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# Risk Engineering for major construction projects

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# 1. Risk engineering

## Its purpose

Risk engineering is a process where a risk engineer undertakes surveys, at regular intervals, during the life of a construction project.

The primary purpose of the process is the prevention of losses by examining the performance and progress of the construction works, identifying key areas of risk, providing recommendations, analysing losses and sharing lessons learnt with the operational teams. This is achieved through regular visits to site, and the discussion of recommendations with the Insured.

A further purpose is the reporting of construction progress to Insurers, including recent or imminent changes, the highlighting of problems that have been encountered, delays that have been faced, how the Insured responded to them and the response to any recommendations made during previous surveys. To accomplish this, information is gathered before, during or after the visit and a report is produced and sent to Insured and Insurers.

Risk engineering is usually initiated by the lead Insurer[1] of a major project with the aim of improving the management of the risks that the project faces. Survey visits also provide an opportunity for insurers to understand:

- Progress including recent or expected changes
- What problems have been or are about to be encountered
- What has taken longer or less long than expected

## Information

At the time of underwriting, Insurers will have concluded that the Insured had a level of risk management adequate to protect the project from those losses that could be expected to occur. One of the first roles of the risk engineer is to witness on site that this understanding is shared not only at project management level but also by those involved in day-to-day construction processes, quality management, and team work. The risk engineer expects to verify that the key areas of risk are understood and taken care of. Third party liability exposure, delay issues and natural catastrophe exposure also need to be looked at depending on the cover provided. The risk engineer's experience in undertaking similar surveys is key in this area.

Underwriting usually takes place before work has started and insurers are given project details but changes occur during the life of most projects. Policies extend over several years and, in that time, projects can expand or contract in scope, participants can change or the characteristics of the setting alter e.g. other works might be started nearby. Cost constraints may reduce the scope, additions may be made to its scale or extent. Contractors' and subcontractors' processes and what is built may alter. Detailed design may not have been completed when the project started, contractors may decide to change the method of construction or the supplier of goods or services. Many types of change can have an impact on insurers' understanding of

[1] For large international projects, the insurer may be a cedant from the country where the project is located that is reinsured by the international reinsurance market. In such circumstances it may be the lead reinsurer who sets up and controls the risk engineering rather than the lead insurer.

what they have agreed to insure. Some may have no impact on the level of risk which insurers perceive the project to carry. Others however may materially affect the level of risk and require changes to be made to terms of the project insurance or adjustment to the premium charged.

A certain level of information is given to the Underwriter at the underwriting stage which in essence should be the best description of the project that can be given at that stage. Risk engineering is an opportunity to regularly update Insurers on progress of the works, and understanding of the project. Highlighting a potential change in risk is a challenging area of risk engineering. It has to be undertaken with care, in a way that is clear to the broker, and as advice to the insured that problems could develop with a policy response if a loss occurs involving an activity that was not considered included at the underwriting stage. The risk engineer, by drawing such potential problems to everyone's attention in advance of a loss, creates an opportunity for uncertainties and issues to be tackled before they escalate in size.

Clear cut changes in the nature of a project (an increased scope of work, an extended project period or a significant change in contract value) will be dealt with by the brokers and underwriters in the normal course of managing the coverage during the life of the policy. Risk engineers sometimes have to report on subtle changes related to perception of risk such as the influence of changes in the activities surrounding the project or the introduction of innovative technology with a limited track record where the underwriting information did not, or could not, fully explain the potential influence on the project risk profile. Underwriters may have to carefully consider, with the risk engineer and the broker, whether the risk is significantly different from what was expected and if so whether changes in the policy can be justified and should be made.

## The parties involved

Risk engineering is usually handled by the lead underwriter on behalf of following underwriters, with the fees shared by all participants to the insurance placement. As such, all information gathered during the visit will be shared with all co-insurers. There is a need for a regular flow of information from the lead insurer to the other insurers who have taken a following position. For large risks, the lead insurer usually takes only a proportion of the risk with other insurers taking the remaining proportions until the risk is completely insured. Whilst insurance covering 100% of the risk is the most common, it does not happen universally. Some projects carry only partial insurance, whilst others may have split insurance with one portion being covered by one group of insurers and the rest by another. Some insurers will carry reinsurance. Whilst those involved in the project mostly do not need to know about these arrangements, the involvement of many different insurers and reinsurers creates a need for all those involved to be kept informed. The brokers who represent those engaged in a project, are aware of the insurance and reinsurance structure that applies. Risk engineering reports provide other involved insurers and reinsurers with updated information.

Brokers being the intermediary/adviser/insurance consultant between the Insured and the Insurers advise the client on insurance issues. Their participation in risk engineering surveys is essential. They are best placed to advise the insured on any potential changes highlighted by the risk engineer, on any impact a recommendation can have on the Insurance programme and to keep the following market informed. They also have a key role in making sure that risk engineering survey visits are well

organised and that the philosophy behind risk engineering is fully understood by the insured to make sure visits are as profitable as possible.

Communication between risk engineer and the project's loss adjuster can also be critical. On a very large project, the risk engineer needs to make sure that as part of the risk management practices, lessons learned from losses occurring on one part of the project are shared with other parts. There are also lessons learnt on one project which could benefit other projects.

