Contract Strategies for the Delivery of Sewer Rehabilitation Projects
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Abstract
At the beginning of a sewer rehabilitation project there many uncertainties. For example, we may not know the condition of the pipes; in some cases we may even not know which pipes are to be included in the project. This paper explores possible contract strategies that can be used to manage these risks, producing a cost effective result for the client, whilst at the same time ensuring that the contractor receives adequate compensation to enable them to continue to invest in equipment, personnel and the development of new rehabilitation techniques. The paper draws on the experience of two Auckland councils.

Keywords
Sewer Rehabilitation, Trenchless Technology, Project Management, Contract Strategies

Introduction
Trenchless methods for the rehabilitation of wastewater sewers were first developed in the 1970’s. Since then a wide range of rehabilitation technologies have been developed, which include techniques for lining, patch repair, on-line replacement and sealing by grouting. These techniques can be used to reduce infiltration, improve structural integrity or reduce the occurrence of blockages.

Trenchless sewer rehabilitation is often less expensive than conventional methods of repair. Trenchless techniques offer significant advantages in urban environments, as they cause far less disruption to businesses, traffic and community activities than conventional methods of sewer repair.

Increased use of rehabilitation techniques has also increased as a result of wastewater authorities adopting an asset management approach to the maintenance of their sewers.

Consequently sewer rehabilitation now represents a significant portion of the expenditure of most wastewater authorities.

As the use of sewer rehabilitation has increased, so has the size of the contracts being undertaken. Whereas at one time sewer rehabilitation contracts covered only small one off repair jobs, multimillion dollar contracts are now common place.

General Contract Delivery Approaches
The generic tasks required to successfully deliver a project are outlined in Figure 1
Key activities include:

- Defining **project outcomes** and **measures of success**
- Allocating **resources** of that the project team has the capability, knowledge and motivation to successfully complete the project
- **Communication** so that all parties are aware of what may occur and what they are expected to do.
- Management of **cost**
- **Risk** identification and management
- Encouraging **innovation** and activities that increase **value**

However, clients have come to recognize that they require more than mere delivery of the project. In order for a project to deliver satisfaction to the client's customers, consideration needs to be given to the higher level outcomes outlined in Figure 2 and these need to be considered in any project delivery strategy.
Contract Issues Particular to Sewer Rehabilitation Projects

Typical tasks included in a sewer rehabilitation project

Typically a sewer rehabilitation works will involve:

1. A **definition** phase to determine which catchments or areas require rehabilitation
2. Detailed **source detection** works to identify the defects in the selected catchments or areas
3. **Analyses** of the source detection data and **design** of the required rehabilitation work
4. Carrying out the **rehabilitation** work as per the designs and agreed standards.
5. A **review** phase to determine whether the project has met the desired outcomes.

In this paper focuses on the investigation, design and implementation phases, i.e. stages 2, 3 and 4.

Sewer rehabilitation works may also involve the investigation and possibly repair of private sewer laterals. It often involves the rehabilitation of manholes. The works often need to be coordinated with upgrades to other Council assets such as roading and stormwater assets.
Construction or Maintenance?

Sewer rehabilitation contracts are traditionally considered to be construction type contracts. They are often managed in the same way as the construction of, for example, a new building. That approach may ensure that the low level project outputs are achieved, e.g. the liner may be installed on time and to budget, but it is unlikely to ensure that the higher level outcomes outlined in Figure 2 are achieved. That is because sewer rehabilitation works are much more akin to maintenance works, as shown in the comparison given in Table 1. The factors outlined in this table should be considered in developing a contract strategy.

Table 1 - Similarity of Project Features with Construction and Maintenance Projects

<table>
<thead>
<tr>
<th>Typical Features Sewer Rehabilitation Works</th>
<th>Similarity with Maintenance works</th>
<th>Similarity with Construction works</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working in live systems</td>
<td>Not unusual</td>
<td>Unusual</td>
</tr>
<tr>
<td>The contractor does not have control of the site</td>
<td>Not unusual</td>
<td>Very Unusual; Contractor normally has full control of the site</td>
</tr>
<tr>
<td>Many sites spread around the project area;</td>
<td>Not unusual</td>
<td>Unusual to have so many sites;</td>
</tr>
<tr>
<td>Many sites buried under busy roads, paved areas, walls, etc.</td>
<td>Not unusual</td>
<td>Unusual to have to discover/make accessible so many sites</td>
</tr>
<tr>
<td>Require repeated entry to site</td>
<td>Not unusual</td>
<td>Unusual</td>
</tr>
<tr>
<td>Customer Issues – every day feature</td>
<td>Not unusual</td>
<td>Unusual</td>
</tr>
</tbody>
</table>

