

FACTORS INFLUENCING THE SAFE MANAGEMENT OF CONTRACTORS ON MAJOR HAZARD INSTALLATIONS

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Contractors are increasingly being used on major hazard installations and now perform many critical roles which can directly cause and prevent hazards. Operating companies have to manage the interfaces with these contractors carefully as experience has shown that fragmented systems and inadequate control of contractors have contributed to a number of recent accidents. This paper summarises the reasons for using contractors and the typical roles performed by different types of contractor (such as design, installation, maintenance, outsourcing of non-core activities, specialist EHS (Environment, Health and Safety) support). Recent incidents in a number of industries which have been exacerbated by poor contractor management are then reviewed and learning points from these incidents are identified. The types of problem which can be caused by contractor interfaces are then summarised and good practices/risk controls are identified for minimising these problems. These contractor management issues are critical within the COMAH (Control of Major Accident Hazard) Safety Case regime for chemical manufacturing companies.

KEYWORDS: COMAH, contractors.

WHY COMPANIES USE CONTRACTORS

All organisations use contractors to some extent and must decide on the appropriate boundaries of the firm. Economic theory would suggest that contractors will be used when work can be completed more cheaply by contractors than by in-house staff.

Table 1 illustrates different ways in which organisations can be structured regarding their use of contractors. Companies can thrive with all of these three structures. It is, however, clear that some organisations are more effective at managing within their structures than others.

Table 1. Different organisational structures

Type	Philosophy	Examples
Virtual Organisation	Strategy, marketing, R&D, product development completed in-house. All other activities outsourced.	High technology companies in Silicon Valley, USA.
Focused on core competencies	Devote resources to critical activities. Non-core activities are outsourced.	Many UK manufacturing companies.
Highly vertically integrated	Maintain full control over whole supply chain to minimise reliance on third parties.	Steel manufacturers purchase iron ore mines.

Positive reasons for using contractors include:

1. Gaining access to specialist skills and staff.
2. Allowing managers to focus their efforts on core company activities without being distracted by peripheral activities.
3. Meeting fluctuating patterns of workload.
4. Internal costs are too high.

Unfortunately, many organisations use contractors for poorly conceived reasons such as:

1. Everybody else is using contractors, it must be a good idea.
2. It's corporate policy.

TYPES OF CONTRACTOR

A typical chemical company will use the wide range of contractors illustrated in Figure 1.

Many of these contractors will therefore play a critical role in the prevention and management of major hazards on the site. Errors made by contractors or caused by poor contractor management would therefore have been expected to have contributed to a number of accidents on chemical sites. In reality, there are relatively few accidents which have been attributed to contractor errors.

This is probably because until relatively recently, many accident investigations did not identify underlying causes such as safety management system and organisational failures. For example, a chemical leak from a flange may have been attributed to human error by a fitter without considering that the fitter was a contractor and contractor supervision had been inadequate.

Table 2 summarises a number of accidents which have occurred in industries with major hazard potential in which contractor management had been identified as one of the causes of the accident.

