Liikennevirasto

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Rantatunneli

Value for money report

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Finnish Transport Agency
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Summary

The cost estimate given in the 2011 road plan for the Rantatunneli project was EUR 185 million excluding the Näsikallio interchange but including provisions for its construction at a later date. The City of Tampere and the Finnish Transport Agency each decided to earmark funds for covering the aforementioned cost with a split of 67%/33%. The split was based on an implementation agreement between the parties (2008).

The Rantatunneli alliance's report on the development phase (DP) of the project was completed in June 2013. The alliance partners declared their acceptance of and commitment to the results achieved by that point, the project plan and a target outturn cost (TOC) of EUR 180.3 million based on the cost level of May 2013. The owner then decided to progress to the implementation phase (IP), at which point the alliance contract for the implementation phase was signed and the development phase ended. The implementation phase consisted of the construction phase and the warranty period. The construction phase was completed in stages: Stage I in November 2016 and Stage II in September 2017.

The value for money report is designed to demonstrate how well the owner's targets for the project have been achieved. The development phase of the Rantatunneli alliance project concluded with the drawing up of a value for money report on the development phase.

The final scope of the alliance contract was decided during the DP. The parties concluded that the objectives of the road plan could be achieved without sacrificing any of the planned works or quality for cost reasons. The most notable risks identified in connection with setting the target outturn cost were contaminated soil in the Santalahti area (the extent of contamination could not be determined in a reliable manner) and the distances for transporting spoils. It had been agreed that all rock extracted at the works site would belong to the City of Tampere and that the City of Tampere would decide where it would be deposited. The aim was to deposit most of it in lake Näsijärvi in Santalahti. Although the associated water permit application had been submitted early, the application took an exceptionally long time to process. There was therefore uncertainty as to whether the spoils could be deposited in the lake. The TOC was consequently based on a two-kilometre journey for transporting spoils (to the lake), and the owner took responsibility for the possibility of extra costs incurred from longer journeys. The target outturn cost included a provision for contaminated soil, based on surveys and irrespective of the extent of contamination, and the division of responsibility between the alliance and the owner was 25%/75% for slightly contaminated soil and 10%/90% for heavily contaminated soil.

The owner decided to introduce just over 20 changes (EUR 14.06 million) to the scope of the project during the IP. The City of Tampere and the Finnish Transport Agency consequently raised the total cost provision to EUR 200 million, while the split remained at 67%/33%.

The owners had targets relating to both land use and transport. These were also used to formulate key targets for the alliance, performance relative to which was to be monitored. A gainshare/painshare regime was used to steer the alliance project towards the owner's targets by rewarding outstanding performance (bonus).

The targets were either met or outperformed. The alliance was able to implement the project in a manner appreciated by the owner by making use of techniques such as collaborative platforms, the Big Room concept and lean construction.

The final TOC is calculated by adding the changes to the scope of the project (EUR +14.06 million) and their impact on the construction partner's fixed fee (EUR +2.38 million) to the original TOC of EUR 180.3 million and deducting the effect of the index (EUR -0.79 million). The final TOC therefore amounts to approximately EUR 195.9 million. The final TOC is estimated to be undercut by EUR 3.76 million (the warranty period has not yet ended). Taking into account 50% of the undercut and performance bonuses, the service providers will be paid a bonus of EUR 4.68 million in total.

Foreword

The implementation planning and construction of Tampere's Rantatunneli were based on alliance contracting. A road plan for Highway 12 and the most important zoning plans had been completed when the alliance was formed. After tendering, the alliance was formed of the Finnish Transport Agency and the City of Tampere as the owners as well as A-Insinöörit Suunnittelu Oy, Saanio & Riekkola Oy and Lemminkäinen Infra Oy.

This report describes the Rantatunneli project and the phases of the alliance contract from the perspective of value for money. The report describes the most important processes, solutions and decisions from the perspective of implementing the project during the development phase and the implementation phase.

The purpose of the report is to demonstrate the value generated to the project's funders and key stakeholders. Reporting was also a management tool. The Alliance Leadership Team (ALT) exercising the highest authority in the alliance and the Project Team responsible for the operative management of the alliance regularly discussed the theme of value for money and the results achieved.

The writing of the report was the responsibility of Mauri Mäkiaho from the Finnish Transport Agency. Several experts from the alliance also assisted in producing and compiling information. Lauri Merikallio from Vison Oy contributed important support and background expertise in value for money reporting as well as content. The drawing up of the value for money report was overseen by Lauri Merikallio from Vison Oy, Director Pekka Petäjäniemi from the Finnish Transport Agency and the City of Tampere's Construction Manager Milko Tietäväinen. A financial expert and a cost expert provided comments on the report, and their comments have been appended to the report unedited.

The process of drawing up the report began during the development phase, and the first part of the report was completed after the end of the development phase of the alliance project and the beginning of the implementation phase, in April 2014. This report was completed during the implementation phase of the alliance project after the end of the construction phase and the beginning of the warranty period, once the attainment of the most significant key result targets from the perspective of appraisal had been established or could be forecast.

Helsinki, February 2018

Finnish Transport Agency
Planning Department

Contents

1 The concepts of value for money and alliance contracting

1.1 The concept of value for money

Almost fifty so-called integrated projects had been launched in Finland by the end of 2016, of which more than thirty are purely based on alliance contracting. Finland's first ever alliance contracting project, which involved repairs on the Lielahti–Kokemäki railway line, was launched by the Finnish Transport Agency in 2010. A total of five alliance contracting projects have been or are being implemented in the Tampere area in 2017. The number across Finland is several dozens.

The concept of value for money is evolving as more alliance contracting projects are launched. The concept of value for money -gives decision-makers and owners a logical model for evaluating progress from a project's business case, i.e. needs assessment and general planning, to completion and commissioning.

The concept is based on five components.

- The owner draws up a business case based on needs assessments and general plans
- The owner sets targets for the project and the alliance contract in a value for money statement
- The owner forms the alliance by selecting partners on the basis of the owner's targets
- The alliance strives to execute the project so that the owner's value for money -criteria are met
- The owner reports to decision-makers on the alliance's success in meeting the targets set for the project and the alliance contract

The value for money -approach focuses not just on the lowest possible cost and a fast or predictable turnaround but also on other factors that generate value to the owner and users. These include, among others, taking users', the owner's and other stakeholders' views and requirements into account, striving for high standards, promoting innovation and giving attention to social and environmental considerations. Value for money reporting also promotes continuous improvement and helps to identify both successes and areas in need of development.

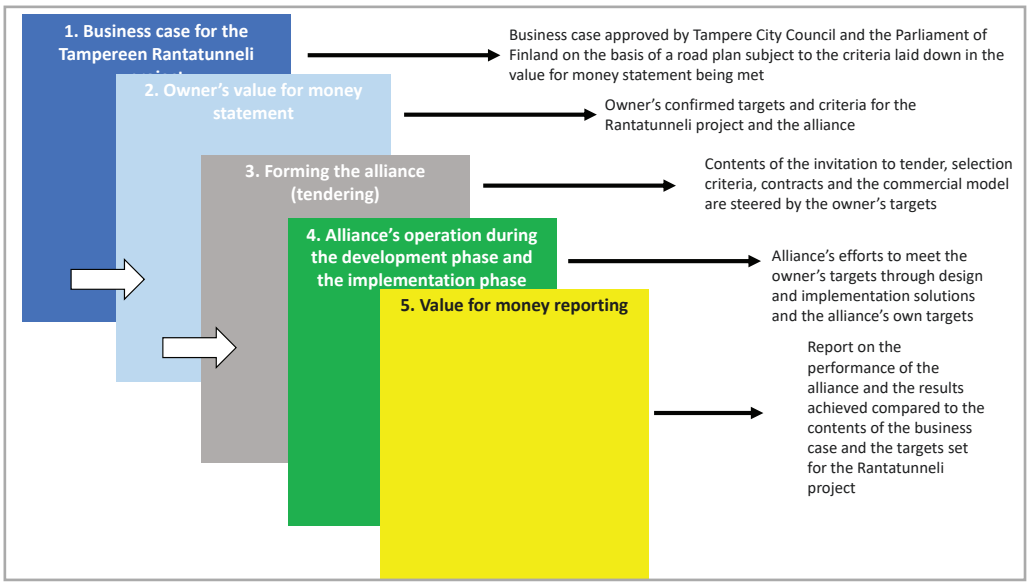


Figure 1. The concept of value for money

The concept of value for money is multifaceted. The key is to not focus exclusively on the lowest possible cost but also on the value of impact. It is also important that all parties to the alliance understand the concept of value for money in the same way. The following are three definitions of the concept of value for money:

"Value for money denotes, broadly, a net measure where the required benefits (including quality levels, performance standards, and other policy objectives such as social and environmental impacts) are balanced and judged against the cost (price and risk exposure) of achieving those benefits." Department of Treasury and Finance, Australia

"Value for money has many dimensions beyond the conventional economic perspective, including social and environmental objectives plus intangible deliverables such as quality of relationships, leadership, learning, reputation and trust." Office of The Government Commerce, United Kingdom

"Value for money is defined as the optimum combination of whole-of-life costs and quality (or fitness for purpose) of the good or service to meet the user's requirement. Value for money is not the choice of goods and services based on the lowest cost bid." HM Treasury, United Kingdom

1.2 Value for money reporting

More and more public contracting authorities use alliance contracting for projects that are intended to make a considerable regional and/or national impact and that tie up significant amounts of public funding and other resources. It is important to measure how successful alliances are in meeting value for money targets and criteria. Value for money reporting gives alliances an opportunity to demonstrate:

- How successfully the owner's objectives were met
- How well the alliance's competence matched the requirements
- Where the alliance succeeded and where it failed
- What the alliance learned from the project

Value for money reporting increases transparency in undertakings that receive public funding. The targets set for projects must be public, and alliances must report openly on their success in achieving targets. Value for money reporting is also important because service providers' bids are not for the total contract but for a fee based on open books. Value for money reports must demonstrate that the target outturn cost set at the end of the development phase is sufficiently ambitious and meets the definition of value for money.

This value for money report concerns the Tampereen Rantatunneli alliance contracting project. The project owners are the Finnish Transport Agency and the City of Tampere, which formed an alliance with A-Insinöörit Suunnittelu Oy, Saanio & Riekkola Oy and Lemminkäinen Infra Oy, which are responsible for design and implementation. This report is based on the Australian National Alliance Contracting Guidelines (Guidance Note 4, Reporting Value for Money Outcomes, September 2015).

Value for money reporting is an element of open information sharing, which is part of open and transparent alliance contracting. The purpose of this report is to demonstrate to decision-makers how the concept of value for money was interpreted in the context of the Tampereen Rantatunneli project and how it has been ensured that the alliance project adds value.

1.3 Alliance contracting

Alliancing is an implementation model in which an owner and one or more service providers form a shared, integrated organisation for implementing a project at an early stage of planning. The alliance partners invest in mutual openness, trust and smooth cooperation and strive to make efficient use of the best available know-how. Ideologies and tools used to achieve a collaborative culture and openness include the Big Room concept, open books and value for money reporting.

The parties' combined know-how and abilities promote the discovery of innovations and value-added solutions, fast implementation and risk mitigation. A gainshare/painshare regime is used to steer the alliance. Targets that can be measured as the project progresses were agreed on the basis of the owner's original targets (see Section 6. Gainshare/painshare regime).

Both the alliance contract model and a commercial model are used in alliance contracting.

Separate alliance contracts are usually drawn up for the development phase (DP) and the implementation phase (IP). The key feature of alliance contracts is that the owner and the chosen service providers share responsibility for the project. The parties are jointly responsible for project planning and construction and share the risks and benefits of the project.

The commercial model of the alliance describes the sharing of both financial benefits and the risks involved in the project. The commercial model consists of three components (Table 1).

Table 1. Commercial model

Reimbursable costs	Reimbursable costs include the project's direct costs and overheads relating to the contract. These can include, for example, the service providers' own labour, supplies, third-party invoices and project management and administration costs.
Fee	The fee includes each service provider's profit margin and a share of the enterprise's overheads. Engineering firms usually base their fee on a percentage, while construction companies set a fixed fee.
Gainshare/painshare regime	The gainshare/painshare regime defines the amount of service providers' performance bonus or penalty. The alliance's gainshare/painshare regime consists of a target outturn cost incentive, key result area indicators that measure the alliance's performance, positive and negative modifiers and major event modifiers. The aim of the gainshare/painshare regime is to steer the alliance to commit to common goals. Success qualifies the service providers for a bonus and generates value to the owner according to the targets.