Other matters particular to sewer rehabilitation projects

Sewer rehabilitation contracts are subject to specific issues that make them different from most other types of works undertaken by councils; these include:

1. The inherent duplication of work activities from source detection to rehabilitation phases such as CCTV and condition assessments, together with the associated supervision and administration costs.
2. The need to document vast amounts of data to transfer from source detection to analysis/design and from analysis/design to rehabilitation phases. This transfer of data often results in communication problems. It has been estimated that a $10mil sewer rehabilitation contract will need 715,000 data entries for monitoring, management, reporting and payment purposes (Basu et al, Ref 1).
3. The quantity and period over which private properties are required to be accessed for investigation and rehabilitation works.
4. The development of new rehabilitation techniques is very expensive.
5. Contractor’s and consultant’s staff require a high level of specific expertise, which can normally only be obtained by spending time working in the sewer rehabilitation field.
6. The high cost for contractors to procure the equipment and develop the expertise needed to undertake the works often means that there only a few contractors and consultants who can undertake the works.
7. The quantity of work required is not known at the start of the project. Quantities of work identified after the source detection and design phases may be significantly different to those assumed at the start of the project.

8. Accurate and complete investigation works are critical to the success of the project. These activities require a lot of operator expertise and management resources, but are normally paid at rates significantly less than those paid for the rehabilitation activities.

All of the above issues need to be considered when developing a contract strategy.

**Types of Contract Available and Their Applicability to Sewer Rehabilitation Works**

**General**

In developing a contract, consideration needs to be given to:

- The contract arrangement
- The scope and duration of the works
- The relationships that will exist between the various parties

**Contract Arrangement**

There are a number of contract arrangements that can be used for sewer rehabilitation works. These include:

- Traditional scheduled rate contract
- Design build
- Construction management
- Alliance.

Each of these contract arrangements have advantages and disadvantages, with there being tradeoffs between owner’s risk, contractor’s risk, contractor’s incentive and owner’s flexibility as outlined in Figure 3.
Figure 3 - Relative Merits of Various Contract Types

**Traditional Scheduled Rate Contract**
The Client will arrange for the works to be designed and schedule of quantities prepared, which tenderers price. The contractor is then paid on the actual amount of work completed under each scheduled item.

Advantages

1. Straight for tenderers to price
2. Changes in scope after the award of the contract can be valued easily

Disadvantages

1. The client has to undertake a lot of work upfront to determine quantities
2. The actual quantity of work completed may be significantly different to that assumed when the tender schedule was prepared.

**Design Build**

The underlying principle behind a Design-Build project is that the owner contracts with a single organisation (generally a contractor), which is responsible for both the design and construction of the entire project. This allows for an integration of design and construction requirements with the objective of optimising the project delivery costs. It could generally be termed as a fixed price contract.

Advantages

1. Project completion can be faster.
2. Overall project cost can be lower, provided that there is a healthy competition among the bidders.
3. Source detection, design and rehabilitation can be done sequentially and without delay.
4. Tenderers are free to offer various design options, which can drive innovation.

Disadvantages

1. The Client has less control over the design.
2. Tenderers may offer different design options, this may diminish efforts to standardise rehabilitation processes.
3. Tenderers may be reluctant to use new innovative rehabilitation processes as they carry the risk of the design. They may prefer to stick to the processes that they are familiar with.
4. Changes in the scope of works after the award of the contract may have significant cost implications.

Construction Management

Construction Management is a flexible process that covers a wide variety of Owner-Project Manager-Contractor relationships. Generally, the owner contracts with a professional project management firm or contractor, which in turn administers and manages both the design and construction of the project.

Advantages

1. The client can retain control over the decision making process of the analysis and design phase of the project.
2. A strong team is developed by combining the project management skills of the management contractor with the specialist skills rehabilitation contractor.
3. Quality issues can be easily enforced on the contractor through the consultant.