In preparation for a risk engineering programme, the risk engineer should be provided with a copy of the policy wording, slip and main underwriting information to set up, with the lead Insurer, a programme of visits and the key areas to be looked at.

## 2. CAR/EAR Insurance

Major construction projects carry a variety of types of insurance coverage. Most will carry a Construction All Risks (CAR) Policy against physical damage to the project works or an Erection All Risks (EAR) when the project primarily involves the delivery and installation of equipment rather than construction.

Projects face a very wide variety of risks including natural catastrophe losses, damage to the works resulting from third party activity, subsidence, landslide, flood, fire, collapse, damage to temporary works, often the consequences of design, materials and workmanship errors, testing and commissioning risks and problems associated with prototypes or recently developed technology, amongst others.

Risk engineering surveys related to all risks policies focus on measures to prevent damage to the works. "All Risks" Policies generally exclude faulty materials, workmanship or design but do cover the consequences and thus the risk engineer will need to know how materials, workmanship and design quality is managed. Whilst general safety will be an issue, a large proportion of the effort put into safety is aimed at preventing injuries to workers or visitors to the project. CAR or EAR insurers will not deal with injury cases and as such do not have an interest in measures used to prevent them, except in so far as these might also prevent damage to the works or affect liability.

## 3. Liability Insurance

Projects also frequently carry third party liability cover in case the project causes injury or damage to persons or property that have nothing to do with the project but happen to be adversely affected by an accident for which the project is responsible. The primary cover (with a relatively small limit) is usually included in the CAR/EAR placement, with higher layers being placed with specialised liability underwriters. Third party issues are an area which risk engineers may be asked to look at during their surveys. In some instances, risk engineering reports are shared with the excess liability underwriters to improve their understanding of the risk. If the risk engineer has been asked to consider risks that could create liabilities for the project and thus claims, it is particularly important that they look at the safety of third parties and third party property.


Erection gantry for elevated guideway segments – Vancouver – working directly above a live highway creates significant liability risks

## 4. DSU/ALOP Insurance

Projects frequently also carry Delay in Start Up (DSU) or Advanced Loss of Profit (ALOP) cover in case an accident involving the project results in a delay in completion of the project and a knock-on impact on the business or lenders that was relying on the project being completed on time. Such policies provide cover for profits that were expected to flow from the project once completed or additional costs that have to be incurred to try to recover delays caused by an insured event. With such cover the risk engineer is interested in anything that causes delay whether insured or not. As it progresses, the project is likely to pick up delays and its room for manoeuvre will diminish the more of the project that is completed and the less there is left to do. So, for example, with a building project most of the hazardous activities will have been completed by the time fitting out takes place. The risk engineer will therefore be checking on whether proper protections are in place for what has been constructed and pressing the project team not to ease back on their vigilance at a time when they may be feeling that they are all but finished.

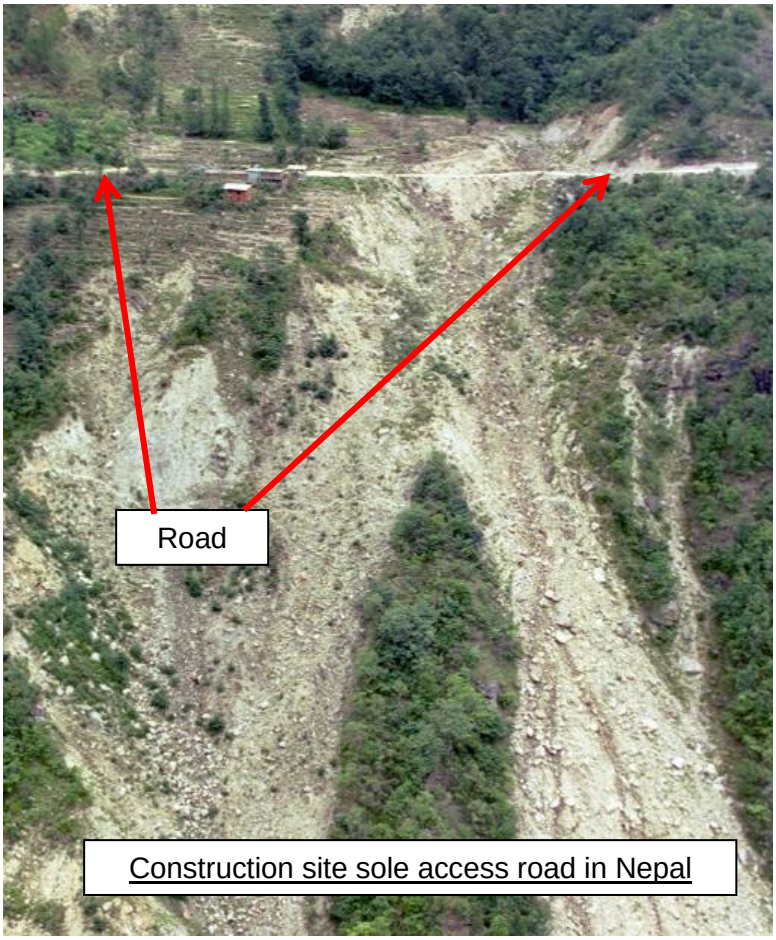
When DSU/ALOP is involved, good relations between the loss adjuster and the risk engineer are important. The two roles are rarely handled by the same person but the risk engineer should be aware of any losses that could have an impact on the progress of the works in order to focus risk engineering inquiries onto activities that are critical to the timing of the completion of the project.