The target outturn cost incentive is based on how successfully the alliance meets the target outturn cost. Any gain from undercutting the target outturn cost is shared between the owners and service providers in accordance with the division set out in the commercial model associated with the alliance contract for the implementation phase. Correspondingly, any pain from exceeding the target outturn cost is split between the alliance partners according to the percentages laid down in the commercial model.

The amount of the key result bonus or penalty is determined by the alliance's performance in meeting targets in key result areas. The owner sets the initial capital of the bonus pool (usually 2% of the target outturn cost), which is divided between the parties on the basis of performance points awarded for key result areas. A portion of any gain from undercutting the target outturn cost is usually also transferred to the bonus pool, and the potential increase of the capital in the pool incentivises service providers to continue succeeding in meeting the targets set by the owner.

The impacts of the target outturn cost and key result areas are determined so that achieving the best result requires succeeding in all of them. In other words, meeting the target outturn cost or the deadline, for example, must be achieved without sacrificing other key targets.

1.4 Implementation of the Rantatunneli project by means of alliance contracting

Considering both efforts to develop the construction industry and the project's interfaces and risks, it was important to create the best possible conditions for cooperation between the various parties involved in the project and stakeholders. In order to meet the targets efficiently in the best possible way, generating value for money invested by society, alliance contracting was chosen as the method of implementation.

The implementation of the Rantatunneli alliance project was divided into five phases:

- Strategy phase
- Forming of the alliance
- Development phase
- Construction phase
- Warranty period

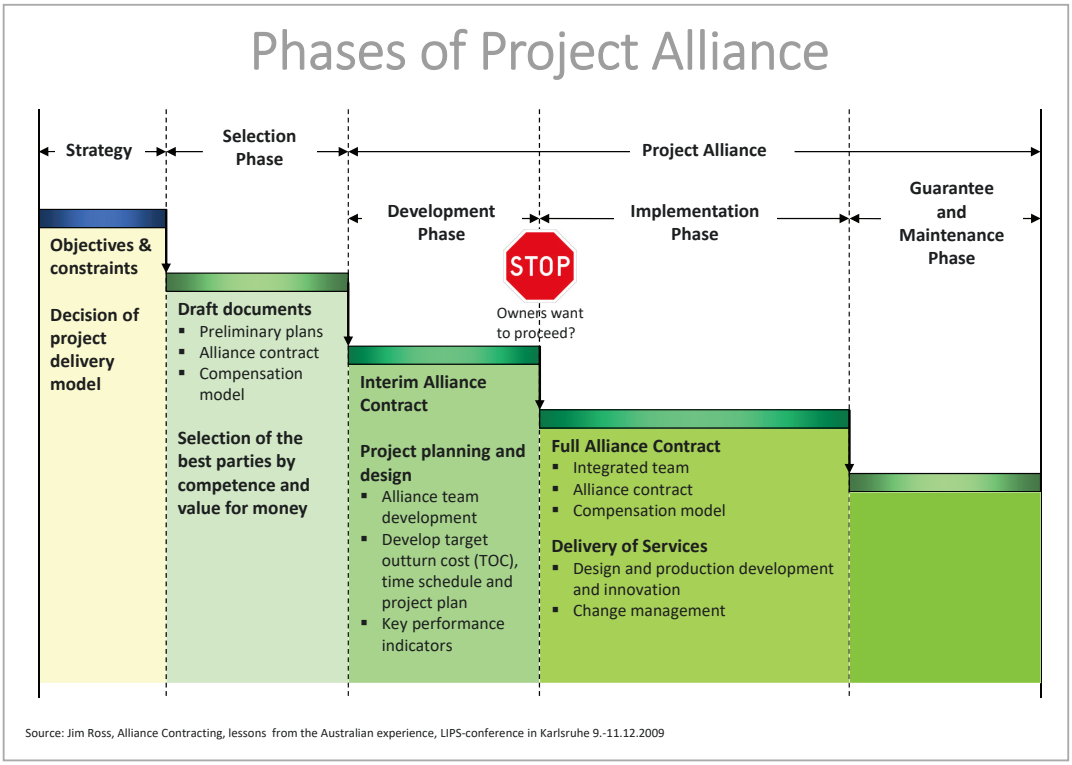
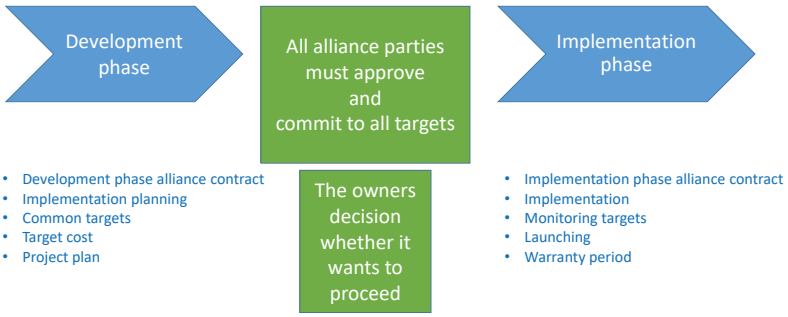


Figure 2. Forming of the alliance, development phase and implementation phase

Table 2. Phases of the Rantatunneli alliance project

Strategy phase	The strategy phase included setting targets and parameters for the project and tasks and decisions relating to the choice of the implementation model. It laid the foundation for the formation of the alliance and was designed to support the progress of the entire project.
Forming of the alliance	The owner used negotiated tendering to find service providers. After awarding the contract, the owner and the chosen service providers formed an alliance.
Development phase	The alliance began the project development phase by signing an alliance contract for the development phase, which involved planning and developing the scope of the project through cooperation and a joint organisation. The development phase involved determining and approving the project's targets and scope, key result areas, the target outturn cost and implementation plans. The alliance shared the responsibility for the design outcomes of the development phase so that any subsequent omissions or mistakes in plans would not justify additional works or alterations. Only the owner's decisions to change the scope or standards of the project could change the target outturn cost.
Implementation phase	The development phase ended with the signing of an alliance contract for the implementation phase once the parties had approved the outcomes of the development phase (project plan, key targets, target outturn cost) and the owner had decided to begin the implementation phase.



The development phase concludes with the owner's decision to begin the implementation phase

The implementation phase consisted of the construction phase and the warranty period. The construction phase was completed as planned in two stages, on 2 November 2016 and 27 September 2017, when the warranty periods also began in stages. The development phase plans and scope changes decided by the owner were implemented according to the targets during the construction phase. This included performing design and construction tasks as well as continuous collaborative problem-solving and development efforts by the alliance partners.

The alliance is responsible for any weaknesses and defects discovered during the warranty period.
Warranty periods:

	Vaihe 1		Vaihe 2	
	alkaa	loppuu	alkaa	loppuu
Ajoratamerkintöjen takuuaika on kaksi (2) vuotta	2.11.2016	2.11.2018	27.9.2017	27.9.2019
Tunnelijärjestelmien takuuaika on kaksi (2) vuotta	2.11.2016	2.11.2018	27.9.2017	27.9.2019
Liikenteenhallintajärjestelmän takuuaika on kaksi (2) vuotta	2.11.2016	2.11.2018	27.9.2017	27.9.2019
Vihertöiden takuuaika on kaksi (2) kasvukautta	2.11.2016	2.11.2018	27.9.2017	27.9.2019
Muut työt	2.11.2016	2.11.2021	27.9.2017	27.9.2022
Vaihe1 sisältö: VT 12 0-3750, E1 alueen rampit ja kadut, E2R1, K6, K10, K11, K13				
Vaihe2 sisältö: VT 12 3750-4200, E2R2-R4, J5, K7, K8, K9				

2 Background and objectives of the Rantatunneli project

2.1 Background to the Rantatunneli project

The regional plan adopted for Pirkanmaa and the 2030 Structural Plan approved by the region's local authorities emphasise the role of the centre of Tampere as one of the country's hubs and a strong commercial centre in the region. The strategy adopted by the City of Tampere highlights the need for a dense and energy-efficient urban structure that supports national land use objectives and climate targets. The ongoing central Tampere development programme also calls for more housing in the city centre, in areas such as Ranta-Tampella, and increasing the appeal of the city centre by making the shores of lake Näsijärvi accessible to all residents of the city.

These objectives relating to the development and urban structure of Tampere city centre were clearly in favour of building a tunnel for Highway 12, as did the fact that building the road above ground in another location was not possible. In other words, the project concerns a stretch of a state-maintained public road (Highway 12) located entirely within Tampere, in an area governed by a zoning plan, confined by urban infrastructure and roads maintained by the city.

Solutions for developing the Rantaväylä route have been discussed in the regional plan and the local plan for the city centre as well as a partial traffic disposition plan for the city centre, based on which work began on a road plan for a long tunnel in 2008.

From the perspective of improving transport functionality, Highway 12 (Tampereen Rantaväylä, Paasikiventie–Kekkosentie) is the busiest public road in Finland outside the Capital Region. The Rantaväylä route is part of the main road network and an important regional thoroughfare network. The road acts as a route into Tampere and as a long-distance thoroughfare towards Vaasa, Turku, Lahti and Jyväskylä alongside the Tampere orbital.

In addition to land use objectives, the project also enables improving traffic flow along the road. For years, the Rantaväylä route has been plagued by congestion and traffic safety problems, which are due to high traffic volumes, an intricate road profile in places and intersections controlled by traffic lights. The biggest problems of the Rantaväylä route are congestion especially between Santalahti and Naistenlahti and a high risk of disruptions and accidents.

The City of Tampere coordinated the road planning process with a revision of zoning plans and the drawing up of an underground zoning plan. Tampere City Council approved an underground zoning plan for the tunnel and zoning changes at the ends of the tunnel in 2011. The road plan was also completed at the same time.

From a transport perspective, the objectives were based on effects resulting from implementing the road plan:

- Fewer barrier effects on land use
- Fewer traffic accidents resulting in personal injury
- Less people exposed to road noise
- Improved flow of traffic and better conditions for public transport as well as a more practical distribution of traffic along different routes

The road plan drawn up pursuant to the Finnish Highways Act coordinates land use and road plans in stages (Figure 3).

Functional zoning	**Local zoning**	
• General land use planning • Development principles • Required areas	• Construction and other land use planning • Specific areas	
General planning	**Road planning**	**Construction planning**
• Need for the road • Basic traffic-related and technical solutions • Required area or corridor • Impacts	• Detailed traffic engineering solutions • Road and surroundings • Accessibility • Impacts • Mitigation of harmful effects	• Detailed building engineering solutions

Figure 3. Level of detail in land use and road plans at different stages

The City of Tampere and the Finnish Transport Agency agreed on the implementation of the project (agreement in 2008 and revisions in 2012 and 2014). According to the agreement, the scope of the project was based on the road plan for Highway 12 (Tampereen Rantaväylä) and more specifically the stretch between Santalahti and Naistenlahti and the effects resulting from its implementation. The plan concerns a 4.2-km stretch of Highway 12 between Santalahti and Naistenlahti and includes various street and road arrangements, interchanges, a provision for building an interchange at Näsikallio and routing approximately 2.3 kilometres of the road through a tunnel.

It was also agreed that all rock extracted at the works site that could not be used in the project would belong to the City of Tampere, which could decide freely how to use it.

The City of Tampere and the 2012 government budget made a provision for the City of Tampere and the Finnish Transport Agency splitting the estimated cost of implementing the road plan (EUR 185 million) so that the City of Tampere would pay 67% and the Finnish Transport Agency 33% of the costs.

The Finnish Transport Agency's share was raised from EUR 60 million to EUR 66 million in the second supplementary government budget of 2016 and the City of Tampere's share was raised correspondingly based on the same split as before and a total cost of EUR 200 million. The sum includes new works added to the contract. The most important of these were more extensive building works on Ratapihankatu enabled by zoning changes, increased contaminated soil treatment costs and changes to the spoil transport distances.