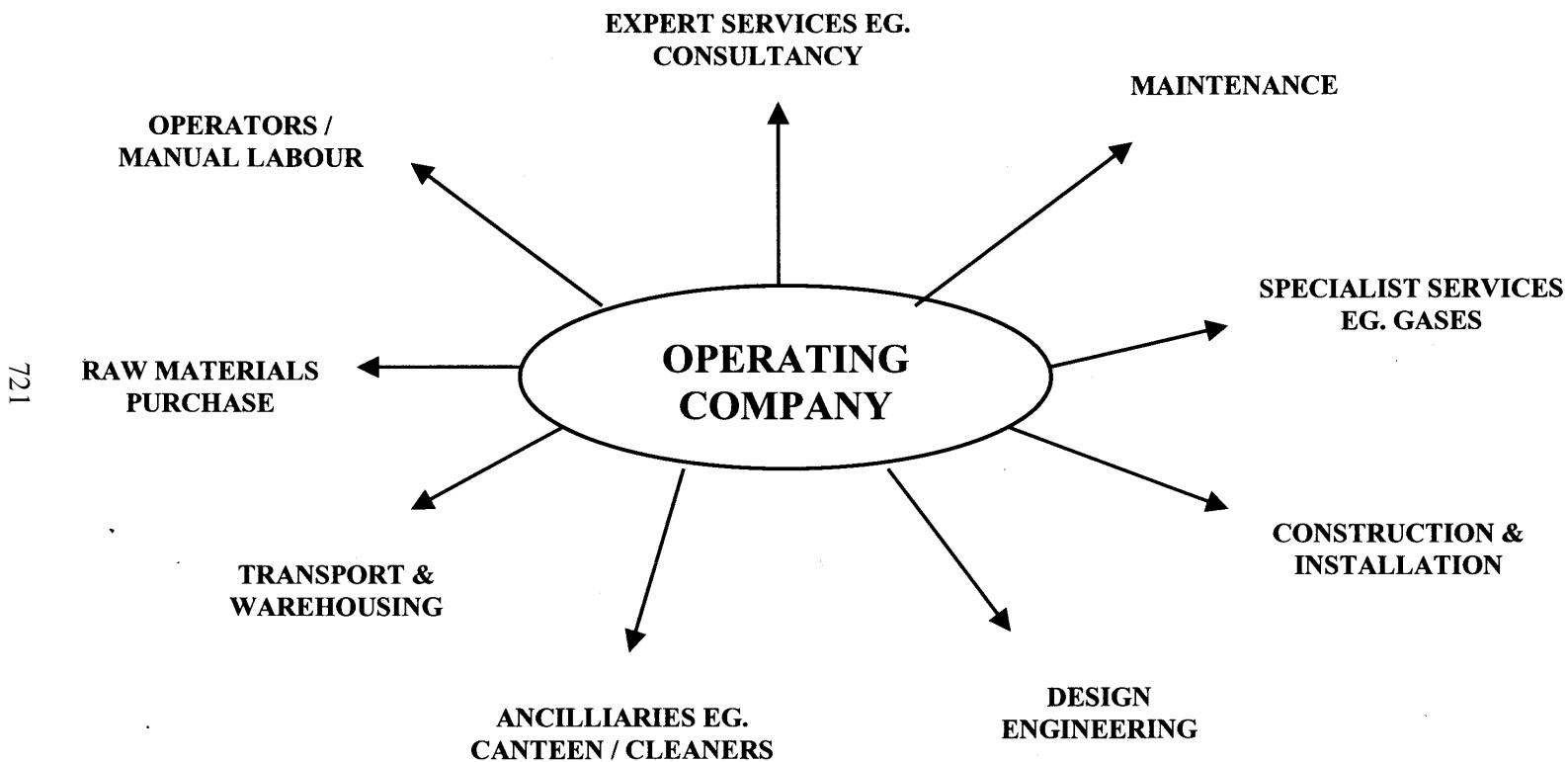
SPECIFIC PITFALLS

CHASE TO THE LOWEST STANDARDS

There is a real danger that the skill and commitment of workers will drop when the use of contractors is driven excessively by cost reduction pressures. Railway industry Trade Unions have identified the following contractorisation mechanism which causes particular concern:

- Work is contracted out.
- The contractor employs subcontractors.
- The subcontractors use temporary agency workers.
- The agency workers have low pay, no job security and no career development opportunities.

In these cases, committed, well trained and motivated staff have been replaced with poor quality staff who have no commitment to the overall goals of the operating company. This should be a cause for concern in major hazard industries.