Project monitoring is an important tool where DSU/ALOP cover has been provided. It involves regularly reviewing how the project programme is changing and tracking the

impact of each source of delay to try to distinguish that part of the delay caused by an insured event from that caused by uninsured events. The exercise will also be looking to identify ways of clawing back time by creative modifications or rescheduling the way in which the works are undertaken. This particularly applies where risks are high or where projects have experienced significant delays. Monitoring on this aspect of the cover starts with agreement with the insured for the risk engineer to have access every three to six months to progress reports and programme updates. Progress monitoring should be part of the agenda for each risk engineering survey. On a project facing delays for whatever reasons (whether insured or not) DSU/ALOP exposure is increased and thus loss prevention is even more important than normal.

## 5. DSU/ALOP extensions

On some placements, DSU/ALOP cover may also be taken out by the project for the suppliers of key equipment so that there is cover for the impact of an accident at a supplier's premises or prevention of access which affects the delivery of goods to the project with possible knock-on consequences. If this is the case, risk engineering can also look at the premises of main suppliers and their risk exposures as well as access to the site to identify the risk of a major blockage (for example if there is a single access route which is vulnerable to landslides). There can be many other possible extensions to policies which the risk engineer may have to be aware of. Instructions from insurers dictate what aspects of the project are to be covered by reports.




Construction site sole access road in Nepal

## 6. Marine Cargo and Inland Transit

Occasionally risk engineering programmes are limited to certain aspects of the coverage because there are other risk review and risk management exercises undertaken separately for insurers or as a condition of coverage. Goods being produced intended for use on the project can be subject to Marine Cargo and Inland Transit Policies for their journey from manufacturer to the site. Whilst risk engineering can cover the risks of marine cargo or inland transit, most often the management of these risks is undertaken in another way, for example by using specialist marine surveyors who are charged with approving vessel movements before voyages take place. An inland transit policy may contain a condition that transit routes and modes of transport be surveyed and approved by a named engineer before major items of equipment are transported to the site.

## 7. Risk Engineers

To obtain risk engineering surveys that are valuable to both insurer and insured, surveys are normally undertaken by an engineer with expertise in the technology and method of execution of the project being surveyed. Expertise in dealing with claims as a loss adjuster is also valuable since the risk engineer then brings experience from other projects and can add value by providing advice on loss prevention. The engineer also needs a detailed knowledge of how insurance policies and the insurance markets work. This is so they can include in their report information and analysis which is relevant to the underwriters. The engineer is examining whether the measures being used to manage risks are reasonable or are in need of improvement. In addition the engineer needs to know what information and analysis may affect an underwriter's judgement as to whether the risk that exists differs significantly from how the underwriter perceived it when the underwriting was undertaken.

A good quality risk engineer needs also to be able to work on his/her own, as insurers' budgets generally do not allow for a team to be appointed. Risk engineers need to be selective in the information requested, focussing on what is likely to be at risk, whilst not giving too much attention to unnecessary details. They must be able to adapt their attitude depending on the project being surveyed and the level of knowledge that the project team possesses on risk management, risk analysis and loss prevention. They also need skills to cope with cultural/language issues.

**Case History – language problems**

**On a tunnelling project, the risk engineer established that supervisors and workers spoke a number of different languages. At certain times a supervisor would only be able to address some of his crew by finding a multi-lingual worker to act as a translator. The risk engineer recommended that a register of language capabilities be established, that instructions be prepared and briefings conducted in several languages and crews configured so that supervisors could communicate with all members of their crew.**

Some risk engineers are the employees of insurers or reinsurers, some are independent consultants and a few are employees of brokers. The choice of the risk engineer usually rests with the lead underwriter but some negotiation may be needed with the brokers and approval is sometimes needed from following insurers or reinsurers before a choice is made. Occasionally, all interested parties may not be able to agree and this can lead to the appointment of more than one risk engineer with surveys carried out jointly or alternately. Care is required over the selection of the risk engineer if conflicts of interest are to be avoided.

## 8. Surveys

### Who is involved

Since risk engineering surveys are an important opportunity for communication, they are normally attended by:

- A representative of the broker (sometimes both local brokers and international brokers)
- A representative of the lead insurer/reinsurer
- Sometimes representatives of following insurers or reinsurers and
- Representatives of the insured.

On the Insured's side, it is important that the owner, project managers and contractors attend the survey. Specialised representation is required depending on the part of the works involved. This can include: programme management, safety and emergency staff, designers, quality managers, commissioning managers, risk managers and those involved in day-to-day construction. The number of people required can be high although often only a few may be required for more than relatively short meetings. It is very important that recommendations are shared by the risk engineer with those involved to discuss the best way of implementing any recommended changes.

As the form of the project changes, the types of personnel who need to attend meetings also changes. The need for the involvement of project manager and other senior managers will remain reasonably constant but the range of specialists required for the surveys will change as different activities are started and then completed.

