Engineer CAE Systems	Telecoms Business Manager
Principal Gas Engineer	Training Manager
	Workshop Manager