Disadvantages

1. Overall cost could be slightly higher than the Design – Build projects.

Alliancing

Alliancing is a project delivery approach most recently applied to new infrastructure in the water industry in Australia and to a lesser degree in New Zealand. Under the Alliance Contract Method, the principal (owner) prepares a project definition study, identifies the project goals and also develops evaluation criteria.

The principal then proceeds through a multi stage short listing process of selecting an Alliance Consortium, including the construction contractor, based on a wide range of factors excluding the price.

Under project alliancing, risks and responsibilities are shared and managed collectively, rather than allocated to individual parties. Performance targets, including the targeted cost of the
project (target outturn cost/TOC), are developed and agreed by the participants during the project development phase. Once the performance targets have been agreed, the alliance participants assume collective ownership of the risks and responsibilities associated with delivery of the project, with equitable sharing (in pre-agreed ratios) of the ‘pain’ or ‘gain’ depending on how project outcomes compare with pre arranged targets.

The contract is based on an open book basis. Independent auditing of project accounts is usually carried out to ensure probity.

Advantages

1. Contractors have an ownership on the project. Selection criteria does not include the price, but is based on other attributes.
2. Overall cost and time for completion could be lowered for large complex projects.
3. All parties should be conscious of the agreed KPIs as gain/pain is determined based on actual outcomes.
4. Incentives are in place for the introduction of new technologies and for the development of relevant personnel.
5. Adjustment of works within an annual budget is more readily achieved.
6. The day to day management of the project is done by an integrated project team to which the members are assigned strictly on a “best-for-project” basis, without regard to which company employs them.

Disadvantages

1. The overhead costs of an Alliance Team could be very high. This process is more appropriate for a very large project.
2. This option is more appropriate when the nature of the work is not clear, and the design is complex.
3. A new culture is required to be developed among the contractors, consultants and council engineers.
4. Proven experiences are currently available only for large projects. Experience with wastewater rehabilitation works is limited.

Contract Scope and Duration

Advantages of larger scale contracts are:

- Cost efficiencies through economies of scale;
- They can attract larger contractors with more experience and access to innovation; and
- Fewer interfaces between contractors to be managed.

Disadvantages of larger scale contracts are:

- Increased significance of poor performance by contractors;
- Reduced expertise in specialised areas; and
- Impact on the market which may reduce competition and result in market capture.
There are a number of options for packaging sewer rehabilitation works. These include:

- Separate contracts for source detection, design and rehabilitation.
- Source detection and rehabilitation works completed under one contract. With design and supervision works being completed by a separate consultant.
- Source detection, rehabilitation and design works being completed under one contract, using the either the design build or alliance arrangements discussed earlier.

**Separate contracts for source detection, design and rehabilitation**

**Advantages**

1. The work scope for the rehabilitation phase can be defined reasonably accurately before tendering.
2. The cost of works can be reasonably accurately estimated (i.e. through an accurate engineer’s estimate).
3. The potential for variations is minimised.

**Disadvantages**

1. The carry over of information from earlier to later phases generates an immense quantity of paper work.
2. CCTV work carried out during the Source Detection stage is later duplicated by the rehabilitation contractor.
3. Residents are inconvenienced by contractors visiting over an extended period of time.

**Source detection and rehabilitation completed under one contract**

**Advantages**

1. Considerably less paperwork.
2. Reduced duplication of work (e.g. CCTV, condition assessments and contract supervision).
3. Same contractor, therefore reduced communication breakdown.
4. Source Detection data will always be up to date.
5. Potential reduction in administration and contractor costs.
6. Less disruption to the public.
7. Likely to reduce the total costs involved.

**Disadvantages**

1. Without the advantage of source detection data being available, work scope could be difficult to accurately define.
2. Work method selection will need to be more carefully defined and specified. This could be more difficult to achieve without source detection data available.
3. There could be an increased likelihood of unforeseen claims resulting.
4. Accurate programming, and allocation of resources, could be more difficult to achieve.
5. The engineer’s estimate would be less certain.
6. There could be a risk of delays to the contract while design assessments are being made.

**Duration of Contracts**
Consideration should also be given to the duration of the contract.

Advantages of longer duration contracts are:

- Increased expertise through stable workforce and management team;
- Time to implement new practices and innovation; and
- Less cost of tendering.