### When they take place and how often

Risk engineering surveys are undertaken at a frequency set by the lead insurer which depends on the nature of the project, the progress of the works and the types of risk involved. The frequency is governed by the budget available but up to twice or three times per year is common. On certain projects surveys may be limited to critical points of the project works. The start of reception, just before a plant is to be commissioned or after a significant number of losses have occurred, risk engineering may be introduced.

The nature of the works included in a project has an impact on the type and timing of risk engineering that will be needed. Different activities attract different levels of risk.

The construction of an underground railway may have its most risky tunnelling phase at the start of the project, followed by a long period of lower risk equipment installation, testing and commissioning. A power station or refinery may have a long period of relatively low risk construction and erection followed by a much higher risk period once fuels are introduced and hot testing starts. Sports stadia may attract high levels of DSU exposure if they are being completed in preparation for a major event. For most projects the greater portion of the project that has been completed the greater the value at risk.

There are some countries which have only recently become involved in major international projects. Contracting companies from these countries are often unaware of the risk engineering requirements of major projects and very little information may be available to the risk engineer before travelling to the site. In these situations, a visit to the contractor's office is often desirable but this may not be possible within the costs budget available for risk engineering.

### Pre-planning

To get the best from a survey, pre-survey communication between risk engineer and all those involved is important to develop a detailed survey agenda. Surveys typically last between 1 and 3 days (sometimes longer) at the project office and on site. The surveyor will identify, in advance, what subjects he/she is looking to cover during the survey and will advise the broker. Sometimes detailed agendas for the survey are prepared and then discussed between the risk engineer, underwriter, broker and the project. These identify what areas are to be covered, how much time is to be allocated for each area, who should attend each session and what documents should be made available. The time required for on-site inspections will also be set out. The mix of time between office based meetings and site tours varies.

### Location and logistics

Site inspections can account for a sizeable part of each survey if the site is large and spread over a wide area, as may occur with a road, railway or pipeline project. Inspections often require visas, security arrangements, safety briefings, translators, permissions for entry and photographs, personal protective equipment, specialist means of transport (occasionally rough terrain vehicles, boats, helicopters or other aircraft).

On some large projects, where risk engineering surveys are being undertaken over a prolonged period, it may be decided to visit different parts of the project on different surveys. As the risk engineer becomes more familiar with the project as it evolves, and the project team gets used to the risk engineering process, the duration of some inspections can often be reduced. With time, different parts and different processes will come to the fore since the form of a construction project will be different at each successive survey.

## 9. Documents

In advance of the first survey and between surveys, the risk engineer will be looking to obtain documents about the project so as to be as informed as possible about the

project before the survey takes place. This is to allow maximum benefit to be gained from the time allocated for the survey.

Projects produce very large numbers of documents that can be important for a risk engineering exercise including:

- contracts and sub-contracts
- permanent and temporary works drawings
- specifications
- procedures
- risk assessments
- risk registers
- method statements
- programmes
- critical path diagrams
- progress graphs
- payment and cost schedules
- progress reports
- reports by engineers engaged in monitoring the project for a variety of stakeholders
- HAZOP studies
- pre-commissioning analysis reports

Often, rather than creating a new progress report just for insurers, the project staff can, with the risk engineer, select one that will be of most interest for insurers or extract material from existing reports.

In addition documents produced by other parties may have to be consulted including:

- codes of practice
- standards
- regulations
- procedures
- materials hazard identification sheets
- product information
- details of nearby works

It is not realistic for the risk engineer to process every project document that exists and so he/she has to be selective in what is requested and what is mentioned in the report.

It is also important for the risk engineering to ensure that procedures are followed on site. Good safety procedures may be in place but these may be ignored on site. The consequences can be severe. A trench collapse or failure of temporary supports could result in serious loss or project delay.

Diagrams, drawings and tables in electronic form are particularly useful since they allow extracts to be easily inserted into the report where these are relevant and avoid the need to transport perhaps several kilograms of paper documents.

Predicting precisely what will be required ahead of a survey can be difficult. Issues can arise during the survey, or occasionally afterwards, that require in depth investigation and analysis. Occasionally survey report recommendations can lead to

the creation of new documents and these can take the project a significant time to prepare if the work required is important and complex.

During a risk engineering programme (between surveys) documents regularly flow between project, broker, risk engineer and underwriter either in anticipation of the next survey visit or as a consequence of something that has arisen on a previous visit.

## 10. Codes

In the last few years codes aimed at improving risk management have been developed to satisfy the concerns of the insurance industry about high numbers of costly losses involving construction projects. These include:

- the Joint Code of Practice for risk management of tunnel works in the UK[2]
- the Joint Code of Practice on the protection from fire of construction sites and buildings undergoing renovation[3]

Where insurance policies are conditional on adherence to such codes or make reference to them, the risk engineer will be looking to check whether they have been followed.

