

Lessons learned from one of New Zealand's most challenging civil engineering projects: rebuilding the earthquake damaged pipes, roads, bridges and retaining walls in the city of Christchurch 2011 - 2016.

Christchurch rebuild, New Zealand: alliancing with a difference

Story: What is SCIRT?

Theme: The SCIRT Model

A paper published in the Management, Procurement and Law Journal Volume 168 Issue MP3 which describes a different form of alliancing.

This document has been provided as an example of a tool that might be useful for other organisations undertaking complex disaster recovery or infrastructure rebuild programmes.

For more information about this document, visit www.scirtlearninglegacy.org.nz



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Christchurch rebuild, New Zealand: alliancing with a difference

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The alliance contract is a flexible form of partnering between organisations, and, to date, alliances for the delivery of infrastructure projects in the construction industry have typically been a partnership between one owner participant and one or more non-owner participants, including a design consultancy. The Christchurch infrastructure rebuild team in New Zealand, set up to deliver the reconstruction of the earthquake-damaged infrastructure, is a multi-client, multi-contractor programme alliance with professional services procured from consultancies amalgamated into four teams that are not participants in the alliance model. This multi-client, multi-contractor alliance is different from more commonly used ‘classes’ of alliances in the procurement of design services. In particular, the introduction of a delivery performance score provides price tension between the non-owner participants and ensures value for money for the client organisations, while the gain/pain incentive ensures both collaboration across the delivery teams and independent target outturn cost development with no direct price influence from the delivery teams.

1. Introduction

Since September 2010, Christchurch in New Zealand has recorded 442 earthquakes of magnitude 4.0 or higher in and around the region, with the largest quake measuring 7.4 on the Richter scale (Nicholls, 2013). During the 22 February 2011 earthquake, 185 lives were lost in Christchurch, as buildings collapsed along with thousands of homes being extensively damaged.

The city also suffered significant damage to its vital infrastructure, while many inner-city businesses were disrupted for a prolonged period because the central business district was cordoned off to allow the demolition of critically damaged buildings to proceed. The land damage suffered in Christchurch was unique because nowhere else in the world had liquefaction been repeatedly experienced across such a great expanse. The total cost of the damage is estimated to be around 10% of New Zealand’s gross domestic product (Parker and Steenkamp, 2012), and the Christchurch earthquake is ranked as one of the most expensive natural disasters suffered by New Zealand (Doherty, 2011).

Immediately following the September 2010 earthquake, the local city council established a programme of works to repair the broken infrastructure. This programme was referred to as the Infrastructure Rebuild Management Office (IRMO). In effect, the city was subdivided into four geographical areas called ‘pods’, each being allocated to a reputable national construction company, which in turn engaged a design consultant to provide the necessary professional services. The companies worked on a cost reimbursement payment model, and provided an instant response for what in hindsight could be described as a modest amount of earthquake damage.

The extent of the damage following the February 2011 earthquake was far greater than that experienced 4 months earlier, which meant that a different procurement model had to be implemented to maximise productivity by sharing knowledge and resources. In addition to being able to incorporate a substantial portion of IRMO projects either in construction or well advanced in the design, the new model had to manage effectively the high risk associated with the unknown scope of work involved in disaster recovery projects, the pressures on schedule performance, the coordination of resources and the need to have access to early contractor involvement (ECI) during the detailed design phase to reduce risk by providing constructability input (Song *et al.*, 2006). This made alliancing an ideal procurement model (Department of Treasury and Finance, 2006; Eriksson, 2010), and the Stronger Christchurch Infrastructure Rebuild Team (SCIRT) alliance was formed to deliver the programme of works for the rebuilding of Christchurch’s horizontal infrastructure. SCIRT became responsible for repairing the water supply reticulation and reservoirs, waste water reticulation and pump stations, storm water reticulation and pump stations, and road networks for both the local council and the national roads authority, including bridge repairs and retaining walls.

Over the past decade there have been a number of studies on alliance contracting, which is a unique form of project delivery in which two or more organisations work collaboratively through sharing responsibilities and reducing risk (Chen *et al.*, 2012; Eriksson, 2010). The alliance form of contracting is a flexible procurement model, and to date there have been various ‘classes’ of alliance contracts used, as follows.