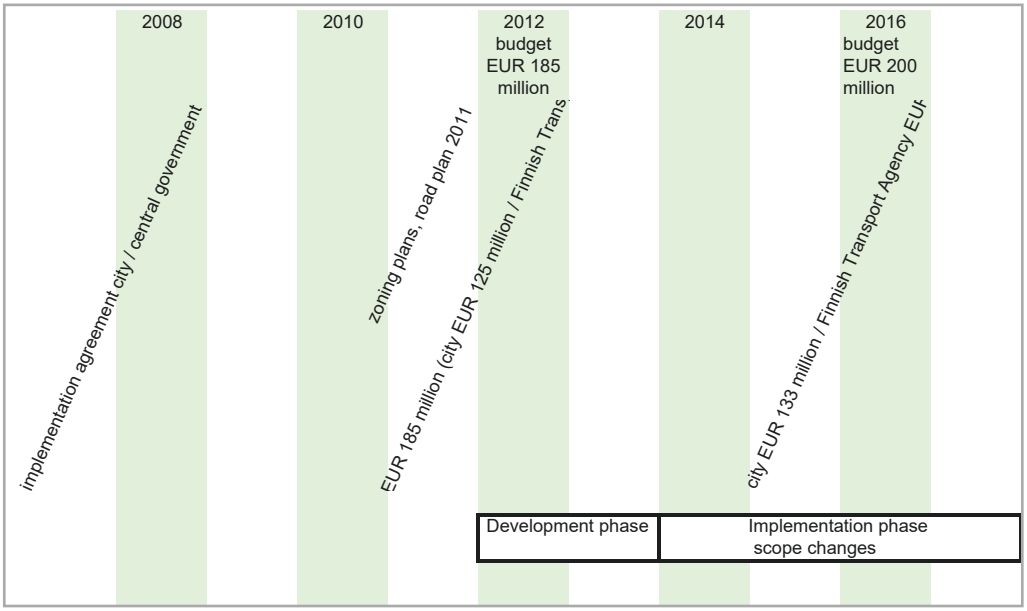


Figure 4. Owner's funding provision

2.2 Owners' objectives

The most important reason for the project relates to objectives to improve the structure of Tampere and land use in the city centre. Highway 12 (Paasikiventie, Kekkosentie) has separated the heart of Tampere from the shores of lake Näsijärvi. The location of the road and the adverse impacts of traffic have prevented the efficient use of the shores of lake Näsijärvi for recreational purposes and land use development. The location of the road has made it more difficult to develop areas such as Ranta-Tampella, Santalahti, Mustalahti marina and Särkänniemi in accordance with the city strategy and hampered the development of links to areas located to the east and the west, which are important for the development of the city.

In addition to the above, other objectives for land use and the development of the city centre and the entire region include the following:

- Transport systems required for the development of Niemenranta, Lielahti and the entire west Tampere and the wider region of Ylöjärvi
- Making the central perimeter and more specifically Ratapihankatu comply with the partial traffic disposition plan
- Development of Särkänniemi and Mustalahti marina
- Conversion of Hämeenkatu into a public transport route and building of a light rail system

Opportunities for correcting road traffic flow and traffic safety weaknesses and mitigating harmful environmental impacts by means of overground construction (road improvement works above ground) had been practically exhausted. The project therefore gave the Finnish Transport Agency a chance to develop the road. Implementing the project made it possible to improve traffic flow and traffic safety and reduce the number of people exposed to emissions from transport. The project was also deemed viable on the basis of its benefit-cost ratio. The practical solution for realising the desired impacts was to implement the works laid down in the road plan completed in

2011. The road plan, which defines technical and qualitative requirements as well as impacts, therefore also helped to form the basis for the Rantatunneli alliance concept. The Finnish Transport Agency's other objective was to improve the productivity of the construction sector nationwide. The project was incorporated into the Finnish Transport Agency's national construction productivity development programme as a pilot investment, and the aim was to apply the procurement principles of alliance contracting, which had yielded positive experiences internationally, and the lean construction ideology.

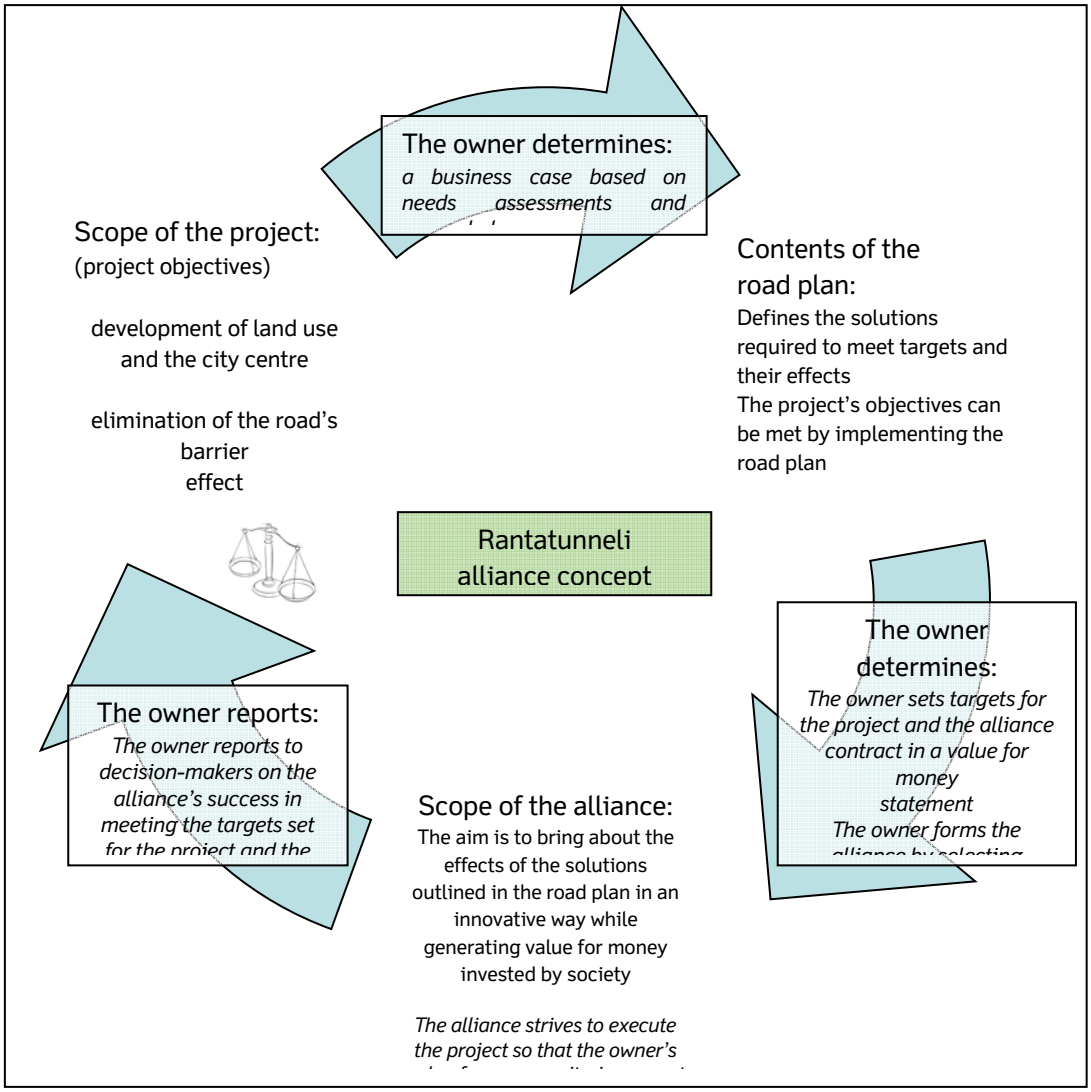


Figure 5. Rantatunneli alliance concept

2.3 Reporting on the owner's targets

The highest decision-making body of the alliance is the Alliance Leadership Team (ALT). The alliance's project manager updated the ALT regularly, on a monthly basis in practice, on progress relating to safety, the schedule, costs, quality and the organisation. The reports covered the most important issues relating to each technology.

Engineering teams reported on the financial situation and equipment relating to design and implementation on a monthly basis. The aim of reporting during the project was to ensure the efficient allocation of resources and project management according to cost, schedule and quality targets. Timely situation reports allowed the owner and service providers to react and make contingency plans separately and as an alliance.

Reports on results and costs, as well as the progress of the alliance contract, the schedule and other targets (safety, usability, public image), costs and cost estimates as well as the effect of scope changes introduced by the owner, were drawn up at regular intervals during both the development phase and the implementation phase. The current number of the alliance's human resources or total human resources up to a point as well as the percentage of Finnish staff were also reported. Project reporting was a continuous process, and reports to the ALT were produced monthly. The contents of the monthly reports were based on the owner's needs, allowing the Finnish Transport Agency and the City of Tampere to use them for financial reporting purposes.

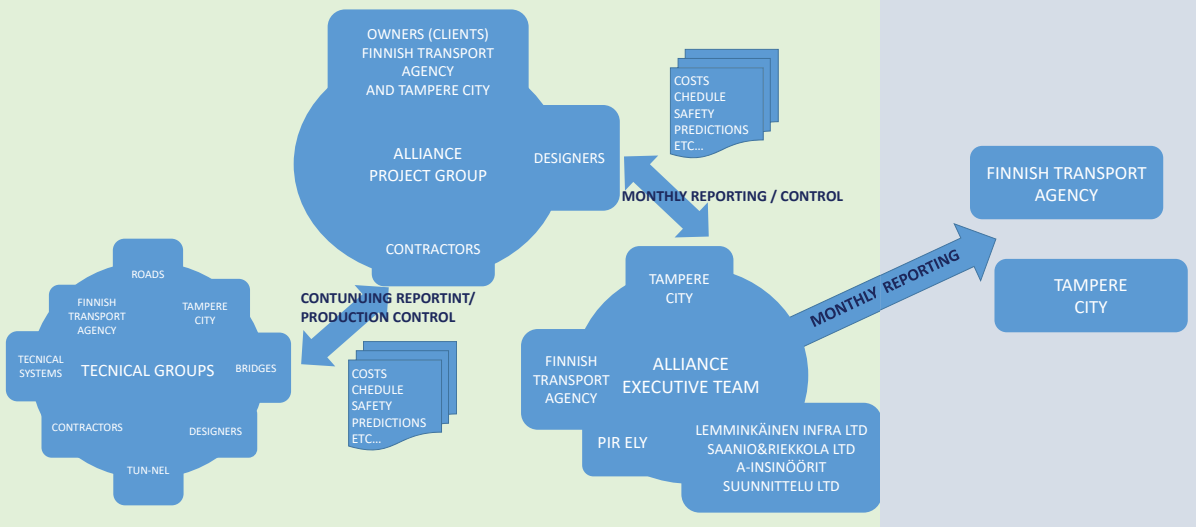


Figure 6. Reporting chain

3 Attainment of the owner's targets

The aim of alliance contracting is to bring about the effects pursued by the owner efficiently and in a manner appreciated by the owner. Reports are drawn up on progress relative to the targets set by the owner for the project (impact targets, Section 4.1, Tables 3–8) and results based on the alliance's performance indicators (final results of the gainshare/painshare regime, Section 6.3).

3.1 Attainment of impact targets

Land use target

Table 3. Land use impact target

Impact target:	Change:
Building a section of the Rantaväylä route underground was designed to reduce the barrier effect of the road and therefore to improve conditions for urban development and increased land use and link land use in Ranta-Tampella, Santalahti and Onkiniemi to the road in a more structured manner	The project enabled turning underutilised areas that have been hampered by transport infrastructure in both Ranta-Tampella and Santalahti into residential developments that better complement the city centre Construction works in Ranta-Tampella began as soon as the tunnel was commissioned, and a zoning plan for Santalahti has been completed Transport system planning required for the development of Niemenranta, Lielahti and the entire west Tampere and the wider region of Ylöjärvi is progressing, and the effects of the tunnel can be taken into account when weighing the routing options of the light rail system Construction works on Ratapihankatu have begun, and a link from Highway 12 to the railway station has been built near the old freight terminal Hämeenkatu has been converted into a public transport route, and construction works on the light rail system are under way The barrier effects of the previous location of the road on the recreational use of the shores of lake Näsijärvi and land use development have been eliminated Särkänniemi and Mustalahti marina can be developed now that the busy road has been rerouted (zoning work is in progress)

Number of people exposed to road noise

Table 4. Road noise impact target

Impact target:	Change:
One of the targets laid down in the road plan was to reduce the number of people exposed to road noise (by 300 during the day and 450 at night) by rerouting the road and building the noise barriers outlined in the plan	All the noise abatement measures outlined in the road plan were implemented. A 2.3-km stretch of Highway 12 was rerouted to run underground. The tunnel entrances are located in troughs, and a total of 1.2 km of new noise barriers were built According to Report No 2/2017 of the City of Tampere Environmental Protection Unit, the Rantatunneli tunnel has made the zones where residents are exposed to noise in Naistenlahti, Ranta-Tampella and Mustalahti considerably smaller