**Case History – Code compliance**

**The policy for a tunnelling project required the contractor to comply with the requirements of the tunnelling code of practice. During the first survey, the risk engineer established that site staff were not aware of this. By examining in detail the risk management tasks that the contractor had used, the risk engineer established that many of the code requirements had already been complied with and was then able to identify the short-comings that the contractor needed to attend to in order to avoid breaching a condition of the policy.**

Other examples of policy conditions which may be unknown or misunderstood by site personnel are:

- The requirement to restrict the amount of construction material in storage to below a certain value.
- The requirement for all safety systems to be fully operational before commissioning of production equipment.

Particular problems can arise with definitions and practices during commissioning of industrial facilities particularly power plants and process plant. Definitions for activities such as mechanical completion, pre-commissioning, Ready for Start-Up (RFU) differ and it is important for the risk engineer to understand and report on the exact definitions.

Policy terms are sometimes open to misinterpretation or can make commissioning impossible. For example, a policy may specify that hydrocarbons cannot be admitted to the plant until a RFU certificate has been signed. However to reach the stage where the plant is at RFU, natural gas or other fuel may be needed for activities such

[2] Published by the British Tunnelling Society
[3] Published by the Fire Protection Association

as drying of refractories in boilers and fired heaters. These issues must be discussed in detail to remove any ambiguity and confusion over the mechanical completion, prestart-up and commissioning stages of the project.

Reliance should not be unquestioningly placed on some of the common international standards such as ISO 9000, ISO 14000 or OSHAS. Application at a site level can be patchy and auditors for the standards may be content to review documents rather than determine actual conditions on site.

The London Engineering Group has also produced a code of practice[4] for Erection All Risks Surveys.

## 11. Reports

The output of a risk engineering exercise is a series of reports produced at regular intervals often one following each risk engineering survey.

Risk engineering reports concentrate on aspects of the project that are relevant to an underwriter making an assessment of the level of risk which the project poses. Those writing the reports will assume that the underwriter is aware of the general details of the project and will only add further description of the works that is necessary to explain a particular risk related point.

## 12. Loss calculations and benchmarking

When underwriting projects, an insurer will often make an assessment of the Estimated Maximum Loss (EML) that the project could generate. The risk engineer will often make EML calculations in the course of the project, highlighting scenarios that are valid at the time of the survey (or before the next survey) depending on the progress of the works. Although these are not intended to impact the capacity that insurers have allocated to the progress of the works, if mid-term EML scenarios produce very different values from the overall project EML, this can be of use to Insurers.

The risk engineering report will sometimes contain the risk engineer's calculation for this value based on information obtained during surveys. This allows insurers to check whether the figure they have used and the scenarios they have analysed before the project started remain valid or need to be modified. It is important that loss estimates are defined and calculated in a consistent fashion. For concentrations of particularly hazardous substances, such as explosive chemicals or fuels, specialist tools such as ExTool[5] for calculating the size of a Vapour Cloud Explosion and financial consequences will have to be used.

Both insurers and projects often want to know how they compare with other similar projects and benchmarking information can help identify areas that require improvement. Since every project is different, it can be difficult to provide exact comparisons and systems are by their nature rarely statistically rigorous. Systems

[4] London Engineering Group Erection All Risks Surveys – A Code of Practice – www.londonengineeringgroup.com
[5] ExTool developed by Swiss Re www.swissre.com/clients/client_tools/about_extool.html

are available however to give a relative rating against a predefined set of criteria such as the KRRIS[6] system.

## 13. Recommendations

Risk engineers will often try to identify and explain likely recommendations during the survey. This is so that the project team has an opportunity to clarify issues or challenge the risk engineer's view immediately. Most risk engineering surveys end with a wrap up meeting at which the risk engineer will summarise the recommendations that have been identified during the survey. This also gives an opportunity for some discussion and an indication of how the project intends to respond. Whilst risk engineers will usually seek to identify recommendations during the survey, sometimes further recommendations or developed recommendations only emerge when documents collected during the survey are analysed later. The risk engineer will normally seek to provide the survey recommendations in written form to the project (via their brokers) a few days after the survey has taken place and ahead of the drafting of the report. This is to allow the project to consider the recommendations as swiftly as possible rather than having to wait for the full report to be released.

The recommendations section is a key element of risk engineering survey reports. Normally in addition to setting out what is recommended, there will be an explanation of the reason and examples of where improvements can be made as well as the reference, date and classification

Recommendations are frequently the subject of debate between the project, their brokers, insurers and the risk engineer. The risk engineer uses his/her judgement as to what is a reasonable recommendation to make and also to evaluate alternative suggestions that may come from the project. Risk engineers are sometimes asked to reduce the extent or depth of recommendations at the drafting stage. Sometimes this leads to compromises. The risk engineer judges how far compromise is reasonable and when to stand firm, albeit that the ultimate judgement on the final form of the recommendation generally rests with the lead insurer's underwriter. There is sometimes a temptation to make numerous minor recommendations but this should be avoided. It is preferable to concentrate on the key recommendations, possibly using the minor issues as examples of greater problems.

It would be wrong to misinterpret recommendations as instructions since the decision about what action to take, when an issue is raised by the risk engineer, rests with the project team.

Recommendation classification systems are not all the same. Many prioritise recommendations into items which require immediate attention, those that are likely to involve expenditure and those where only human involvement is necessary (such as where procedures need to be changed).