- Single target outturn cost (TOC) alliance – in which the selection of tenderers is based on one tender that is normally based on non-cost attributes only.
- Two TOC or competitive alliance – in this form of alliance there is a desire to focus on the cost of the alliance by requiring a competitive price (TOC) to be part of the selection process.
- Pure alliance – this form of alliance includes agreed decision-making between principals with no deadlock-breaking mechanisms, no mechanism to distribute liability between partners and the sharing of all project risks.
- Hybrid alliance – this form of alliance includes deadlock mechanisms, capping the government contribution, not sharing all the risks by allocating risks to one party, excluding negligence and cost of rework as a result of an error by the non-owner participants (NOPs).
- Programme alliance – this form of alliance involves the subdividing of the forward workload into a number of projects and then selecting one contractor to deliver all the projects (Department of Treasury and Finance, 2006).

SCIRT has been developed as a multi-client, multi-contractor programme alliance to deliver the large number of smaller projects that make up the programme of works associated with the rebuild. Here, the commercial framework of the SCIRT alliance will be highlighted. The framework is different from other alliance set-ups in that it relies on collaboration and price tension between co-operating companies. How the differences impact on the operations is discussed.

2. Methods

A qualitative method of data analysis has been used for this single case study. The form of alliance developed for the delivery of the infrastructure rebuild has some unique features, and according to Yin (2003) it is acceptable for a single case study. Data have been collected through the studying of the alliance agreement and the most recent versions of the management plans. Certain clarifications on the interpretation of the commercial framework as well as the history of the formation of the alliance have been sought by interviewing members of the management and commercial teams within the alliance. The results from the data collection were compared with the available literature on alliance contracts, and the identified differences are discussed in this paper.

3. The SCIRT alliance model

The SCIRT alliance model has been developed to ensure value for money for the client organisations, which is done by ensuring there is both co-operation and competitive tension between the contracted construction companies.

3.1 Alliance structure

The alliance has been tasked with assessing, managing, coordinating, prioritising, designing, estimating and delivering the various work packages associated with the rebuild of the Christchurch infrastructure programme. The management team responsible for the above functions is referred to as the integrated

services team (IST). The SCIRT alliance structure is shown in Figure 1. The alliance was created between the central government, the local government and the New Zealand transport authority as the owner participants and five of the major construction companies in the New Zealand civil construction industry as the NOPs, also called the delivery teams. The NOPs were the same companies that were involved in the first rebuild programme (IRMO). IRMO had consisted of four companies, but one of these was a joint venture between two major construction companies, which in SCIRT became individual participants. These five construction companies formed a joint venture that then entered into an alliance with the owner participants. SCIRT is directed by a board, in which a senior executive member of each participating organisation is represented. The function of the alliance board is to oversee the rebuild programme, and it oversees the various services required to deliver the programme, while the daily management has been delegated to the management team embedded in the IST. In order to prevent price fixing and to ensure fair trade practices are being followed as well as to ensure price tension between the delivery teams, the setting of the TOC for each project is done by a dedicated estimating team in the IST that works independently of the delivery teams and is verified by an independent estimator.

3.2 Commercial model

The alliance services are progressively reimbursed across several categories within the alliance structure as follows. The actual cost to deliver each project is fully reimbursable with a pain/gain incentive also known as a three-limb payment structure (Table 1 and Figure 2) (Queensland Government Chief Procurement Office, 2008). Each project will have a TOC that is the estimated actual cost to deliver the project (limb 1). The limb 2 component for each project is a fixed amount calculated as an agreed percentage to compensate for corporate overheads and assumed profit on the TOC value. The limb 2 component for each project is a percentage mark-up, and thus changes with revisions of the TOC value through approved work scope changes. Limb 3 is the aggregation of all individual project TOC over- and underruns across the whole programme of works. At the conclusion of the programme, a 50% share is taken by the owner participants. The remainder is distributed among the delivery teams, based on the share of completed TOCs assigned to each individual delivery team expressed as a percentage of the programme TOC.

The delivery teams also provide a significant proportion of the resources and services required for the IST to function, and are reimbursed for actual costs as well as a limb 2 margin (see Table 1) on these costs. The limb 2 margin for the services provided by the delivery teams to the IST, calculation does not apply to any goods and services provided by the owner participants, which only get reimbursed for actual costs (limb 1).