Disadvantages are:

- Increased significance of poor performance by contractors;
- The relationship between the contractor and client may become “stale”;
- Less opportunity for other contractors, may result in smaller contractor pool; and
- Less opportunity to improve specifications. Shortcomings in specification will have a longer impact.

Some of these disadvantages can be overcome by specifying a contract period that has a right of renewal clause that can be enacted if performance is satisfactory. At the renewal stage there is the opportunity to negotiate changes to the contract specification.

**Partnering Relationships**
Active contract management is required to ensure that the customer’s needs are understood by the contractor and are being met. Performance contracts, and other forms of contract, fail when the customer does not maintain an active involvement in the contact relationship and the assessment of ongoing performance. One way that this can be achieved is through the development of a partnering relationship.

Partnering is a relationship between companies that is intended to promote best value and performance for the client by integrated planning and constant review. The intention is that the joint working and improved co-operation stemming from the Partnering Relationship will increase efficiency by reducing disputes and costs and the amount of time it takes to complete work, thereby resulting in an increase in profits. The concept of good faith and fair dealing between the parties is central and parties resolve to act reasonably and fairly.

Partnering relationships may take the form of:

- an informal expression of intent between two parties to behave in accordance with a set of agreed principles.
- binding or non-binding partnering agreements.
- an integrated relationship and works contract.

Advantages of partnering are:
Greater efficiency and cost effectiveness.
Increased opportunity for innovation.
Continuous improvement of quality services.
Less disputes.

The disadvantages of partnering are:

- Increased time spent on meetings and collaboration.
- The client may become focused solely on the partnering relationship work at the expense of considering other opportunities.
- It may conflict with commercial realities of contracting.

Case Studies

North Shore City Council
North Shore City Council owns and operates a separated wastewater collection and treatment system serving a population of some 180,000. This population is envisaged to grow to 300,000 over the next 50 years. Increasing population growth and deterioration of the existing wastewater collection system has resulted in regular overflows of sewage during periods of wet weather. North Shore City Council has come under increasing community pressure to eliminate these overflow events and in 1998 commissioned Project CARE, an optimised citywide solution for reducing overflows and beach pollution. The wastewater improvements have involved treatment plant upgrades, sewer amplification works; pump station upgrades, provision of wastewater storage tanks and the rehabilitation of sewers to reduce infiltration and inflow (I/I).

North Shore City Council are typically completing $5 - $6 million worth of wastewater investigation and rehabilitation works per annum to reduce rainwater entering through defects in the sewer pipe network and the inflow due to low gully traps and illegal connections etc.

Previously, the source detection and the analysis/design works were carried out under one contract and the rehabilitation works were done under another. Contracts typically covered 4km of pipe and 400 properties. As a consequence of the investigation, design and rehabilitation being carried out sequentially it used to take 2 to 3 years to complete an area.

Since 2005 source detection and rehabilitation works have been combined together. Contracts typically have a value between $1.5 to $2 million. The advantages obtained from the combined contracts are:

- reduced inconvenience to the property owners
- overall rehabilitation process expedited. Areas are now completed with 9 months.
- double handling of activities, such as CCTV inspections, has been eliminated.
- A slight reduction in costs has been achieved.

Whilst the combining of the source detection and rehabilitation brought improvements it still had the following shortcomings:
• There was uncertainty for Contractor’s as they had to tender for contracts and they there was doubt as to whether they would have continuity of work.
• There were significant costs in tendering each contract.
• The uncertainty brought about by the short-term contracts acted as disincentive for contractors to develop innovative approaches.
• The contracts tended to focus on the low level outcomes (e.g. completing lining works), with little emphasis on higher level objectives such as customer satisfaction.

The Council is therefore considering to change their contract strategies and use a model that combines features of Construction Management and Alliancing. It is hoped that this model will create a partnering environment and a long term engagement. The new contract strategy is expected to be implemented in the second half of 2008.