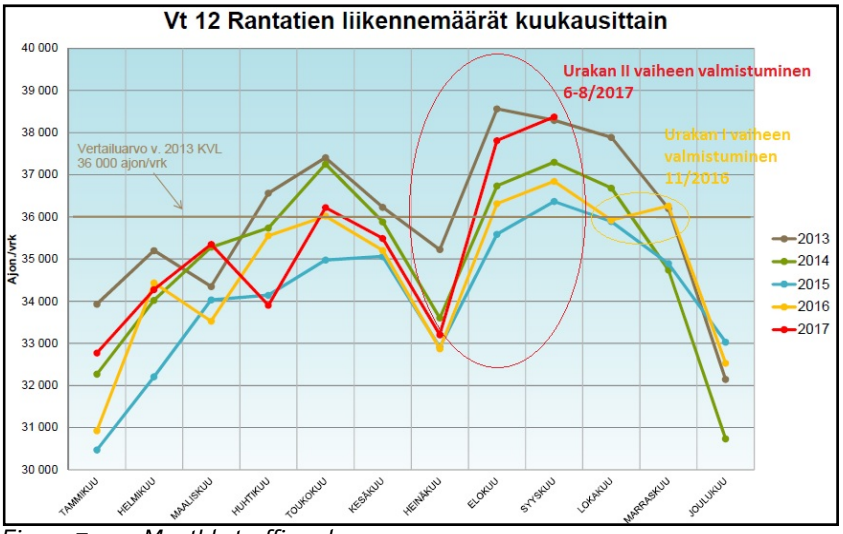
Number of people exposed to emissions from transport

Table 5. Emissions impact target

Impact target:	Change:
Based on atmospheric dispersion modelling carried out by the Finnish Meteorological Institute in connection with the drawing up of the road plan, air quality will improve across a large area of Tampere city centre once the tunnel is completed and long-distance traffic rerouted through the tunnel. However, air quality may deteriorate in the vicinity of the tunnel entrances	All the solutions outlined in the road plan that affect air quality were implemented, including extraction flues that help to control emissions at the tunnel entrances The tunnels were also equipped with suction chambers, which made the extraction flues even more efficient Based on air quality monitoring carried out by the Finnish Meteorological Institute, air quality near the tunnel entrances appears to have remained unchanged. The Finnish Meteorological Institute published the latest Tampere Tunnel air quality monitoring report on 5 April 2017. It states that the monitoring period is still young

Traffic flow and distribution

Table 6. Traffic flow and distribution impact target

Impact target:	Change:
One of the targets laid down in the road plan was to improve the flow of traffic and conditions for public transport on Highway 12 as well as Pispala road, to reduce congestion and to achieve a more practical distribution of traffic along different routes	Traffic volumes remained relatively unchanged during the works. Traffic volumes dropped slightly or remained unchanged both during the construction phase and after the tunnel was commissioned (15 November 2016) Traffic volumes along the Rantaväylä route have increased after the completion of Stage II of the project, i.e. the finalisation and commissioning of the Naistenlahti interchange (summer of 2017)  *Figure 7. Monthly traffic volumes* After the completion of Stage I of the alliance project, i.e. the commissioning of the tunnel, congestion along the Rantaväylä route has decreased especially during the morning rush hour. Traffic flow in the area has improved while the road's susceptibility to disruptions has decreased The completion of Stage II of the project, when the eastern end of the tunnel was linked to the rest of the transport system, improved the flow of traffic to and from the city centre, as Highway 12 (Rantaväylä tunnel) can now also be used to bypass the centre in addition to the city's street network The Vaitinaro junction, which is located outside the planning area, has been improved after the commissioning of the tunnel, as the smoother flow of traffic within the tunnel's planning area has caused higher traffic volumes in other critical points of the transport network

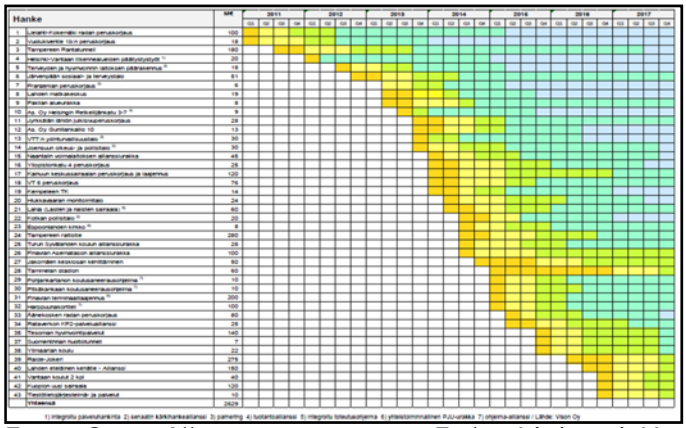
Traffic safety

Table 7. Traffic safety impact target

Impact target:	Change:
According to the road manager's statistics, there were previously more accidents resulting in property damage and personal injury, such as rear-end collisions and collisions between pedestrians and cyclists and cars, within the planning area than elsewhere along the road network on average This was partially due to numerous intersections controlled by traffic lights, where vehicular traffic along Highway 12 and the city's street network as well as pedestrians and cyclists crossed each other at the same level, in addition to which the road profile was challenging A tangible target with regard to traffic safety was to reduce the number of accidents resulting in personal injury within the planning area of the tunnel by 20% (6.4 accidents/year)	The Rantatunneli project included eliminating intersections between Highway 12 and the city's street network as well as pedestrian and cycling routes or replacing them by interchanges. The target would have been met even if the additional footbridge across Highway 12 in Santalahti had not been added to the scope of the project. However, the bridge in question undoubtedly improves the quality of pedestrian and cycling routes The tunnel was commissioned on 15 November 2016, and the subsequent monitoring period of just under one year is still relatively short. In order to provide a cautious estimate, however, monitoring data collected by the Transport Department of the Pirkanmaa Centre for Economic Development, Transport and the Environment across an area slightly wider than the tunnel's planning area (Vaitinaro intersection – Teiskontie junction, approximately 7 km) can be used: The number of accidents decreased by approximately 50% (from 23 accidents to 11 accidents) between November 2016 and August 2017 Five of the accidents occurred within the Rantatunneli planning area and six occurred outside the planning area Three of the accidents that occurred within the planning area resulted in personal injury

The Finnish Transport Agency's objective of improving the productivity of the construction sector

Table 8. Construction productivity impact target

Impact target:	Change:
One of the objectives of the Finnish Transport Agency was to apply the procurement principles of alliance contracting, which had yielded positive experiences internationally, and the lean construction ideology	Positive experiences from alliance contracting have increased the popularity of collaborative models in Finland rapidly The Finnish Transport Agency first piloted alliance contracting in 2011. The Rantatunneli project was the Finnish Transport Agency's second alliance contracting project, the procurement phase of which began at the end of 2011. The Rantatunneli project, both as an undertaking and an example of alliance contracting, has attracted extremely high levels of attention since the beginning, and it has been the most eagerly, or almost the most eagerly, followed of all of the Finnish Transport Agency's projects during several years, including the current one. Several studies and academic theses have been written about it Lessons learnt from alliance contracting and the visibility of the projects have made several building contractors and the entire construction industry keener to promote the alliance contracting model and also to develop other contracting models From the perspective of the sector's development, the following conclusion of VTT Technical Research Centre of Finland on the alliance contracting model is one example (indirect quotation): *"Combining the expertise of different project partners, cooperation and the right kinds of incentives can also be used to make conventional implementation models more efficient. This also provides an opportunity to respond to current challenges posed by the pursuit of innovative procurement, the exploitation of digitalisation and the reform of procurement regulations"* Source: Lahdenperä, P (2015). Allianssiurakan arvontuoton mekanismit. Johdon sosiaalinen kognitiivinen kartta. [Value-creation mechanisms of alliancing. A social cognitive map of executives.] VTT Technical Research Centre of Finland, Espoo. VTT Technology 243. Lahdenperä, P (2016). Hanke- ja hankintaprosessien kehittäminen – Esiselvitys Liikennevirastolle. [Development of project and procurement processes – Preparatory study for the Finnish Transport Agency.] According to Vison Oy's statistics (1/2017), the number of planned, ongoing or completed alliance projects in Finland currently stands at more than 40. Around half a dozen projects are also being contemplated and planned elsewhere in Europe.  *Figure 8. Alliance contracting in Finland (1/2017), Vison Oy*

3.2 Works included in the contract

The project involved implementing technical solutions and associated systems and controls that were vital for rerouting a 2.3-km stretch of Highway 12 between Santalahti and Naistenlahti in Tampere through a tunnel in order to achieve the desired effects. It included street and road arrangements necessary for linking the tunnel to the rest of the transport system, relocating cables and devices, interchange arrangements at Naistenlahti and Santalahti as well as systems relating to traffic control, monitoring, safety and supervision, tunnel systems and associated devices, automation, control and management systems and associated telecommunications and operator training. All in all, the works covered a stretch of Highway 12 (Tampereen Rantaväylä) approximately 4.2 km long. The planning area starts from Santalahti marina on Paasikiventie in the west and ends to the west of the Kalevan puistotie slip roads on Kekkosentie.

The technical scope of the project also included a provision for building an interchange at Näsikallio in the middle of the tunnel in the event that extensions are necessary in the future. This meant ensuring that the tunnel will not need to be closed to traffic if the City of Tampere decides to build the interchange at a later date.

In addition to the technical scope of the project, the quality level was determined on the basis of the quality, functionality and impact targets laid down in the 2011 road plan for the stretch of Highway 12 (Tampereen Rantaväylä) between Santalahti and Naistenlahti.

The functionality and impacts outlined in the plan had to be achieved in compliance with all relevant guidelines and requirements set by the owner and the authorities. The integration of technical and functional systems related to other urban infrastructure and traffic management was included in the scope of the project in so far as changes to these systems were necessitated by the Rantatunneli project.

The works carried out in the course of the Rantatunneli alliance project were chosen on the basis of the scope determined by the owner during the procurement phase, which was revised by adding more detail during the development phase and the implementation phase. The works included in the project are referred to as the scope of the project.

Table 9. Scope of the project

Scope of the project	The scope of the project refers to the technical, functional and qualitative measures taken to meet the owner's targets. The target outturn cost is tied to the scope of the project. The owner can decide to revise the scope of the project if necessary in order to meet the owner's targets. Only a change in the scope of the project can change the target outturn cost.
Original scope	The owner determines the original scope of the project in the invitation to tender. The contract covers the scope determined by the owner. Procurement phase of the Rantatunneli alliance project: The scope determined for the Rantatunneli alliance project during the procurement phase was based on implementing the 2011 road plan for the stretch of Highway 12 (Tampereen Rantaväylä) between Santalahti and Naistenlahti. https://www.tampere.fi/liikenne-ja-kadut/liikenne-ja-katusuunnittelu/rantatunneli/tiesuunnitelma.html Changes to the scope of the Rantatunneli alliance project during the development phase: The technical and qualitative concepts relating to the scope of the project became better known during the development phase, as design and implementation solutions as well as source data, surveys and risk management progressed. The scope was defined in more detail in order to allow the alliance partners to decide on the transition to the implementation phase and the target outturn cost. A description of the scope of the project drawn up during the development phase can be found in Part 3 SCOPE OF THE PROJECT of the Rantatunneli alliance project plan (dated 26 June 2013). The revised scope of the project was based on implementing the 2011 road plan for the stretch of Highway 12 (Tampereen Rantaväylä) between Santalahti and Naistenlahti. The target outturn cost for the alliance project was set at EUR 180.3 million. It was decided during the development phase that works included in the original scope of the project determined by the owner would not be left out just to achieve an acceptable target outturn cost. Changes to the scope of the Rantatunneli alliance project during the implementation phase: All the works included in the original scope of the project were carried out during the implementation phase. The owner also decided to add new works to the scope of the project.

Scope change	Scope changes refer to revising the original technical or qualitative scope of the project and the target outturn cost by leaving works out or by adding new works. Decisions on scope changes are taken by the owner and reviewed by the Alliance Leadership Team. The effects of scope changes are taken into account in the target outturn cost (increase/decrease) and the gainshare/painshare regime. Examples: If more works are added to the scope of the project, the target outturn cost increases. If works are left out of the scope of the project (the scope shrinks), the target outturn cost decreases. Failures to meet a quality target can be taken into account as a negative scope change (target outturn cost decreases), if it does not make sense to correct the failure (cf. procedures for dealing with changes in value in the context of different contracting models). Qualitative overperformance is only considered to constitute a scope change (target outturn cost increases) if the owner decides to insist on a higher level of quality than what was originally agreed. The realisation of risks for which the owner is solely responsible constitutes a scope change if the alliance incurs costs as a result. Changes implemented during the alliance project that are necessary for completing all the works included in the scope of the project do not constitute scope changes. If it transpires that, in hindsight, the alliance would have been able to factor in or prevent a realised risk, a change or a weakness by means of research, design or implementation, the event does not constitute a scope change. (Recognised or unrecognised) risks identified during the alliance project for which responsibility was not given exclusively to the owner when the target outturn cost was set do not constitute scope changes. <u>Changes to the scope of the Rantatunneli alliance project:</u> The owner introduced just over 20 changes to the scope of the project (Table 10 and Figure 10), the majority of which increased the scope.
Final scope	The final scope of the project consists of the original scope and any scope changes introduced by the owner. <u>Changes to the scope of the Rantatunneli alliance project:</u> The changes introduced by the owner to the original scope of the project laid down in the project plan raised the target outturn cost by EUR 14.06 million (Table 10 and Figure 10).