Each delivery team's off-site overhead percentage is set annually, based on the expected turnover for each delivery team for the following financial year. This includes the costs for staff required to run the business effectively (i.e. safety, quality and environmental management, commercial and communications teams), excluding

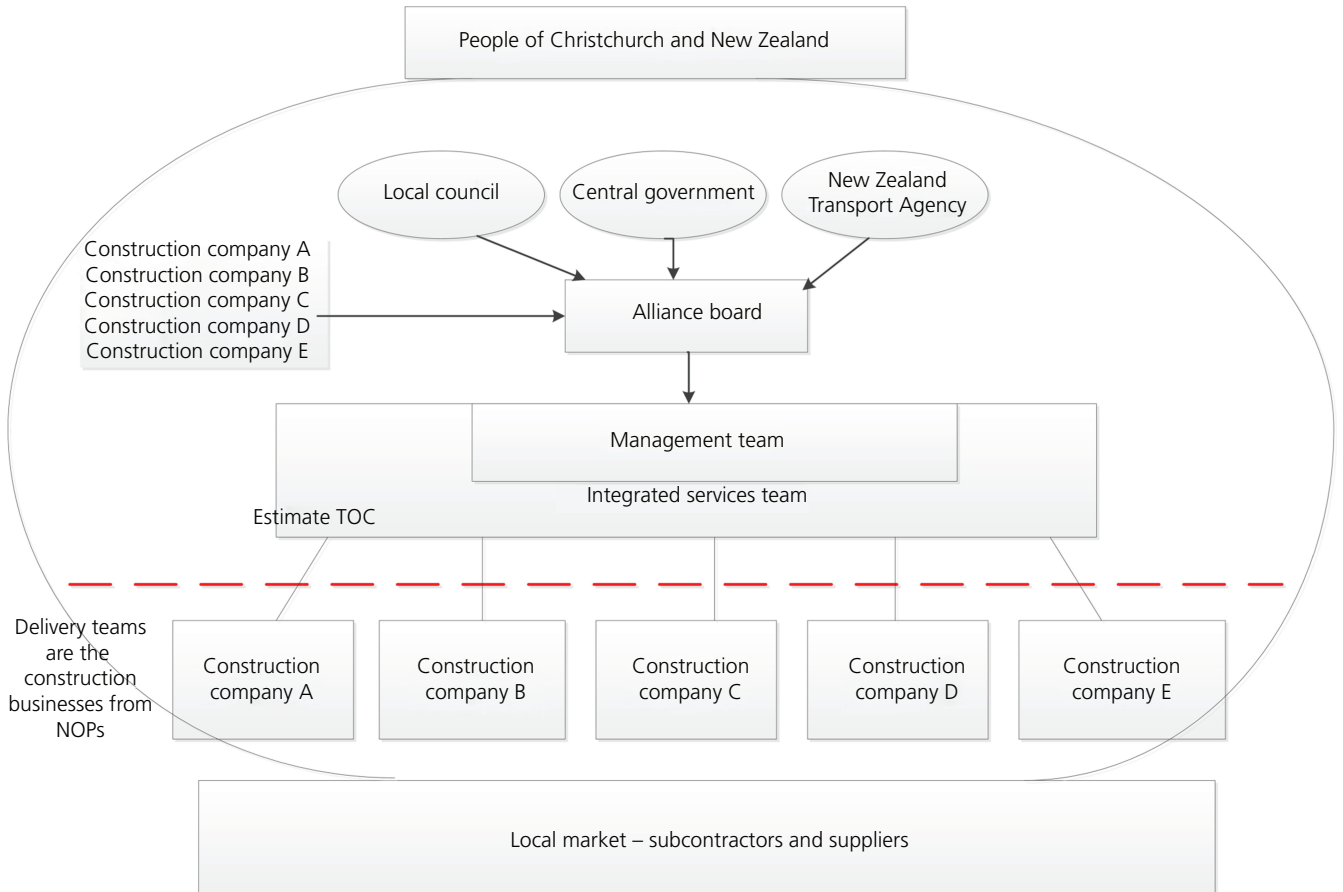


Figure 1. SCIRT alliance structure

any project-specific staff such as supervision and project managers. Reimbursement for the cost of the off-site overheads is also paid under a three-limb commercial framework.