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Figure 1. Types of contractor used by chemical companies

Table 2. Accidents involving contractor management

Ref	Company and date	Industry	Causes	Consequences	Contractor issues	Reference
A	Albright & Wilson, Avonmouth, 3rd October 1996.	Chemical	Incorrect chemical delivered to storage tank by haulage company.	Explosions and fire creating a 100 m black plume of smoke.	Paperwork for two chemical tanker loads was mixed up by haulage company, causing wrong chemical to be sent to site.	(TCE, 1996)
B	AEA, Dounreay, Scotland, 7th May 1998. <i>(HSE Audit Report Following Incident)</i>	Nuclear	Mechanical digger damaged power cables supplying part of site.	Loss of power to part of site for significant period.	Contractorisation so weakened technical and management base that company could not manage it's technical operations. Over delegation of control to contractors. Unable to act as 'intelligent customer'.	(HSE, 1998)
C	Kaiser Aluminium, Louisiana, USA, 5th July 1999.	Mineral Processing	Explosion in milling facility.	Multiple serious injuries.	Striking permanent staff replaced with 400 temporary workers.	(CHI, 2000)

D	EVC, Merseyside, 8th March 2000.	Chemical	Bellows leak in section of 12'' diameter pipework.	Release of 500 kg of hydrogen chloride gas to air.	Plant under control of contractor during commissioning.	(HSE, 2001a)
E	Railtrack, Hatfield, 17th October 2000.	Rail	Derailment, mechanical failure of rail.	Multi-fatality rail accident.	Management and maintenance of rail infrastructure by contractors. Delays in responding to known problems with bureaucratic contractor management system.	(HSE, 2001b)
F	Railtrack, Potters Bar, 10th May 2002.	Rail	Derailment, loose bolts on points.	Multi-fatality rail accident.	Points maintained by contractor but many were loose. Different standards of work across UK rail network.	(HSE, 2002)

PROVISION OF INADEQUATE INTERNAL RESOURCES

The economics of contracting often appear attractive because the operating company has not made adequate budgetary provisions for the internal costs of contract management. The most common error is to allow insufficient resources for supervising and checking contractor performance. This tends to cause a gradual erosion in the standard of work, which accelerates as the contractor realises that the supervision activity has been cut back.

Figure 2 illustrates the contractor management lifecycle.