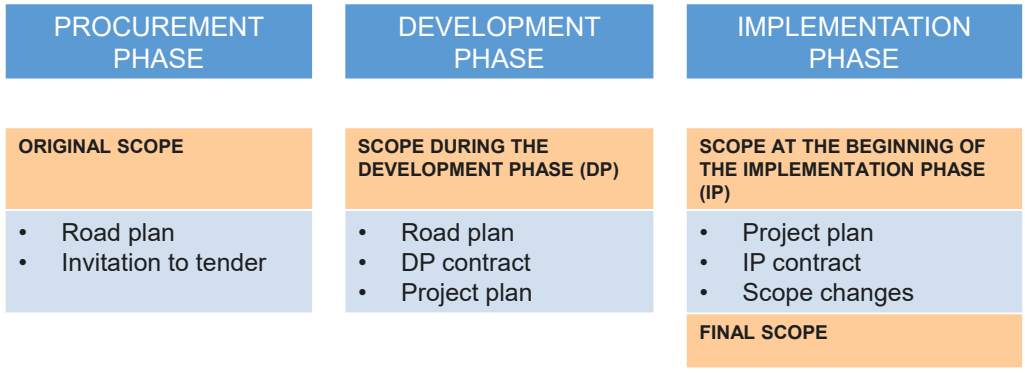


Figure 9. Technical scope of the project during different phases

The owner introduced just over 20 changes to the scope of the project during the implementation phase of the Rantatunneli alliance project (Table 10 and Figure 10). The decisions concerning the scope changes were reviewed by the Alliance Leadership Team, and some of them increased the target outturn cost while others decreased it. On the whole, the target outturn cost increased by EUR 14.06 million.

Table 10. Scope changes and reasons behind them

Scope change	Reason
Changes to driving distances (beyond 2 km from the works site)	Only some of the locations where spoils could be deposited were known or available when the target outturn cost was agreed (water permit application pending). As according to the contract the City of Tampere would decide where to deposit any spoils belonging to the city with the aim of depositing most of them along or near the shore of lake Näsijärvi no more than 2 km away from the works site, the target outturn cost only included transport within 2 km of the works site, and the longer distance therefore constituted a scope change.
Widening of the Rauhaniemi bridge (bridge No 6) by one metre	The bridge design included in the target outturn cost and the road plan met the functional and qualitative requirements set for the carriageway, the pavement and the cycle lane. The owner (City of Tampere, which was to be the owner of the bridge once it was completed) decided to add a qualitative improvement relating to the space reserved for pedestrians and cyclists (by widening the bridge by one metre) after the target outturn cost had been agreed.
Light rail provision in Santalahti	The target outturn cost included a provision for the light rail system on the bridge according to the City of Tampere's light rail plan. The owner (City of Tampere, which was to be the owner of the bridge in question and which is building the light rail system) amended the light rail plan after the target outturn cost was agreed so that even more space had to be reserved for the light rail system.
Change in traffic volumes in the dimensioning of the ventilation system	The target outturn cost included dimensioning the ventilation system in accordance with the traffic prognosis used to draw up the road plan. The owner decided to add a qualitative improvement by dimensioning the ventilation system for higher-than-forecast traffic volumes after the target outturn cost had been agreed in order to account for an increase in traffic volumes in the future.
Owner's share of contaminated soil	The target outturn cost included the costs of treating contaminated soil in so far as it had been possible to estimate the extent of contamination on the basis of surveys and in so far as contamination was due to the construction of the Rantatunneli tunnel. As it was not possible to get a more accurate estimate of the extent of contamination on the basis of surveys, design and construction, a decision was made to split the risk between the alliance and the owner so that the alliance would be responsible for 25% and the owner for 75% of costs incurred from slightly contaminated soil, while the division between the alliance and the owner was 10%/90% for heavily contaminated soil.
Traffic control centre servers	The target outturn cost included any necessary servers built in compliance with the relevant requirements. The Finnish Transport Agency decided to move its nationwide development project concerning a control system for technical road transport systems forward after the target outturn cost was agreed. The traffic control centre's server capacity had to be increased due to the proactive virtualisation of the control system server environment.
Foundation of the eagle statue on the shores of Tammerkoski	The restoration of the eagle statue was not included in the scope of the alliance contract. The City of Tampere decided to restore the statue after the target outturn cost was agreed and to commission the alliance to restore the statue's foundation for reasons of synergy.

Scope change	Reason
Changes to the equipment of the Tampere traffic control centre	The target outturn cost included the equipment and devices required by the tunnel systems at the road traffic control centre. The virtualisation of the server environment, which was done after the target outturn cost had been agreed, meant that less equipment was needed in the road traffic control centre.
Dry fire water pipe for the tunnel's connecting corridors	The target outturn cost included fire extinguishing water pipelines in accordance with the plans and requirements, associated equipment as well as a sprinkler system. The alliance decided to introduce a qualitative improvement after the target outturn cost was agreed by adding a second dry pipe to lead from one tunnel to the other in each connecting corridor, which makes it possible to conduct fire extinguishing water from one tunnel to the other by two different methods.
Gas pipeline change in Naistenlahti	The target outturn cost included all necessary cable and device relocation works. The need to reroute a gas pipeline in Naistenlahti was only partially due to the alliance project. According to the contract, the costs incurred from the underwater gas pipeline between Naistenlahti and Santalahti were to be divided 80%/20% between the City of Tampere and the alliance based on the length of the pipeline. The City of Tampere decided to change the alignment of the gas pipeline after the target outturn cost had been agreed, which increased the technical scope of the alliance project (need for more extensive surveys, increase in the length of pipeline for which the alliance was responsible).
Realignment of Tipotienraitti	The target outturn cost included all necessary traffic arrangements. The City of Tampere decided to change the alignment of its pedestrian and cycling route (Tipotienraitti) after the target outturn cost had been agreed, which increased the technical scope of the alliance project.
Public address system speaker solution	The target outturn cost included a speaker system designed according to the requirements. After the target outturn cost had been agreed, the Finnish Transport Agency decided to build the public address system proactively by basing it on the principles of guidance that will not be drawn up until some time in the future (tunnel horns).
Final road surfacing layer	The target outturn cost did not include a second layer of pavement. Typically, the second layer is applied when a road has already been open to traffic for several years, and the work is often carried out in connection with maintenance. The Finnish Transport Agency decided to stipulate that the final road surfacing layer be included in the scope of the alliance project in the form of an additional qualitative improvement after the target outturn cost had been agreed.
Changes affecting Ratapihankatu	The target outturn cost included linking the Naistenlahti interchange to the rest of the transport system in so far as the same was possible according to the zoning and street planning status of the road plan. The zoning and street planning status of Ratapihankatu changed after the target outturn cost had been agreed so that it became possible to connect the transport system more extensively in connection with the alliance project, producing better quality and reducing temporary arrangements considerably.
Santalahti footbridge (bridge No 12)	The target outturn cost included all necessary pedestrian and cycling routes outlined in the road plan. The City of Tampere decided to improve the quality of pedestrian and cycling routes after the target outturn cost had been agreed by adding an extra footbridge for pedestrians and cyclists in Santalahti.

Fault monitoring system duplication	The target outturn cost included a fault monitoring system and the associated hardware and software. The Finnish Transport Agency decided to improve the quality of the system (by means of duplication) after the target outturn cost had been agreed in order to make the software and management environment of the fault monitoring system even more reliable in special circumstances.
Watts SDK fault monitoring system interface	The target outturn cost included the kind of closed OPC interface typically used by the Finnish Transport Agency between the fault monitoring system and the control room software. After the target outturn cost had been agreed, the Finnish Transport Agency decided to upgrade the interface proactively to increase usability and facilitate future development (by opting for an open Watts SDK interface).
Software updates	The target outturn cost included the programming required for controlling the tunnel's technical systems as defined by the Finnish Transport Agency as well as interfaces. After the target outturn cost had been agreed and the tunnel commissioned, the Finnish Transport Agency's road traffic control centre and the Pirkanmaa Centre for Economic Development, Transport and the Environment insisted on the addition of new functions to lane control signs, the system's interface, the fault monitoring system's cameras and the road sign concept library.
Defective tunnel lighting	The target outturn cost included a lighting system that met the requirements. An inspection revealed that although the tunnel was not as consistently light as stipulated in the requirements in theory, the discrepancy was not noticeable to the eye or functionally significant enough to warrant changes to the lighting system. The target outturn cost was lowered as a result of the defect.
Changes to slip road lane control signs	The target outturn cost included all necessary lane control signs designed in accordance with the relevant guidelines. After the target outturn cost had been agreed, the Finnish Transport Agency decided, in response to a stipulation by the Pirkanmaa Centre for Economic Development, Transport and the Environment, to make the lane control signs functionally different from those used elsewhere in the country and the requirements laid down in guidelines.
Changes to the centralised alarm management system	The target outturn cost included building the tunnel's technical systems along with all necessary hardware and software. The Finnish Transport Agency decided to introduce a new centralised alarm management system after the target outturn cost had been agreed, as a result of which the Rantatunneli control room software had to be integrated with the Finnish Transport Agency's centralised alarm management system.
Street No 7 between poles 100 and 175 and pedestrian route No 11	The target outturn cost included linking the Naistenlahti interchange to the rest of the transport system towards Ranta-Tampella in so far as the same was possible based on the road plan and the zoning and street planning status. The City of Tampere began to develop the Ranta-Tampella area after the target outturn cost had been agreed. The development project interfaces with the alliance project. The City of Tampere decided that it made sense to limit the original scope of the alliance project in order to avoid investing too much into the quality of structures that would end up being temporary.

WORKS NOT INCLUDED IN THE ORIGINAL TARGET OUTTURN COST (SCOPE CHANGES EXCLUDING THE FIXED CONSTRUCTION FEE)	
DRIVING DISTANCES > 2 KM (No 5)	1 721 375
WIDENING OF RAUHANIEMENTIE, BRIDGE No 6 (No 7)	196 44 5
LIGHT RAIL PROVISION IN SANTALAHTI (No 8)	90 000
CHANGE IN TRAFFIC VOLUMES IN THE DIMENSIONING OF THE VENTILATION SYSTEM	398 016
OWNER'S SHARE OF CONTAMINATED SOIL (No 13)	6 117600
TRAFFIC CONTROL CENTRE SERVERS (No 14)	14 500
FOUNDATION OF THE EAGLE STATUE ON THE SHORES OF TAMMERKOSKI (No 15)	17247
CHANGES TO THE EQUIPMENT OF THE TAMPERE TRAFFIC CONTROL CENTRE	-7422
DRY FIRE WATER PIPE FOR THE TUNNEL'S CONNECTING CORRIDORS (No 18)	55 888
GAS PIPELINE CHANGE IN NAISTENLAHTI (No 19)	34 402
REALIGNMENT OF TIPOTIENRAITTI (No 21)	30 000
CHANGE TO THE PUBLIC ADDRESS SYSTEM SPEAKER SOLUTION (No 22)	73200
FINAL ROAD SURFACING LAYER (No 24)	1 317602
CHANGES AFFECTING RATAPIHANKATU, STREET No 6	3 266 1 5 5
SANTALAHTI FOOTBRIDGE (BRIDGE No 12)	571 818
FAULT MONITORING SYSTEM DUPLICATION	48 756
WATTS SDK FAULT MONITORING SYSTEM INTERFACE	13 125
SOFTWARE UPDATES	28 500
DEFECTIVE TUNNEL LIGHTING	-834
CHANGES TO SLIP ROAD LANE CONTROL SIGNS	10 000
CHANGES TO THE CENTRALISED ALARM MANAGEMENT SYSTEM	97462
Street No 7 between poles 100 and 175 and pedestrian route No 11	-29 19 5
	14 064 640

Figure 10. Extract from the October 2017 cost report, effects of scope changes on costs.