Competitive tension between the delivery teams has been built into the alliance model. The actual cost per project of each delivery team is compared with the respective TOC, and their performance is also

measured against non-cost key result areas (KRAs). This serves to benchmark each delivery team against the other teams. During the programme, projects are allocated based on total performance; those delivery teams that perform best are allocated a greater share of future work than those that perform poorly. This has been devised to ensure that the owner participants get value for money. Earned value analysis is undertaken monthly, to provide a measure of the actual

Target	TOC	TOC established by the SCIRT estimating team and verified by the independent estimator
Payment	Limb 1	Net actual cost
	Limb 2	Margin, agreed percentage on the TOC, also the agreed percentage of cost incurred on services plus delivered to the IST
	Limb 3	If limb 1 is larger than TOC → cost overrun (pain); otherwise cost underrun (gain) <ul style="list-style-type: none"> ■ If pain: NOPs will pay 50% × pain less a bonus to a maximum of 10% based on key result area (KRA) performance ■ If gain: NOPs retain 50% × gain plus a bonus to a maximum of 10% based on KRA performance ■ Final distribution: in proportion to the NOPs' allocation of TOCs completed as a percentage of the overall programme

Table 1. The three-limb payment in detail

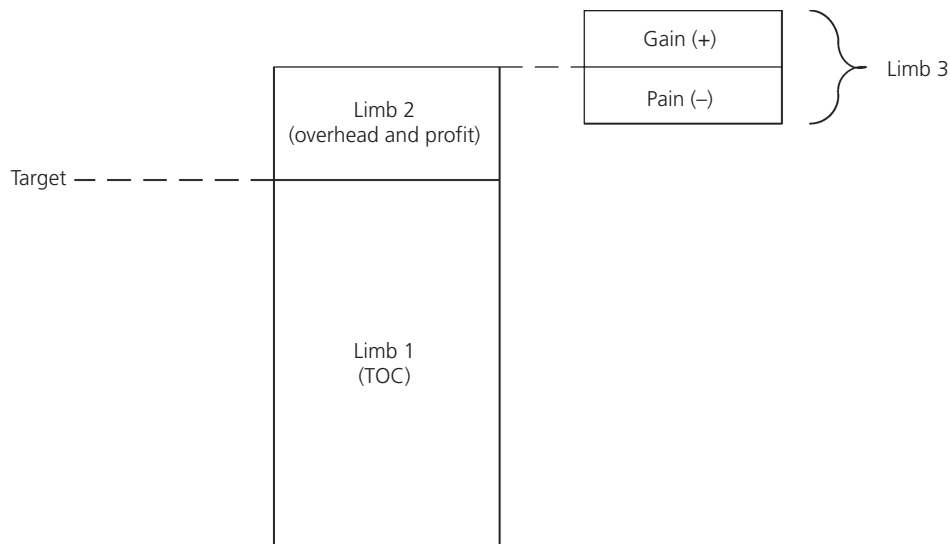


Figure 2. Limbs 1, 2 and 3 graphically explained

cost and schedule performance of each project, but importantly also serves as an early warning tool for cost overruns and delays.

3.3 Project life cycle

The project life cycle in SCIRT is a linear process with a nine-point 'gate' structure (shown in Figure 3), starting with asset assessment to determine the extent of damage to the asset. If the damage is found to be earthquake related, a project is defined, and both a design team and a delivery team are appointed to work towards achieving the most cost-effective solution in terms of the whole-of-life cost. Following the completion of the detailed design, an independent and first-principles TOC estimate is undertaken within the IST and verified independently through parallel pricing done by a client-appointed independent estimator. Final allocation for construction by a delivery team follows TOC completion through a process that is described in more detail in Section 3.9.

3.4 Design services

Four design teams have been established in the IST offices. These teams are a combination of multiple local design consultancy companies in Christchurch that were selected through a tender process. In the SCIRT alliance model, design services for each project are procured from one of the four design teams in accordance with the procurement management plan, which outlines a competitive process based on the cost performance and abilities of each design team. The design cost is reimbursed on a time and materials basis.