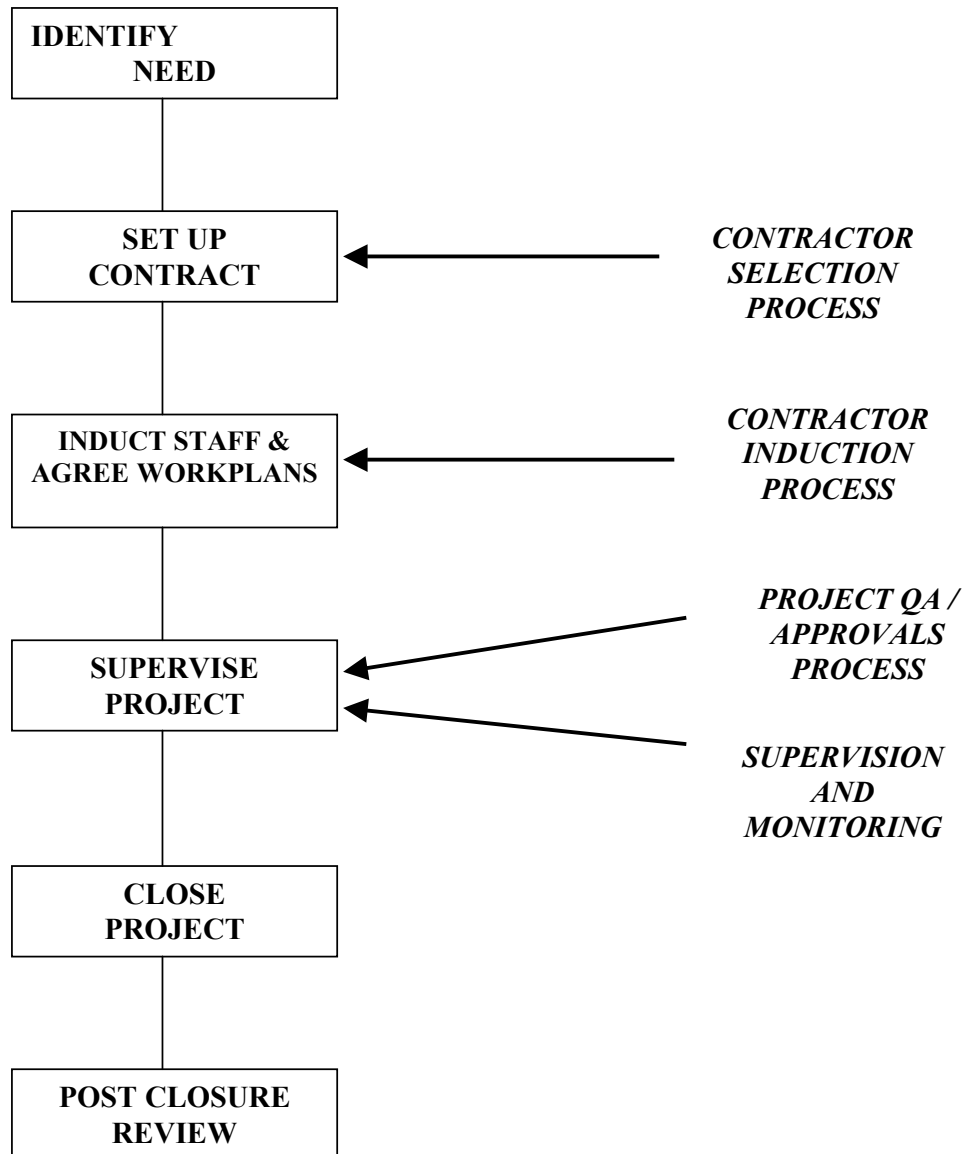


Figure 2. Contractor management lifecycle

SYSTEM INCOMPATIBILITIES

Operating companies tend to use complicated safety and business management systems. Contractors will have their own systems and will have to climb a learning curve to properly understand the operating company's systems.

There is a risk that work may be completed deliberately or accidentally without complying with corporate systems because:

- Critical standards and systems were not agreed before the contract was signed.
- Some critical standards were not defined and agreed in the original contract.
- The contractor fundamentally fails to understand one or more critical corporate standards.
- The contractor works to a different standard because it is felt that this is more suitable than the corporate standard.

If contract supervision is poor, these problems may not be identified until a late stage in the project, exacerbating their impacts.

These problems often affect the human factors aspects of projects as the impact of system incompatibilities is often:

- Poor or no training.
- Inadequate project documentation.
- EHS (Environment, health and safety) studies which are difficult to use or different from the standard format.

UNMANAGEABLE SYSTEMS

From a theoretical viewpoint, it may be argued that any organisational structure involving contractors can be made to work effectively. In reality, the more complicated the structure, the higher the risk becomes that significant problems will occur. Problems normally occur because:

- There are inadequate internal resources to adequately supervise and manage the operation.
- Bureaucracy slows down the fluent operation of the overall system, delaying critical operations.
- Communications between all of the operations are imperfect, driven by the complexity of the arrangements or the fact that different contractors have different and incompatible business objectives.

One of the best examples of how systems can become unmanageable can be found in the post privatisation UK railway industry.

- An operating company (COMPANY 1) will operate the front end service to the customer using rolling stock which is leased from a separate company (COMPANY 2) and track which is managed by another separate company (COMPANY 3).
- The track is inspected by a specialist company (COMPANY 4) and repairs are completed by another company (COMPANY 5) on approval of COMPANY 3.
- COMPANY 1 may operate a number of franchises in different regions of the UK. In each region, it may be dealing with different companies performing the roles COMPANY 1 to 5.

Acceptable safety standards can only be achieved if the interfaces between all of these companies are carefully managed. On a practical level, this has not been achieved.

Similar problems may well exist on some UK chemical sites with:

- An operating company running the site.
- Engineering design activities outsourced to a number of specialist design companies.
- Construction activities outsourced to separate companies.
- Maintenance activities outsourced to other separate companies.

These activities all need to be carefully co-ordinated to minimise risks. The operating company also needs to ensure that its overall contracting strategy is mutually consistent and workable.

CONTRACTORS WHO DON'T COMMUNICATE

Contractors will be under financial pressure to complete agreed scopes of work as quickly as possible. This pressure will often discourage them from fully communicating with other contractors and the operating company. Particular problems occur when errors are made by a design company and are not detected by a separate construction company. These problems can be minimised using control methods such as regular team meetings and formal design approval systems or by structuring contracts so that one company is responsible for both design and construction activities.