[6] KRRIS – Key Risk Rating Indicator System developed by Charles Taylor technical - www.cttechncial.com - KRRIS & Colour-Coded Risk Management Doug Scott – September 2007 – www.cttechnical.com - Publications

Recommendations from each survey are followed up in the following survey. Frequently projects will be looking to address any issues raised soon after they have been identified and often actions are completed between surveys sometimes in sufficient time that the response to them can be included in the survey report before it is issued. Most projects will be looking to complete any changes that are needed quickly, if this is possible, but not all issues have a quick solution. Sometimes some aspect of the work may need an additional study, a re-design, a change in the method of construction or something else which cannot be implemented immediately.

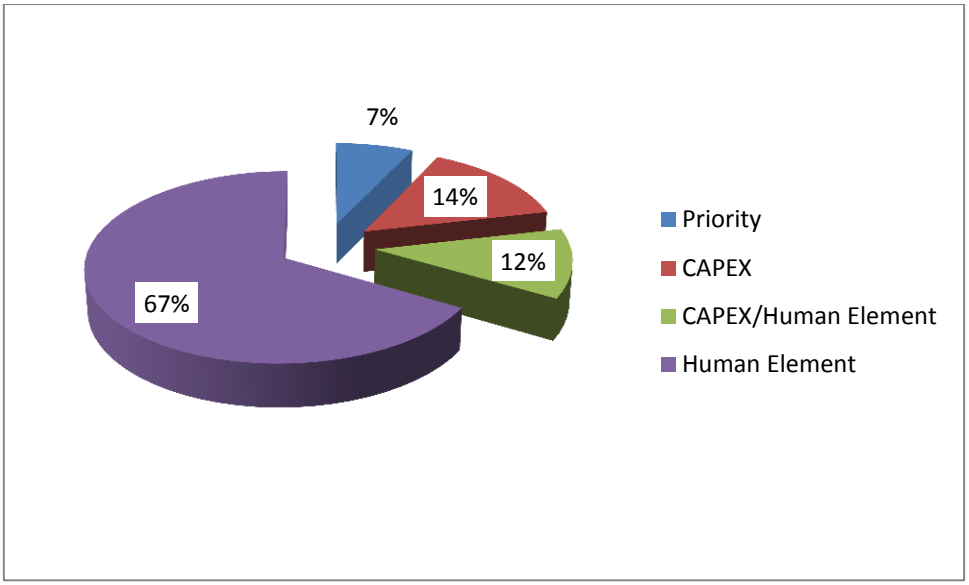
**Case History – Early identification of risks**

**During an early survey for the construction of a new manufacturing plant, the risk engineer identified that windows in the site's main switchgear room faced directly onto transformer bays making the plant vulnerable to losing its entire power supply in the event of a transformer explosion despite the intention of the plant to contain 100% redundancy. Modifications involving blocking up the windows and extensions to fire walls completed during the construction period and before start-up significantly reduced the risk.**

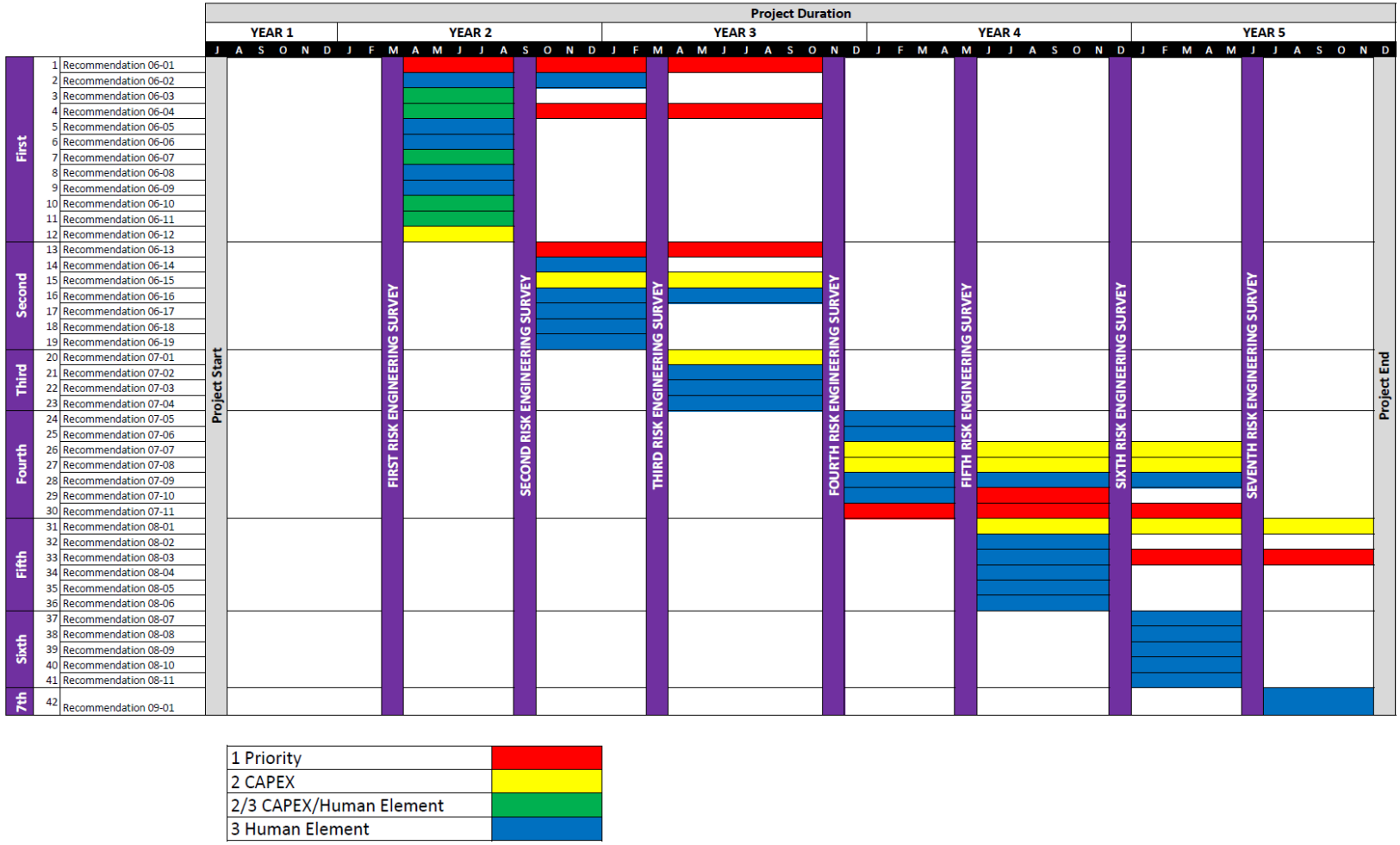
Whilst a risk engineer can point out a problem and make a suggestion as to how it could be overcome, projects will sometimes want to consider a range of possible solutions before deciding which to adopt. Alternatively they may wish to challenge what the risk engineer has said by generating evidence. This can lead to recommendations being changed or even withdrawn. This should not be seen as a retrograde step but instead the realisation that the project team has already found a solution to avoid the risk.