SCIRT encourages innovation in design, and it is allowed to seek departure from the client's design standards and specifications through what is referred to as the scope and standards committee (SSC). This committee is made up of the various asset owners from the owner participants and representatives from the central government and the New Zealand transport authority. In order to get approval for a departure during design, a particular lead designer submits a paper with a recommendation and a cost estimate, provided by the estimating team, to the SSC for consideration.

Once the design for an individual project is completed, the designers produce a full set of 'for construction' design documentation, including drawings, specifications, a risk register and a bill of quantities.

3.5 Early contractor involvement

Alliance contracting provides an opportunity for construction input during the detailed design phase (Figure 4) through early contractor involvement (ECI) (Queensland Government Chief Procurement Office, 2008). The purpose of ECI in the SCIRT alliance is for the design team and the dedicated ECI manager and project manager from the delivery team to work collaboratively to ensure that constructability opportunities, issues and risks are identified and taken into consideration throughout the design phase of each project. Regular interface meetings are held during the design phases, including constructability workshops and risk workshops. A particular delivery team's ECI manager has the responsibility to lead

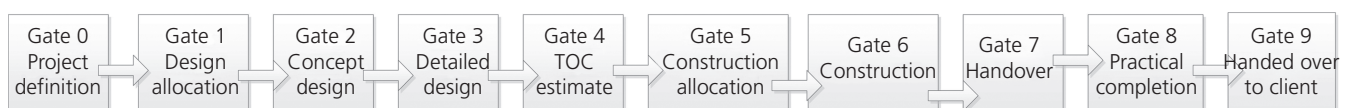


Figure 3. Project 'gate' structure

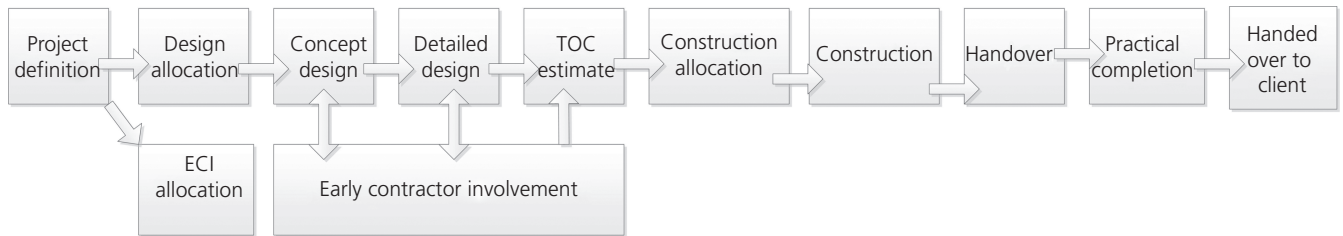


Figure 4. Early contractor involvement

the interface by chairing the meeting and ensuring that the milestone dates are met (SCIRT, 2012).

Once the detailed design is completed, the delivery team receives a copy of the ‘for construction’ documentation to review. On every project the delivery team is responsible for confirming that the quantities, as derived by the designers, accurately reflect the physical works as described by the project documentation.

A further objective of ECI in the SCIRT alliance is to inform the development of a TOC for each project. The ECI team is required to provide the estimating team (within the IST) with a comprehensive set of documentation detailing the methodology, schedule (in bar chart format) and traffic management staging plans, temporary works, and an inspection and test plan. The team also has the opportunity to review the risk register to ensure that the estimator is well informed to develop the TOC.

Immediately prior to estimating a TOC, a handover meeting is scheduled between the ECI manager and the estimator, to discuss and agree on the methodology required to construct the project. The key protocol of the handover meeting is that the meeting is open for discussions around methodology, schedule and risk, but any discussion regarding cost is forbidden. This is to prevent price fixing and to ensure that the independence of the TOC is maintained. The ECI teams do not have access to the priced bill of quantities until the TOC has been signed off and allocated to the delivery team for construction. This approach satisfies the requirements as set out by the commerce commission to ensure fair trade practices are being followed and that no price fixing occurs.