CONTRACTORS WHO ARE GOOD AT BUILDING SHOPPING CENTERS AND DANGEROUS WHEN WORKING ON CHEMICAL SITES

General fitting and maintenance work is often performed by specialist contracting companies who operate in a wide range of industries. Some of these companies do not have adequate experience of working on high hazard sites. Their safety culture often does not match that of the operating company because of factors such as:

- Poor awareness of the hazards around them.
- Lack of familiarity with site safe systems of work.
- Temptation to use working practices deployed in other less hazardous industries.

Experience must therefore be carefully assessed before the contractor is selected.

REMOVAL OF CORE TECHNICAL KNOWLEDGE

Operators of high hazard installations must retain a sufficient depth of technical knowledge such that they can safely run the facility. Care has to be taken when staff with key technical knowledge are replaced with contractors. When this happens, the internal knowledge that has been built up over many years is often dissipated causing problems when:

- Unexpected events occur.
- People require unwritten knowledge which is held in people's heads.
- Organisations forget about past errors and repeat these errors causing easily avoidable accidents.

Examples of each of these problems from the chemical industry are:

- A chemical reactor exceeds its safe working envelope. It is suspected that this has been caused by a hardware or design fault. Experienced engineers will be required at short notice who have a good working knowledge of the plant.
- A certain type of valve performs poorly with the chemicals handled on the site and should not be used.
- Reliance on one temperature probe at the base of the reactor is inadequate as experience has shown that it often becomes coated with a viscous layer of polymer.

SPECIFIC RISKS

OPERATORS

Risks tend to be increased when temporary staff are used on short term contracts. The staff then have a:

- Poor awareness of plant hazards.
- Poor understanding of the implications of doing the job wrongly.
- Lack of experience in the event that unexpected conditions occur on plant.
- High risk of causing human errors.
- Lack of recognition of unsafe acts.

These risks can be effectively controlled by adequate induction training and supervision.

RAW MATERIALS, TRANSPORT AND WAREHOUSING

Most companies rely on external suppliers for the provision of some or all of these services. The most dangerous errors are likely to involve:

- Delivery of the wrong chemical to a plant or storage tank.
- Incorrect labelling or paperwork associated with a chemical delivery.

Better quality suppliers will often be able to provide additional safety features such as:

- Dedicated tanker sizes and designs, minimising offloading leak risks.
- Deliveries in tankers fitted with dry link couplings to minimise operator chemical contact during the offloading process.
- Facilities for reprocessing offspec material.

ANCILLIARIES

In general, this group of contractors has a relatively minor impact on major hazard risk levels. The two main problems tend to be:

- Blocking escape routes or critical access points for emergency services by parking vehicles in inappropriate locations.
- Lack of awareness of emergency plans.

These problems can easily be prevented by induction training and site supervision.

One particular group of ancillary contractors does often, however, play a critical role in managing major hazards: security staff. In an emergency situation, they will have to liaise with the emergency services and media, respond to alarms, control access to and from the site and man the emergency control center. The critical role of security staff must therefore be emphasised and agreed before a contract is signed for this type of service. Additional emergency management training will probably be required for these staff.

DESIGN

Design activities can be performed successfully by contractors as long as operating company staff are fully involved in the design process and effectively approve all designs.

Specific problems which can be encountered include:

- Lack of corporate knowledge and site experience.
- Specification of equipment which is incompatible with the rest of the site, which then causes problems with spares and maintenance.
- Use of inappropriate design or EHS standards.

CONSTRUCTION AND INSTALLATION

These activities often occur under severe time pressure. Contractors often select the fastest installation method rather than the best pipe layout, causing future operability problems. Manual valves may be poorly located and excessive pipework or leak sources may be installed.

Revealed or unrevealed damage may occur to adjacent equipment either because of human error or because the contractor was not aware of the importance of this equipment. Typical damage would range from bent pipes because fitters have stood on them, removal of pipes which were not shown on installation drawings but performed an important role and accidental activation of safety systems. This type of damage should be identified and corrected during the project commissioning phase but the more of these errors that occur, the less the likelihood that they will all be identified and corrected.