4 Achieving the right price

4.1 Procurement phase

Conditions for achieving the right price were created during the procurement phase. The procurement phase lasted approximately six months, and the procurement process consisted of two stages. The procurement phase is described in more detail in the value for money report for the development phase. The tender comparison criteria were based on the tenderers demonstrating their competence and management skills and their ability to set a target outturn cost and other key targets at the right level. The tenderers also had to demonstrate their ability to execute the development phase and the implementation phase of the alliance project in the required manner. The tender comparison criteria are listed in Table 11.

The price element of the tendering process consisted of the tendered fee. The tenderers based their fee on a theoretical sum determined by the owner, according to which directly reimbursable costs excluding the fee were EUR 150 million and the contractor's fixed fee would not be affected if the amount of directly reimbursable costs ended up being smaller at the end of the implementation phase. In other cases, the fixed fee would be adjusted proportionately to the amount of directly reimbursable costs. Engineering firms' fees are based on a percentage, and there was therefore no need for a similar mechanism in that respect. This arrangement ensured that service providers had a genuine incentive to undercut the target outturn cost and that no-one's fee would be reduced relative to directly reimbursable costs (= services rendered) as a result.

Table 11. Tender comparison criteria

Assessed component	Weight	Evaluation criteria
Project implementation plan and organisation	Stage I 25% Stage II 10%	• the ability to carry out key tasks related to the project • the method of ensuring the availability of the competence and resources required for design and construction • organisational structure and resourcing • how well the tenderer has understood the contracting model and the project and what each of the various phases requires of the organisation as well as the tasks and roles of staff
Proof of profitable operations in key result areas	Stage I 25% Stage II 10%	• the results achieved by staff with regard to the stated key issues • the scale and significance of the results achieved • in particular, results achieved in traffic tunnel projects implemented in cooperation with engineering firms, construction companies and different businesses (design–build and life-cycle models)
Learning from mistakes	Stage I 10% Stage II N/A	• readiness to report failures • analysis of failures and identification of their causes • the ability to learn from failures • proof of the development of operations
Setting the target outturn cost	Stage I 25% Stage II 15%	• determination of the parties' roles, tasks and responsibilities • how risks and opportunities are identified and managed • task schedules, phasing and the determination of checkpoints • demonstration of the target-oriented nature of the target outturn cost

		• cost steering of design solutions • the processing of ideas and innovations
Review of the owner's cost estimate	Stage I 15% Stage II 15%	• evaluation of the accuracy of costs and its grounds • the risks and opportunities stated • determination of measures required for setting the target outturn cost
Management skills of the Alliance Leadership Team and the Project Team and the tenderer's alliancing skills	Stage I N/A Stage II 25%	• organisational skills • decision-making and problem-solving skills • the ability to build and reinforce mutual trust • self-reflection skills • commitment and the ability to operate in accordance with the principles and targets of the alliance
Price	Stage II 25%	• Engineering firms: percentage-based fee • Contractors: fixed fee

The owner and the tenderers convened in a two-day workshop to carry out tasks that were vital for the execution of the project, while external teamwork experts observed each tenderer's leadership and teamwork skills.

The two best tenderer consortia performed well and scored high for quality. Within the winning consortium, Lemminkäinen Infra Oy had quoted a fixed fee of EUR 12,541,000. It equates to a 9.12% fee on top of directly reimbursable costs. The engineering firms' fee was 32.90%. When comparing the tendered fees against fees charged for similar alliance projects as well as general fee levels, Lemminkäinen Infra Oy's fee can be deemed to be normal and reasonable. The fees tendered by the engineering firms, A-Insinöörit Suunnittelu Oy and Saanio & Riekkola Oy, were low.

The owner had hired an impartial observer (Toimi Tarkiainen) to ensure that the procurement negotiations were fair and non-discriminatory. The impartial observer found no issues with the tendering process.

4.2 Determination of the target outturn cost during the alliance project

The target outturn cost for the alliance project was determined during the development phase. An ambitious target outturn cost makes it more likely for the owner's targets to be met. Setting a sufficiently ambitious target outturn cost requires up-to-date and as-realistic-as-possible price information and evaluation of changes in the cost level, forecasting or hedging. The target outturn cost was determined taking into account any opportunities for lowering the cost that the alliance felt were probable based on the information available. Similarly, factors that were taken into account for raising the target outturn cost included risks that the alliance felt were probable and could not be eliminated based on the information available. Any residual risks were priced as accurately as was possible based on studies and reports and by means of design. If there was still considerable uncertainty relating to a residual risk or the estimate of its effect on costs, the risk provision incorporated into the target outturn cost was supplemented by a risk sharing agreement whereby the owner would be responsible for the risk in so far as it was beyond the service providers' control. Any risks that were completely beyond the alliance organisation's control based on studies and reports and that the alliance organisation could not influence by means of design or implementation were not included in the target outturn cost at all and were left to the owner to bear. The key tasks in setting the target outturn cost are listed in Table 12.

Table 12. Key tasks in setting the TOC

Preparation	• Identification of the largest cost items and an assessment of how they could be influenced • Critical review of design principles • Detailed determination of interfaces between fields of engineering and a review of the definition principles • Launch of the innovation process and a determination of its systematics • "Broad framework innovation days" • Discussions with the authorities on questions of alignment • Determination of the level of accuracy for plans and volume calculations for pricing purposes • Determination of interim design targets • Guidelines on the recording and handling of risks for purposes of future pricing
Design	• Programming of ground surveys and the launch of site investigations • Launch and steering of design and the determination of interim targets • Cost comparisons for alternative solutions and a review of work methods • Drawing up of the work plan and schedule • Continuous updating of the risk list
Pricing	• Competitive tendering of suppliers and subcontractors • Checks on volume calculations with particular attention to interfaces • Entering of quantities into the tender calculation software • Retrieval of resource-specific consumption data and input prices from the cost calculation system • Agreeing on the principles for pricing increases in costs • The probability and realisation costs were estimated for all risks. A share of the costs of potential realisation corresponding to the probability of each risk was used to include risk costs in the target outturn cost

It was decided to make the target outturn cost transparent. It had to generate value for money from the owner's perspective and be ambitious enough from the perspective of the gainshare/painshare regime.

A cost expert was invited to participate in the entire process of setting the target outturn cost in order to allow them to form an opinion on the process and the ambitiousness of the target outturn cost. The cost expert's views were taken into consideration when deciding on the acceptability of the target outturn cost. The process of setting the target outturn cost is described in more detail in Table 13 and Figures 11 and 12.

Table 13. Determination of the target outturn cost during the development phase of the alliance project

Start of the development phase (DP) August 2012 TOC I	The level of accuracy required for setting the target outturn cost was determined before the start of construction and implementation planning in order to be able to calculate quantities for tender price enquiries, the scope of procurement and timing in a reliable manner. The accuracy requirements also took into account interfaces between different technologies. A comparative target outturn cost estimate (TOC I) was calculated on the basis of the road plan, which amounted to EUR 221 million. There was still a lot of uncertainty in the cost estimate. The next step was to investigate which design solutions could be influenced and replaced by more efficient solutions.
DP August–October 2012	Optimal solutions were sought during the development phase through iteration in cooperation with the designers' and developers' cost controllers. The daily cost steering of design within individual fields of engineering was overseen by area managers and the cost steering of the entire project by project management staff. Design steering was carried out informally through daily interaction and more formally in meetings and workshops. Risk provisions that could be controlled through further surveys and design were eliminated by identifying and assessing risks. The design work focused on examining alternatives for major questions of principle and on dialogue with the authorities, the selection of alternatives and innovation.
DP October 2012 Setting the target (challenge)	The alliance project group challenged itself to achieve a target outturn cost of EUR 180 million. The target was parcelled out to engineering teams to steer field-specific design and the costs of design solutions. It should be noted that the feasibility of the target was not known at this stage.
DP January 2013 TOC II	The next target outturn cost estimate (TOC II), EUR 196 million, which was based on the alliance's own volume calculations and partly on the volumes specified in the road plan, was completed at the end of January 2013. Based on this figure, the Alliance Leadership Team decided on 7 February 2013 that there was no need to alter the scope of the project and that the search for more efficient solutions and focusing on the assessment and management of risks would continue in order to lower the target outturn cost.

DP January–May 2013 Progress with regard to pricing, provisional procurement, provisions for cost increases and cash flow forecasts	Based on the plans and quantity lists drawn up during the development phase, the project was priced by resources, using Lemminkäinen's Hakku software in compliance with the nomenclature associated with the general quality requirements for infrastructure construction. The alliance sought to obtain binding prices for subcontracts and supplies, which would remain fixed for the duration of the whole project or whose annual increases were clearly indicated. In so far as this was not achieved, the estimated increases in costs were priced by the alliance. Increases in costs were priced separately in order to avoid mixing accurate price information and cost-increase provisions based on guesswork in the actual cost calculation. The cost estimate and the related cash flow forecast were completed in May 2013.
DP May–June 2013 Decision on the risk provision TOC III	The pricing of risks and opportunities was based on an analysis carried out alongside design work and pricing. Any identified risks were minimised by means of design solutions, and those that could not be mitigated were priced together with the opportunities. The third target outturn cost estimate (TOC III), EUR 185.4 million, was completed on 31 May 2013. A decision was taken at the Alliance Leadership Team's meeting on 6 June 2013 to review the target outturn cost during the weeks beginning on 3 and 10 June at least with regard to technical systems, risks and opportunities and the provision for cost increases. It was also decided that a risk provision of EUR 3.3 million would be included in the target outturn cost estimate and that the scope of the project would not be altered to achieve an acceptable target outturn cost. A risk provision of EUR 3.3 million (ALT, 6 June 2013) was included in the target cost estimate.
DP June 2013 Final TOC	The final target outturn cost estimate, EUR 180,299,106, was completed on 25 June 2013. As the project was to run over several years, a decision was made to tie the target outturn cost to the cost level of May 2013 instead of using a fixed cost-increase provision. The cost expert's report from 25 June 2013 states that the cost estimate was mostly drawn up in accordance with the alliance contract and that it was sufficiently ambitious. The Alliance Leadership Team decided unanimously on 26 June 2013 to adopt the target outturn cost estimate as the project's target outturn cost. The Alliance Leadership Team also decided to approve the key targets guiding the implementation phase and concluded that a solution meeting the technical and financial targets had been achieved during the development phase.

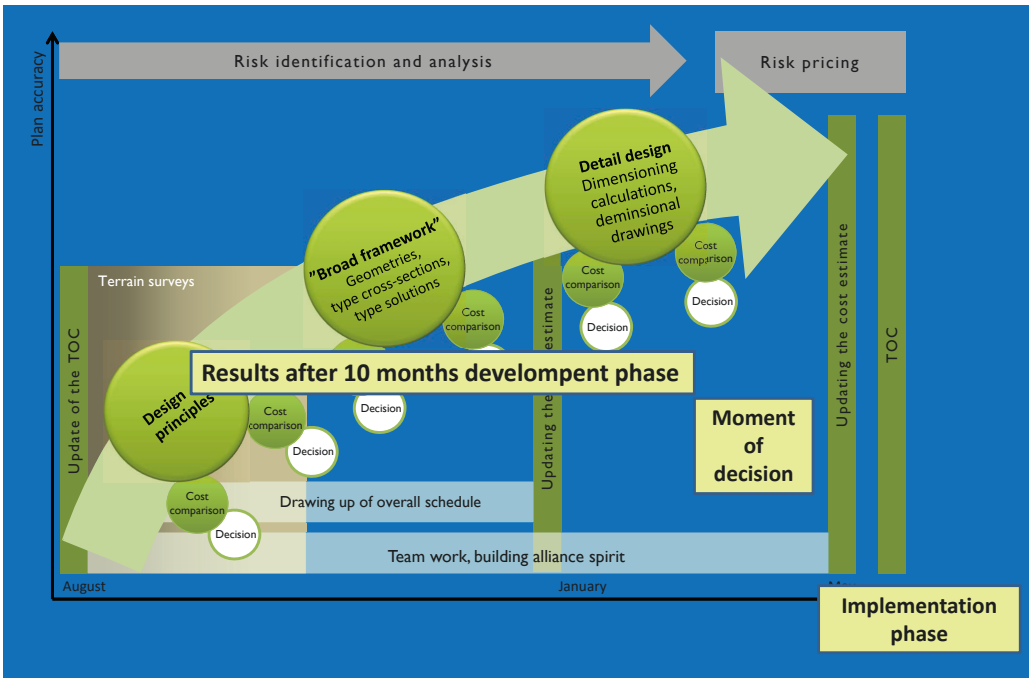


Figure 11. *Setting of the target outturn cost by means of a TVD process during the development phase*

Figure 12. *Evolution of the target outturn cost during the TVD process*

4.3 Ideas and innovations during the development phase and the implementation phase

The target outturn cost for the alliance project was determined during the development phase. In addition to forecasting risks and opportunities, innovations also played a significant role in the setting of the target outturn cost. No structural component could be left out without failing to meet the project's impact targets. A process was formulated for ideas and innovations (the key principles of which are shown in Table 14) in order to achieve the impacts more cost-effectively. The aim of the process was to generate ideas, and the ideas that were found to be in the best interests of the project overall were implemented. Staff were encouraged to come up with ideas and explained the importance of ideas, in addition to which training was provided. Efforts were also made to improve the process by identifying and mitigating obstacles to innovation. The basic premise was to find a way to work more efficiently, get more attention for ideas and identify obstacles, and the aim was to improve the process on this basis.