3.6 Risk

By selecting an alliance model as the procurement option for coordinating and managing the city’s rebuild, the owner participants have expressed their willingness to share the risks associated with the programme of works. Risk in the rebuild has been divided into two levels: programme risk and project risk. An example of a programme risk is the risk of another earthquake causing damage to the newly repaired infrastructure. At the start of the alliance in 2011, the risk of another big earthquake occurring was very high, but over time the geological stresses beneath Christchurch have reduced; consequently, the risk of another major earthquake has also reduced. Another example of a programme risk is a change in a design that constitutes an adjustment to the original TOC.

The next level of risk is referred to as project risk: this typically cover risks specific to an individual project such as that of trench collapse due to poor ground conditions. Project risk is managed with a live project risk register that is created in the concept design, with input from the delivery team, designers, stakeholder liaison and traffic management staff. The risk register is constantly updated throughout the life of the project. During the preparation of a TOC, each risk item is individually assessed and evaluated by means of a first-principles approach. Once a TOC has been completed, the resultant provision for risk is incorporated into the TOC. The delivery teams are responsible for the risk on any quantity discrepancies in the design documentation provided by the designers along with managing the risk during the delivery phase.

3.7 TOC for each project

After the detailed design is completed for an individual project, the TOC is developed. The TOC is derived using first principles to estimate the cost to construct the project as designed and documented (limb 1). It includes all the direct costs, based on agreed blended labour and plant rates from the delivery teams, and on market quotes for materials. The used blended rates are set by an independent estimator who uses open-book data from each company to derive an average rate for each plant and labour resource used in the estimate build-up. This open-book information remains confidential to the independent estimator. These rates are reviewed 6-monthly, and can change to allow for changing salary costs of the companies. The TOC also includes on-site indirect cost items (supervision and site establishment) as well as an allowance for risk.

Normally, a benefit of an alliance is the reduction in variations and processing costs of variations or work scope changes (Department of Treasury and Finance, 2006). However, under this alliance model the TOC can be adjusted for scope amendments that are client instructed or a result of design changes. This is necessary as the TOC over or underrun influences a company’s future workload. Variations in quantities for items on the bill of quantities used to derive the TOC value do not constitute a TOC adjustment.

3.8 Monthly reporting

Each delivery team uses its own company business systems, such as financial software packages and cost-reporting structures, to capture the information and to report on the performance of each project. A monthly project progress claim on a life-to-date basis is submitted by each delivery team for the limb 1 cost of each project,

accompanied by a report with the forecast cost to complete per project (Smith, 2013).

One of the key requirements of the alliance agreement is to report monthly on the earned value for each project. The earned value is an internationally recognised project management tool that provides an accurate measure of cost and time performance compared with the planned values (Kim, 2009) (i.e. the TOC and baseline schedule as developed by the delivery team). The earned value is obtained by calculating the cost performance index and the schedule performance index for each project.

The IST collates all the information from each delivery team into an overall reporting structure, to track and report on the performance of the overall programme as well as forming a basis on which to calculate the financial performance of each delivery team for allocation of future work.

3.9 Project allocation

One of the key objectives of the SCIRT alliance agreement is to reward good performance through future work allocation, and this applies to both the design and delivery teams.

3.9.1 Design team allocation

Design allocation is based on the performance capabilities of each design team as well as the knowledge of a particular asset (e.g. waste water design capability or structures design capability within each design team) and the availability of design resources within each design team.

Further to this, the following items are also considered for design allocation by the design manager.

- Quality – the quality of a concept design and detailed design reports, measured based on a modified version of the performance assessment by evaluation system as developed by the New Zealand transport authority (Topham, 2012), and also the value of design work scope changes.
- Cost – the performance against the TOC: the average number of design hours to design NZ\$1 million of work and the value of innovation captured and assessed on the value register.
- Timeliness – the delivery of reports and designs against target dates: the average time to deliver NZ\$1 million of design.

3.9.2 Delivery team allocation

The default position at the start of the programme was to split the work allocation equally by TOC value between the delivery teams: with five teams the default position was to allocate 20% of the work by TOC value per delivery team.

The allocation of work is a two-step process, taking the following into account.

- Part A: the influence of delivery team performance against KRAs and cost performance against TOC for each project.

- Part B: the influence of the delivery team capacity and other programme context.