The number of recommendations following each survey is impossible to predict since it depends upon a large number of factors. It would be rare to find no recommendations at all being made. Each subsequent survey will follow up on all recommendations made previously that have not been closed. Some recommendations will be closed by the time the next survey arises, some will span more than one subsequent survey and others will only be closed after several surveys. Occasionally a situation may deteriorate rather than improve and this could result in the recommendation classification being increased at a subsequent survey. Either that or the risk engineer may increase a recommendation classification to make clear to a project that their response to a previous recommendation has been inadequate.

A pie chart of 42 recommendations made during the life of a project is shown below. This shows the proportion of each type for that project. Usually human element recommendations are the most common but each project is different. The bar chart also below shows an example of a risk engineering survey programme with the times when surveys were conducted, the number and classification of recommendations made and the development of these recommendations as the project progressed.




Example pie chart showing proportion of different types of recommendation made during the life of a project




Typical programme of risk engineering surveys and resulting recommendations

## 14. Reactions to recommendations

Project teams deal with risk recommendations differently. Some find it very difficult to handle a report that says anything other than that the situation is perfect. Others look for an instant solution perhaps simply telephoning a member of their staff to complain or to issue instructions for an instant improvement. But instant solutions are rarely appropriate with some issues requiring a study or review to be undertaken before the best solution is found. Occasionally projects have no formalised risk management and it has been known for risk engineering to be ignored completely.

**Case History – differing national approaches**

**On a railway project with contractors of different nationalities a risk engineering recommendation for the establishment of a near-miss reporting scheme with a lottery style incentive was successfully implemented by a contractor of one nationality but the incentive was not considered useful by another after workers submitted excessive numbers of near miss reports to increase their chances of winning.**

The risk engineer has to be sensitive to cultural differences. Publicly admitting that improvements are needed may be difficult and embarrassing in some cultures and this can generate hostility or a desire to find a scapegoat. Sometimes projects may be aware that improvements are needed but the required changes have become bogged down by bureaucracy. In this situation the risk engineering survey can be useful to clear the obstruction. Sometimes there are internal power struggles within projects and risk improvement recommendations may be used to try to support one party's position. For insurers, the important issue is to ensure that improvements are made when needed.

## 15. Concerns

Risk engineering exercises have their problems. Those not familiar with risk engineering may have concerns about why it is being undertaken and be suspicious of the process. Typical feelings include:

1. Suspicion that insurers are looking for fault or simply to criticise
2. Concern about loss of confidentiality
3. Concern that if recommendations are not followed the policy may be cancelled
4. Worry that recommendations will be impractical or prohibitively expensive
5. Worry that the person undertaking the survey will not understand the project
6. A belief that risk engineers cannot make a meaningful contribution to the project by undertaking a survey that occurs only every 6 months and lasts only one or two days

1) In general, insurers consider risk engineering as a way of adding value to the product they provide. Instead of simply waiting until losses occur and claims are made, they are able to assist those involved with the project in making

their risk management as effective as possible. Insurers, reinsurers and risk engineers have considerable experience of major projects and what can go wrong and this can be of great benefit to a project whose staff may not have had to face such situations. Whilst a risk engineer will certainly try to identify any areas that need to be improved their task is not to be critical for the sake of it.