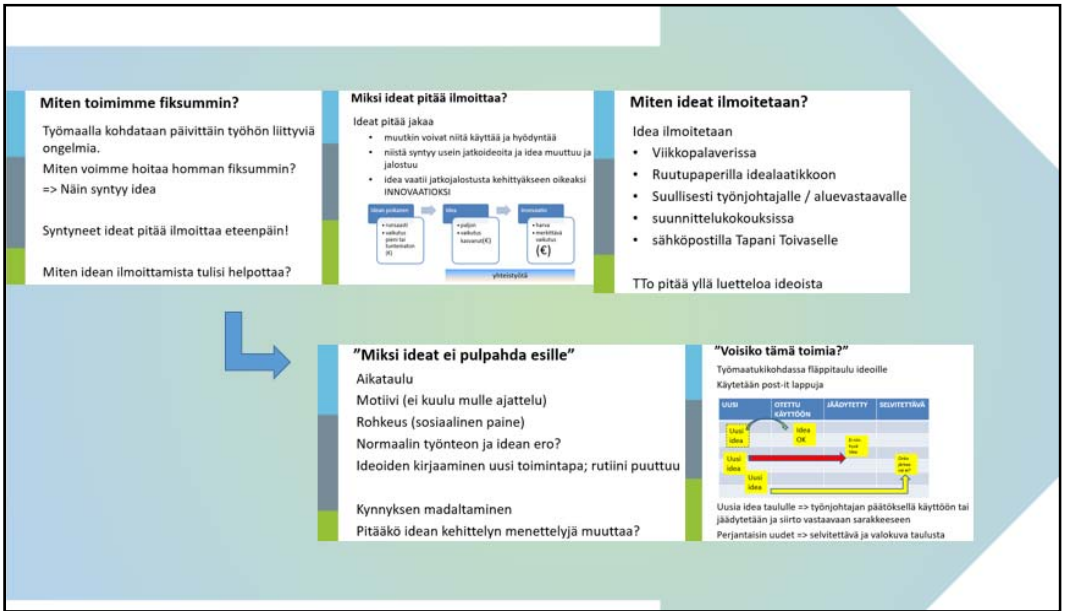


Figure 13. Extract from an innovation workshop presentation

Some of the ideas were found to help cut costs. These were categorised as innovations due to their commercial significance. Innovations resulted in a total saving of approximately EUR 20 million in connection with the setting of the target outturn cost during the development phase.

Table 14. Key principles of the ideas and innovations process

Principles	• A structured process was designed for identifying ideas and innovations • A coordinator was appointed for the process • The process was incorporated into the alliance's operations and routines • All those involved in the project were also given training concerning the ideas and innovations process • Staff were encouraged to come up with ideas and rewarded for innovativeness • The process of designing, planning the implementation of or procuring a previously chosen solution is not discontinued on the basis of an alternative idea (an idea of an alternative design or implementation solution) unless a decision is made specifically to that effect
Promises	• All ideas are explored • Staff members do not need to know whether their idea is feasible when presenting it • All ideas are documented, and a decision is taken on all ideas • Abandoned ideas are not taken off the list • Ideas could be communicated to the ideas coordinator or a supervisor by any means, as the ideas coordinator and supervisors had been trained and instructed to report them forward
Exploration of ideas	• All ideas were added to the list of ideas • A coordinator was assigned for each idea and a target schedule set • As a rule, the coordinator was never the person who came up with the idea (to prevent staff from feeling that coming up with ideas increased their workload) • The coordinators could turn to any member of the alliance for their expertise in order to explore an idea
Deciding on ideas	• A decision was taken as soon as the potential of an idea had been investigated as to whether to approve the idea, continue investigating the idea, discontinue investigations or abandon the idea as unviable or incomplete • Decisions on ideas were based on their impact and taken at the level of management that was the most practical or that had the authority to make the decision • Decisions to discontinue the planning of a previously chosen design or implementation solution were taken once it was clear that the new idea would definitely be more advantageous overall • Decisions to relaunch an investigation into an idea could be taken if new information came to light regardless of whether the idea had been set aside or abandoned
Assessment of value for money	• Ideas were evaluated with regard to technical feasibility, quality requirements, effects on other aspects of implementation, effect on costs, effect on safety and life-cycle impact
Follow-up and reporting of ideas	• Ideas and innovations were reviewed by the design management team, the alliance's Project Team and the Alliance Leadership Team • Ideas and innovations were discussed in engineering team meetings and at coordination events and at the works site as necessary
Incentivisation	• Staff were rewarded for ideas and given feedback

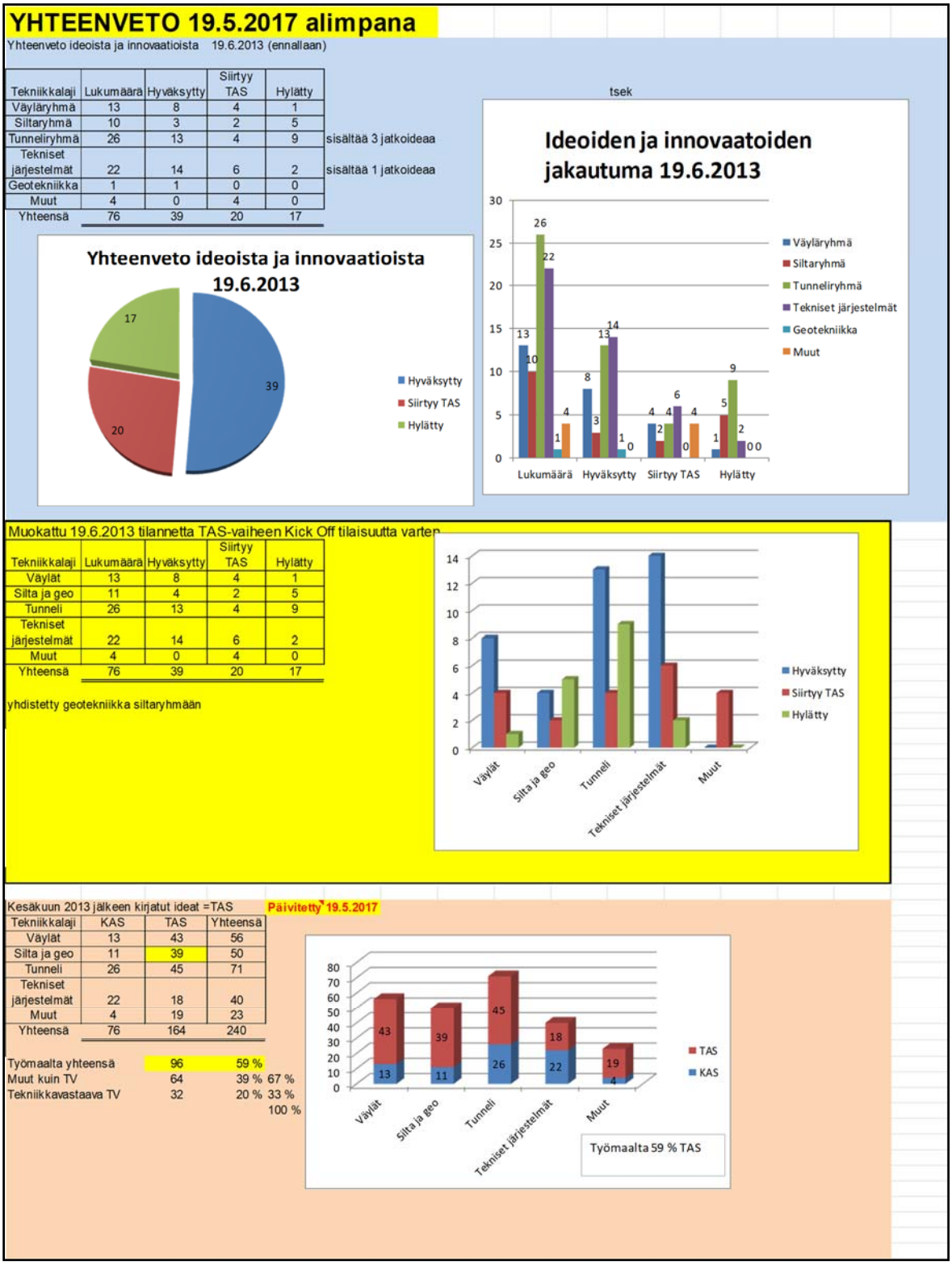


Figure 14. Statistical summary of ideas and innovations

4.4 Pricing of risks and opportunities for the target outturn cost

The target outturn cost incorporated a risk provision as well as predictive opportunities (cost savings). With regard to risks, it made the most sense to agree on the sharing of risks between the owner and the alliance so that the risk provision included in the target outturn cost was justified and the target outturn cost was ambitious.

The key principles of risk management, the division of responsibilities and the sharing of risks were determined at the beginning of the development phase. It was agreed that the alliance would not take any personnel, transport or tunnel safety risks but would manage them by mitigating and, where possible, eliminating them. A systematic, continuous risk management process was adopted for identifying, assessing and controlling risks and for pricing them for the target outturn cost. The main principle of risk sharing was that the alliance would be responsible for any technical risks.

The owner was to be solely responsible for any risks over which the service provider had no control (such as the progress of administrative issues that were crucial for the implementation of the project or unexpected changes to guidelines or regulations concerning design or implementation).

Some risks, such as the risk associated with contaminated soil, were to be shared between the owner and the alliance. Neither the owner nor the alliance were able to affect the collection of information affecting the risk by means of surveys, design or implementation to an extent that would have allowed for the risk to be priced in an expedient and reliable manner. The alliance was nevertheless deemed to be able to minimise effects on costs depending on how efficiently the works site was able to recycle, sort and deposit contaminated soil. The costs associated with the owner's risks and shared risks were calculated transparently.

The total impact of risks on costs was estimated by also taking opportunities into account (as a way of mitigating the impact). There was also a goal to eliminate risks wherever possible, and any residual risks were to be priced as follows:

> *Risk provision included in the target outturn cost = probability (%) x estimated direct impact on cost if the risk is realised*

Risk pricing principles:

- Changes in conditions constitute risks
- Plans on which the target outturn cost was based were based on guidelines and obligations that were in force when the target outturn cost was set
- With regard to pending permit applications, risks were evaluated on the basis of the permit criteria and the owner was to be responsible for any tightening of criteria
- With regard to increases in labour costs, the target outturn cost included labour costs at the level of May 2012 excluding the risk
- Risks relating to cost level increases were factored in as cost-increase provisions
- Life-cycle risks were not included in the target outturn cost
- Insurance was taken out to hedge against damage caused by excavation

Opportunities were managed separately from the risk management process as part of the ideas and innovations process. The risk management process is described in more detail in the project plan of 26 June 2016, in Section 5.1.2 Risk management during the development phase and Section 5.1.3 Principles of risk sharing and pricing for the target outturn cost.

The most notable differences between the risk provision and realised risks were the volume of contaminated soil at the Santalahti works site and the extent of temporary traffic arrangements both within the works site and along routes that were open to the public.

Excavation was carried out across a large area. As the associated source data and findings of surveys only represented a specific location, it was not possible to come up with an informed estimate of the total volume of contaminated soil and the level of contamination. The risk was realised almost five-fold (EUR 1,252,000) compared to the provision of EUR 312,000 included in the target outturn cost. The standard of temporary traffic arrangements was raised in order to minimise adverse environmental impacts and ensure the reliability of logistics at the works site. Approximately four times the provision of EUR 172,000 made for "other risks" (including temporary traffic arrangements) in the target outturn cost was therefore spent on other risks (EUR 735,000).

The total risk reserve of EUR 3,647,500 included in the target outturn cost nevertheless ended up being sufficient, and approximately 84%, or EUR 3,065,000, of it was spent (Table 15).