Although the delivery team performance model is formal, it provides flexibility to allow an overall ‘best for programme’ decision to be made in allocating a project: for instance, if one team is overly committed and cannot deliver a project on the scheduled time, the project might be allocated to another team that has resources available.

3.9.2.1 PART A

Five non-cost KRAs have been identified in the alliance agreement, and a set of key performance indicators (KPIs) has been developed for each of the KRAs to measure the performance of each team by calculating a delivery performance score (DPS) for each delivery team on a 6-month weighted rolling average as follows (Table 2).

The cost performance of each delivery team is measured for allocated projects under construction and in handover as the aggregated earned value per delivery team/cost to date, and a combined performance score is calculated. The overall performance score is calculated, and each delivery team’s standard deviation is calculated to determine the change in the target work-share split.

4. Discussion

Due to the complexities and high risk associated with disaster recovery projects, an alliance was chosen as the procurement model (Department of Treasury and Finance, 2006), and set up between central and local government in partnership with five of New Zealand’s major construction companies to coordinate resources and manage the rebuild programme. The design services for each project are being procured from contracted design consultants who are required to reside full time in the IST offices, reporting to the management team within the IST. In this particular form of alliancing, due to the complexity of the commercial model and the number of companies involved, it was decided from the start that the design consultants would not become formal participants of the alliance, and therefore do not share in the gain/pain (limb 3) as in the more conventional alliances (Department of Treasury and Finance, 2006). The design teams work on cost reimbursable payment contracts.

During the design phase the projects are allocated on a preliminary basis to a delivery team, which is then required to provide ECI into the design, providing constructability input to ensure the design is optimised to reduce risk, and project cost, and enable improved performance against the schedule through collaboration (Gransberg, 2013; Jergeas and Van der Put, 2001; Osipova and Eriksson, 2011). This input into the design provides the delivery team with the only option to have an influence on the setting of the TOC, which otherwise would be set independently from the delivery teams. The objective of this ECI process in SCIRT is thus to inform the independent TOC development, once the design is completed, and to ensure the methodology used to develop the TOC is safe and constructible while all construction risks have been identified

KRA (% weighting)	KPI (% weighting)
Safety (25)	Measure of safety engagement/awareness (12·5) Safety initiatives/action (7·5) Protection of utility services (5)
Value (30)	Productivity (12) Construction quality (9) Innovations (9)
Our team (15)	Alignment and involvement of the team (7·5) Well-being initiatives (3·75) Developing a skilled workforce (3·75)
Customer satisfaction (20)	Community and stakeholder satisfaction with the product (8) Community and stakeholder satisfaction with communication (8) Planning and execution of communication strategies (4)
Environment (10)	Construction culture and incident/hazard reports (6) Waste minimisation (4)

Table 2. Non-cost KRAs and accompanying KPIs

(SCIRT, 2012). The way that ECI is set up is similar to a conventional ECI procurement process in which the contract is formally awarded for delivery at the completion of detailed design and price development (Queensland Government Chief Procurement Office, 2008). The success of this alliance therefore relies heavily on trust and commitment between all the parties involved.

In alignment with the SCIRT alliance agreement, good performance is rewarded through future work allocation (SCIRT, 2011); this was done with the introduction of the DPS. The DPS is the centre of the commercial model, and future work allocation depends on the DPS performance of individual delivery teams. The best-performing team is, as a result of more work being allocated, able to grow its business successfully and employ more staff. The DPS has been designed to ensure the best-performing team in all areas of the programme (i.e. safety, value, quality, environmental, cost and stakeholder liaison) is rewarded with future work allocation, but also drives innovation by introducing price tension in a collaborative environment (Teece, 1992). This reduces the reputational risk of the alliance by ensuring that a non-performing delivery team is not exposing the alliance to poor work performance, and also ensures value for money for the client organisations. The pain/gain calculation (limb 3) is shared in relation to the amount of projects performed as a percentage of the programme of works, which is the same as with other forms of alliance contracts (Department of Treasury and Finance, 2006). However, the SCIRT alliance agreement rewards good delivery performance through work allocation, which in turn will result in a bigger gain/pain share for the best-performing team. Therefore, the DPS is creating price tension between the delivery teams while the limb 3 gain/pain share incentive ensures collaboration between the alliance participants throughout the project life cycle (Love *et al.*, 2011). This part of the alliance model has the same goal as other alliances that were developed to avoid disputes, and improves

co-operation between all parties in the construction industry, which has long been criticised for its lack of co-operation (Davis and Love, 2011).