2) For insurers to have been able to insure a project they will have needed to see full details of it including confidential information that is relevant to the risk they have insured. If the cover includes DSU or ALOP, very commercially sensitive information will have seen by them. Insurers recognise that confidential information must remain so and this applies as much to information provided during risk engineering surveys as to any other information received. In some cases confidentiality agreements are used to record the basis upon which information is made available.

3) The insurance policy wording is the document that defines the terms of the contract between insurers and the project. As such, it is that document that will determine under what conditions the policy terms may be altered or in extreme circumstances when the policy might be cancelled if this is allowed. Insurers generally do not expect risk engineering surveys to find anything that would result in policy cancellation. They will expect projects that are surveyed to respond thoroughly and carefully to each recommendation that is made. In the vast majority of cases, if there are disagreements about the applicability or content of a recommendation, a compromise is arrived at which is satisfactory to both the project and the insurers. Sometimes this may require some negotiation and the involvement of brokers can be very helpful in this area.

4) Risk engineers recognise that it is pointless making a recommendation that will not be acted upon because it is impractical or prohibitively expensive. Recommendations take time to form. They will normally be discussed during the survey at which time the project can provide immediate comments, they will then be prepared in written form by the risk engineer, reviewed by the insurer, sent to the broker for further review before being passed in draft form to the project. The project then has an opportunity to make further comment, request revisions or make suggestions as to how the recommendation might be fulfilled perhaps in a different way to that suggested by the risk engineer. Upon receipt of comments, the risk engineer will revise the wording of the recommendation and may include in the report the project's response. Once the full risk engineering report is produced, it will also be sent in draft form first to the insurer, then to the broker, then to the project and further revisions can be discussed and agreed. Only when issues have been dealt with will the report be finalised and issued to all insurers, the broker and the project. There are therefore many opportunities for any concerns about recommendations or indeed the content of the report to be raised.

5) Insurers are very careful about who is selected to undertake risk engineering. There is little point asking someone who does not understand what they are looking at to review a large and complex project. Those delivering the project will have considerable experience so, for a risk engineer to add value, they must have knowledge and experience of the what can go wrong and suitable measures that can be adopted to minimise the risk.

6) In the past, site visits by insurers tended to take the form of a conducted tour. Insurers still encounter instances where, either the visit takes the form of a drive around the site or the contractor is not allowed to attend. In some cases, when risk analysis is mentioned, insurers are told “you are the risk analyst and should be aware of what you are facing and accept it.” Or when the owner is asked about fire prevention best practice the response is a statement that “this is all in the contractor’s contract and it is not our concern anymore”. Nowadays risk engineering surveys have developed in sophistication to the point where they are able to add value both for Insurers and Insureds. Awareness of this has, however, not yet spread to all projects. Those who have been involved in projects where risk engineering has been applied normally find a periodic independent review of their risk management helps to improve its quality and effectiveness even though it may take one or two surveys before the process is accepted.

## 16. Is risk engineering worth doing?

Insurers clearly consider that money spent on risk engineering is money well spent otherwise they would not continue with it. Proving to a project team, in absolute terms, that risk engineering is beneficial can be difficult, particularly in the early stages. There will be no identical control project that has not been risk engineered to compare to the risk engineered one to see which fared best.

Like anything to do with risk management, the best outcome that can be hoped for is that nothing adverse happens. If nothing adverse does happen, it is tempting for all those involved to claim, without being able to prove it, that it was their influence that produced the good result.

In practice, insureds involved in major projects see the benefit of avoiding accidents and losses. They already try to identify where these might come from and take measures to reduce the likelihood. If a risk engineer is able to identify potential sources of accidents or losses that the project team has overlooked or risks that have not been properly managed, their advice will be welcomed. Accidents not only cause claims against policies but they generate uninsured losses. It is therefore in the interest of both insured and insurer/reinsurer that they are minimised.

Most project teams welcome a periodic review by a fresh set of informed eyes that the risk engineer brings. Experience from seeing different project management and risk management systems in action, experience of losses and alternative ways of solving problems is seen as a valuable source of information. This applies particularly where the engineer has relevant international experience and can benchmark the project in the context of other comparable projects.

**Case History – winter working**

**During a survey for the construction of a new winter sports facility, the contractor revealed the intention to continue working through the winter period rather than suspending work and restarting in the spring. The risk engineer provided to the contractor recommendations for winter working procedures to avoid damage to the works and precautions to be taken to minimise the risk of injuries to workers. These recommendations were derived from practices used on another continent with greater experience of winter working.**

Major construction projects regularly suffer sizeable incidents in addition to a steady flow of more run of the mill failures and accidents. Managing construction risks effectively requires persistent attention to detail and training for a workforce with a culture of getting things built. Internationally standards of risk management vary considerably and there is almost always room for improvement. City centre infrastructure projects in particular are becoming more and more complex with ever more sophisticated methods for controlling them. When they do go wrong the cost of repairs and the resulting disruption can be extremely high. Insurers have a common interest with contractors and clients in minimising losses and see risk engineering as a way of contributing positively to the process of achieving better risk management and thus a worthwhile investment.