A crucial part of installation is the handover phase. Some of this involves work which improves the human factors aspects of plant operation such as plant manuals, documentation, drawings and operator training. If the handover phase is not completed properly, the operators will find it difficult to operate the plant.

Arrangements also have to be put in place for dealing with unforeseen post commissioning problems. The maintenance staff will be climbing a learning curve and critical plant knowledge will still rest with the design/installation contractors.

MAINTENANCE

This is high risk activity as the contractor may (i) be working next to live plants and (ii) any errors could cause future accidents when the plant is switched on and runs live. There are numerous examples of accidents caused by poor maintenance and these have been highlighted by recent experience in the UK rail industry.

Fundamentally, the contractor must have the skill and discipline to be able to work safely under a Permit To Work system. Permits must be agreed, understood and followed.

Short cuts must not be taken. Contractors may be tempted to take short cuts when they are 'custom and practice' in other industries.

Problems often occur when work is inadequately supervised. If the bolts on the points at Potters Bar had not been adequately tightened (HSE, 2002), one person must have made an error in tightening the bolts in the first place, but another person or organisation must also have made an error in not detecting the problem. Operating companies using contractors for maintenance activities need to think carefully about defining the responsibilities for supervision and inspection activities. Some degree of independent checking will be required.

SPECIALIST SERVICES

Two particular problems tend to undermine the quality of work completed by specialist external consultants:

- Inadequate involvement of operating company staff. The work may then be based on incorrect assumptions and base data.
- Lack of clarity in the report. Staff fail to understand the logic and analysis in the report and do not incorporate its recommendations correctly.

AVOIDING PROBLEMS WHEN USING CONTRACTORS

A number of factors contribute to the successful management of contractors. These include:

1. Carefully select contractors and check that they have experience in high hazard industries.
2. Develop a good working relationship based on trust and underpinned by a sound legal contract.
3. Provide clear scopes for the contractor and agree any required changes to these scopes as the contract progresses.
4. Clearly specify all responsibilities and interfaces between parties affected by the contract.
5. Define the EHS systems and standards which are to be used in the contract.
6. Train and induct contractor staff before they start working at the site.
7. Allocate adequate internal staff resources so that the operating company can manage the contract effectively.
8. Supervise the work completed by the contractor carefully and provide feedback quickly so that small issues do not escalate into major problems.
9. Formally close the contract when the work has been completed satisfactorily and identify any areas where improvements could be made in the future with the contractor.

Table 3 lists some of the key controls that operating companies use for managing contractors.

Table 3. Key controls for managing contractors

Control	Objective
EHS questionnaires	Review EHS performance and safety management systems for potential new suppliers.
Approved supplier lists	Only allow suppliers who meet the site EHS standards to work on the site.
Contractor inductions Specialist training	Train contractors about site risks and systems. Specialist training for high risk activities like roof work, vessel entry and permit-to-work.
'Passport' scheme	Only allow suppliers who meet the site EHS standards to work on the site.
Site supervision Design/drawing approval system	Independently identify problems quickly. Check by operating company that design/project is fit for purpose, including EHS issues.
Contractor audits	Ensure that contractor performance is being maintained.
Workplace inspections	Spot check of compliance with site systems.

CONCLUSIONS

Every organisation uses contractors in some part of its operations. Some companies are heavily reliant on contractors and operate as virtual organisations. Others limit their use of contractors to specific non-core activities. All of these contractor structures can be made to work but some may require large amounts of effort and internal resource for contractor supervision.

Historically, contractor accident rates may have been underestimated with many accidents involving contractors being attributed to other causes such as 'equipment failure' or 'maintenance error'. Recent events in the railway industry have focused attention on the critical importance of effective contractor management. Contractors on major hazard sites therefore play a critical role in the prevention and control of major accidents on these sites. This paper has highlighted some of the problems which can occur with contractors and some of the techniques which can be used to control these problems.

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