Key features of the new contract strategy include:
1. Owner – Project Manager – Construction Contractor relationship as in the Construction Management model and utilising a partnership approach. The Council – Professional Services Provider – Contractor arrangement, which is being practiced at present, will be continued.
2. Early contractor involvement in the design, construction and commissioning processes is seen as beneficial.
3. A suitable package costing approximately $2-3 million, which should be a representative sample of the rehabilitation process will be used for a competitive and interactive tendering process which should be held every 3-4 years. Best contractors and the prices will be selected after an evaluation process which includes a minimum of three contractors. Select and appoint two contractors for the investigation and rehabilitation contracts.
4. Negotiate with the selected contractors and fix the rates for three years.
5. Open book method will be used when any work is not defined.
6. Innovations will be encouraged.
7. Suitable KPIs are to be introduced. (Time, Quality, Cost, Customer Relations, Innovations).
8. Works packages will be distributed equitably among both contractors. However, when the work is in progress, additional works are to be allocated to the contractors based on their performance.

**Metrowater Ltd**

Metrowater owns and operates the reticulated wastewater system in Auckland City (excluding the trunk wastewater system owned by Watercare Services), which covers an area of 153 square kilometres. As it is not practical or cost effective to inspect the entire network on a regular basis Metrowater has adopted a risk-based approach.

Each pipe in the network is allocated a criticality ranging from A (most critical) to E (not critical). Criticality is assigned depending on a range of factors including the effect of an overflow on the environment, the potential damage caused by failure to other structures in close proximity, the
interruption to other activities (traffic and pedestrians) and the interruption to other services that an open-trench repair might cause.

The critical A, B & C sewers, representing approximately 20% of the network, are inspected on a cyclical basis. Approximately 15% of pipes inspected will be recommended for remedial action, ranging from complete replacement/relining, to spot repairs or maintenance. Metrowater’s budget for completing these remedial works is in the order of $3-$4mil per annum.

Metrowater have appointed a panel of five contractors to undertake their capital works programme. This programme includes potable water and wastewater activities, including new constructions and is not limited to sewer rehabilitation works. Panel members then bid for contracts to carry out particular types of work. These packages are typically worth several million dollars and cover several years work.

Metrowater selected the panel based on the contractor’s ability to manage complex projects and to deliver higher level outcomes related to customer satisfaction, the environment and safety. Metrowater have worked with the panel contractors to develop relationships and to communicate their vision and values.

In late 2007 Metrowater let a contract for wastewater renewal works. It is envisaged, at least in the early years, that majority of the contract works will involve trenchless sewer rehabilitation, but there will also be some replacement by traditional opencut methods. The key components of this contract are:

- The contract period is one plus one plus one, with a maximum term of three years.
- The contract is a relationship contract. NEC framework was used as the form of contract as this form of contract has been specifically written for relationship contracts.
- Metrowater considered using an alliance type contract, but felt that the contract was too small to warrant the additional management structures required.
- The contract was awarded based on a combination of price and non-price attributes.
- Contract payment will initially be based on a schedule of rates, but will move to open book with pain share/gain share provisions, once relationships have been established and true costs become apparent.
- Metrowater require that the contractor be able to provide a “toolbox” of rehabilitation options, this involves being able to provide, for example CIPP, spiral and reverting linings. Of the five panel contractors only two had in-house lining capabilities and none were able to supply the full range required by Metrowater in-house. Metrowater acknowledge that as a result they may pay a slight premium, but they feel that this is offset by the value obtained in being able to use the most appropriate technology for each particular circumstance.
- The contractor is responsible for selecting the most appropriate technology for each particular circumstance, with input for Metrowater. The contractor is also responsible for completing routine designs.
Summary
As the use of sewer rehabilitation has increased, so has the size of the contracts being undertaken. Whereas at one time sewer rehabilitation contracts covered only small one off repair jobs, multimillion dollar contracts are now common place.

Clients have also come to recognize that they require more than the mere delivery of the project. They are seeking value for money and are striving for higher level outcomes related to customer satisfaction, the environment and safety and they want to work with contractors that share their vision and values.

This has brought about a move toward longer term, partnering type contracts with the focus on developing sustainable relationships between the client, contract and consultants.

Key aspects of these types of contracts include:

- Long term contracts, e.g. three years or more.
- Multimillion dollar values.
- More transparency in costs, with an open book approach often being used
- Key performance indicators being introduced for items such as time, quality, cost, customer relations, innovations.
- Early involvement f the contractor in programme development and design.

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