In an alliance, the usual way of setting rates for plant and labour is by open book. However, as multiple contractors are involved in SCIRT, blended rates were created to cope with the differences between plant and labour costs of the delivery teams. The development of the TOC is done within the IST, independently from the delivery teams, and is based on blended plant and labour rates. These blended rates represent the average plant and labour rates that each of the delivery teams agreed with the independent estimator on an annual basis and can claim as part of their limb 1 cost per project. The blended rates for labour used in the TOC build-up include all uplift costs such as overtime, medical allowances, training, personal protective equipment and so on, whereas plant rates include all costs including replacement value and maintenance cost. Material prices are market related, with quotations from various suppliers and/or specialist subcontractors being obtained by the IST estimating team during the estimating process. The TOC estimate is a first-principles build-up, but the actual procurement of the works is a business decision for the delivery team. It decides whether to self-perform, use subcontractors to help with resource availability or use any specialist subcontractors, as well as which suppliers to use. To ensure that the TOC is fair and market related, an independent estimator performs a full parallel estimate for every project based on the same design documentation, using the same blended rates, but not necessarily accepting the same methodology, and once alignment is reached (i.e. within 2% of the overall value), following a discussion and alignment of assumptions on price variances for activities listed in the bill of quantities, the TOC is reviewed by senior IST management staff and released for construction allocation. The TOC is therefore not completely open book in that the delivery teams do not have insight into the price build-up until the TOC has been allocated after sign-off with the independent

estimator, but also because it is based on blended rates. The financial performance of the delivery team is measured against the TOC. Each project is then delivered by one of the delivery teams as a lump-sum contract (limb 1), to which a negotiated margin (limb 2) is added, and finally there is the gain/pain share arrangement (limb 3) calculated over all the projects at the end of the programme.

Whether an alliance is effective to a large extent relies on the opinions of the participants. Key people in the delivery teams and the SCIRT organisations opined that SCIRT has been important in getting a large workload started in risky circumstances. To get things underway and the work finished, it seems to perform better than the preceding organisation (IRMO). At the time of writing, halfway through the term, roughly half of the work has been done. Also, along the way the contractors have taken collaboration between themselves seriously, and, keeping the end goal in mind, they are supporting each other. The interviewees were of the opinion that the advantages of this type of project delivery could mean that the delivery method could be used in the future for other disaster-recovery programmes or even for very large projects.

5. Conclusion

SCIRT as a multi-client, multi-contractor programme alliance has been set up to manage the rebuild of Christchurch's damaged civil infrastructure, and incorporates some significantly different features compared with the more familiar 'classes' of alliance models.

A unique feature of the model is that it aims to create a programme in which multiple contractors both collaborate and compete. Good performance against the TOC and non-cost KRAs by the delivery teams is rewarded by an increase in future work allocation. A DPS is used to evaluate the performance of each of the delivery teams against the construction TOC of each project and the SCIRT non-cost KRAs as agreed by the alliance board. Next to this competitive element, collaboration between the delivery teams is achieved because they all share in the aggregated limb 3, or the pain/gain of the programme. As this is calculated at the end of the programme and the result of all TOC over- and underruns from all projects, the construction companies have a vested interest in making sure that they all perform well against the TOC. The tension of the DPS and the collaboration of the gain/pain share drive innovation, ensuring value for money for the client organisations.

Because multiple different construction companies are tasked with similar work, a 'blended rate' for labour is used. This blended rate is based on averaging and comparing open-book information from the construction companies by an independent estimator. In the SCIRT alliance model the development of the TOC for each project is an independent process with no price input from the delivery teams: this is to ensure fair trade practices are being followed. This is not the case for other alliances.

Finally, ECI is cemented into the process: the construction companies get paid for the time and material they spend by providing ECI input into the design – this is separate from their

construction work. This means that the delivery teams have an influence on the TOC, while the alliance gets better value through this process through constructability advice resulting in fewer design changes.

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