The target outturn cost also included an assumption of savings resulting from opportunities, which almost equalled the risk provision (EUR 3,800,000). However, savings amounted to more than twice what had been assumed, and EUR 8,366,000 was saved (Table 16).

The most notable difference in terms of opportunities stemmed from the fact that the alliance spent considerably less on supplies than had been anticipated. There was also a relatively large discrepancy between the assumption and the final design costs.

Procurement assumption:
When the target outturn cost was determined, the estimate was that EUR 2,675,000 could be saved by efficient and timely procurement. However, subcontractors were not always willing to give binding prices during the development phase, as the project seemed uncertain based on media reports. This created uncertainty with regard to the target outturn cost. Once the implementation phase began and the uncertainty relating to the project had vanished, subcontractors were more prepared to commit themselves to the project. EUR 12,450,000 was eventually saved on supplies.

Design assumption:
When the target outturn cost was determined, the estimate was that EUR 500,000 could be saved, when in fact EUR 3,724,000 more than what had been anticipated was spent. In other words, design costs vastly exceeded the estimate. The assumption of savings was based on efficient design that would minimise the need to revise plans and phase design according to production needs and progress. However, coming up with a large number of new solutions was also an objective. The number of ideas could not be predicted (240 ideas were explored during the project, see Figure 14). Exploring ideas

increased designers' workload considerably while they also had to produce plans for the production team, and the adoption of approved ideas also resulted in frequent plan revisions. The savings generated by the higher-than-expected investment in design during the implementation phase far outweighed the cost.

Table 15. Risks and their realisation

Risk	**Description**	**Risk provision, EUR**	**Final spend, EUR**
Procurement assumption	All fields of engineering in total	535,000	300,000 (tunnel construction)
Contaminated soil	More contaminated soil needs to be treated than indicated by preliminary surveys.	312,000	1,525,000
Pricing of the tunnel's technical systems	The risk involved in the accuracy of the resource-based input price calculations. The accuracy of calculations based on subcontracting enquiries. The reliability of tenders entails a risk.	365,000	0
The information on the elevation of the rock face and rock quality does not correspond to reality	The estimated reinforcement amounts are based on the results of local studies, and rock quality will be determined in further detail during the probing performed in connection with excavation. Costs may be incurred from phased excavation and immediate reinforcement needs.	200,000	0
Operating principles and calibration of the smoke venting and ventilation systems	Adjusting the smoke venting and ventilation systems may prove to be more difficult than anticipated and require more extensive testing and calibration.	160,000	0
Disturbances caused by blasting	The noise, vibration and/or pressure shocks from blasting create such a disturbance that working hours will need to be adjusted.	160,000	50,000
Timing of excavation works or more cautious excavation methods than anticipated	The timing of excavation works or the need to employ more cautious excavation methods will create additional costs. E.g. issues related to noise or vibration / sensitive properties, hospitals, etc.	160,000	50,000
Operating principle of the fire extinguishing system	No traffic tunnel in Finland has been equipped with an automated fire extinguishing system before. Unanticipated changes may arise in the operating principles, influencing the system's scope and dimensions.	150,000	0
Functionality of the Santalahti excavation	A more-extensive-than-anticipated need to reinforce the bases of supporting walls due to groundwater management	150,000	0

The area of absorbent clay will double	A significant change in reinforcement needs due to absorbent clay, estimated on the basis of survey results (the target outturn cost covers reinforcement along 200 metres of tunnel)	142,500	0
Relocation of municipal engineering systems	The moving of lines and equipment proves to be more expensive than anticipated or requires more planning, integration and resources.	125,000	0
Linking the concrete tunnel to the rock tunnel	The concrete and reinforcement structures entail a cost risk, if rock quality and location diverge from those predicted on the basis of the source data.	125,000	0
Increased amount of work required for routes	Risks involved in existing structures, supports and drainage during work	120,000	175,000 (stabilisation)
Traffic arrangements during the works	Traffic arrangements during the works prove inadequate; traffic will be significantly congested and diverted into the street network. Traffic arrangements need to be changed radically.	90,000	0
The lowering of the groundwater level for the duration of the works will not succeed as planned	Isolating the area where groundwater will be lowered proves more difficult than anticipated, and additional costs are incurred from structures that prevent hydraulic conductivity (supporting walls and additional waterproofing).	75,000	0
Route pricing	Calculation accuracy. The calculations have been made based on resources using input prices.	75,000	0
Increased need for supporting walls	Variations in the rock face at the locations of supporting walls increase the wall area required on top of the rock. Provision: +10%	70,000	0
The commissioning of the tunnel is delayed due to the testing and integration of technical systems	The testing of technical devices, integration of control and information systems, training traffic control centre staff, testing related to tunnel safety and rescue drills take more time than anticipated.	64,000	0
Increased amount of work required for bridges	Inaccuracies in the volume calculations included in the construction plan. The most significant risk relates to the amount of concrete reinforcement required.	60,000	180,000 (concrete tunnel)
Pumping station capacity in Naistenlahti	The capacity of pumping stations proves inadequate and needs to be increased.	50,000	0
Relocation of the rock face at the tunnel's western end	Onkiniemenkatu will need to be cut; drainage and traffic arrangements during the works will be difficult.	50,000	0
Sealing the tunnel during the works	Back-grouting requirements arise after the initial grouting (walls, ceiling and base).	50,000	0

Erroneous space provisions	Additional space requirements arising after excavation. The cost effect will be caused by delays in the schedule and the dismantling of existing reinforcement structures.	50,000	50,000
Hydraulic conductivity of the rock in Naistenlahti	Water will be directed through the rock into the excavation around the mouth of the tunnel, increasing the grouting area.	45,000	0
Inoperability of individual technical systems	The tunnel's interoperability testing is delayed and installation and testing resources need to be increased in order to enable commissioning.	32,000	0
Bridge pricing	Calculation accuracy. The calculations have been made based on resources using input prices.	30,000	0
Excavation delays caused by train traffic	Agreed gaps for carrying out works are not available due to trains running late, for example. The gaps are at inopportune times. Only affects the three railway underpass sections.	30,000	0
Other risks	Geotechnical solutions, grouting spread, degradation of water quality, temporary traffic arrangements	172,000	735,000 (management of public traffic)
Total		**3,647,500**	**3,065,000**

Table 16. Opportunities and their realisation

Opportunity	**Assumed cost saving**	**Final saving, EUR**
Procurement assumption (all fields of engineering in total)	2,675,000	12,450,000
Design	500,000	-3,724,000
Tunnel cladding structures	400,000	-360,000
Earthmoving	175,000	–
Total	**3,800,000**	**8,366,000**

4.5 Roles of the cost expert and the financial expert

Cost expert:

The owner's cost expert, Juhani Immonen from UJI Konsultointi Oy, participated in commercial negotiations during the procurement phase. The cost expert and the financial expert also contributed to checks on tenderers' cost calculation systems. The cost expert contributed to the calculation and setting of the target outturn cost, cost monitoring, checks on unit prices, monitoring of the alliance's procurement costs, risk management and risk pricing throughout the alliance project. Monthly meetings during the implementation phase addressed subcontracting, risks, index development, the adequacy of the organisation and scope changes on the pricing of which the cost expert gave his opinion. The cost expert's comments, memoranda and opinions were reviewed and factored into the alliance's operations.

The cost expert identified the following as his most important conclusions:

- *An opinion was given on the target outturn cost before it was adopted during the development phase. The opinion stated that the target outturn cost was for the most part sufficiently ambitious. Most of the uncertainty in pricing was due to inadequate plans relating to technical systems.*
- *The project organisation worked according to the "best interests of the project" principle laid down in the alliance contract throughout the development phase and the implementation phase. This was always evident in project meetings and solutions to problems as well as in meetings with designers, building contractors and the owner's representatives.*

Financial expert:

The owner's financial expert, Idman Vilén from Grant Thornton Oy, inspected the internal and external accounting of the two best tenderers during the procurement phase, participated in commercial negotiations and contributed to the drawing up of the commercial model. During the project's development phase and the implementation phase, the financial expert ensured that reimbursable costs and fees complied with the commercial model and were based on information that could be verified from accounting systems. The financial expert also carried out regular inspections during the development phase and the implementation phase in order to ensure that bills and payments complied with the alliance contract. Instructions and recommendations given by the financial expert were reviewed and factored into the alliance's operations.

The financial expert identified the following as his most important conclusions:

- *The general aim of the inspection performed by the financial expert during the implementation phase was to review the calculation principles used by the undertaking during the project and therefore to verify that billing principles were correct in view of the commercial model. We reviewed costs entered for the project and ensured that the costs belonged to the project. With regard to the project's direct costs, it was verified, for example, that bills for purchases and costs were based on project accounts and belonged to the Rantatunneli project and that they had been appropriately checked and approved. With regard to personnel costs included in direct costs, it was also verified, for example, that working hours monitoring and project accounts were sound and that the hourly rates used were correct.*
- *With regard to overheads charged to the project, attention was given, for example, to calculation principles and how compliance with them was monitored. With regard to scope changes, we reviewed, for example, the correctness of calculation principles and the soundness of the audit trail (derived from separate cost monitoring).*

4.6 Conclusions, the original target outturn cost and the revised target outturn cost on 3 November 2017

The target outturn cost covered the development phase and the implementation phase. The implementation phase also includes the warranty period. The construction phase was completed in stages: Stage I in November 2016 and Stage II in September 2017. The warranty period will end in stages by September 2022.

Changes made to the target outturn cost by 3 November 2017

The original target outturn cost was EUR 180,299,106 (for more details, see Table 4.1 on page 17 of the project plan). The target outturn cost was tied to the cost level of May 2013.

To calculate the change in the target outturn cost, scope changes (+ EUR 14,042,140) and the effect of the scope changes on the fixed fee (+ EUR 2,389,000) need to be added to the original target outturn cost (EUR 180,299,106) = EUR 196,730,246. The effect of the index (EUR 791,402) then needs to be deducted.

The final target outturn cost was EUR 195,938,844 (EUR 196,730,246 – EUR 791,402).

The target outturn cost changed by EUR 15,639,738
(EUR 195,938,844 – EUR 180,299,106).

As undercutting the target outturn cost determines the bonus payable to service providers, it is reported before the final target outturn cost estimate, which also includes bonuses for both undercutting the target outturn cost and qualitative performance.

Based on the cost estimate, the costs of the development phase and the implementation phase amount to EUR 192,183,048 in total before bonuses.

The target outturn cost was therefore undercut by EUR 3,755,796
(EUR 195,938,844 – EUR 192,183,048).

Table 17. Calculation of the TOC undercut on 3 November 2017 (Lemminkäinen)

TAVOITEKUSTANNUS (TAS)	180 299 106
Laajuusmuutokset	14 042 140
Kiinteän palkkion muutos	2 389 000
	196 730 246
Indeksin vaikutus	-791 402
Lopullinen korjattu TAKM	195 938 844
Loppukustannusennuste ilman bonuksia (lukema tulee suoraan kustannusraportista, KAS+TAS yhteensä	192 183 048
Tavoitehinnan alitus	**3 755 796**

Table 18. Extract from the October 2017 cost report

RANTATUNNELIN ALLIANSSI KUSTANNUSRAPORTTI		20,55 %	20,53 %		31.10.2017
TAKM (LAAJUUSMUUTOKSILLA KORJATTU)	BUDJ.	TOT.	ENNUSTE	MUUTOS	.
VÄYLÄRAKENTAMINEN	33 687 754	31 971 510	33 096 903		97 %
SILLANRAKENTAMINEN JA MUUT TAITORAKENTEET	18 421 724	16 470 287	16 474 916		100 %
TUNNELIRAKENTAMINEN	57 360 063	55 430 931	55 430 931		100 %
TEKNISET JÄRJESTELMÄT	23 627 134	20 108 039	20 997 668		96 %
JOHTOSIIRROT	6 335 604	5 899 654	5 933 991		99 %
HANKETEHTÄVÄT	27 677 606	26 693 616	27 087 892		99 %
RAKENTAMISKUSTANNUKSET (TAS)	**167 109 885**	**156 574 036**	**159 022 301**	8 087 584	**98 %**
KIINTEÄ PALKKIO (TAS)	13 750 000	13 566 250	13 750 000		99 %
SUUNNITTELUKUSTANNUKSET (TAS)	**9 465 869**	**13 004 078**	**13 190 000**	-3 724 131	**99 %**
TILAAJAN HANKINNAT (TAS)	150 000	181 216	193 470		94 %
TAS -VAIHE YHTEENSÄ	**190 475 754**	**183 325 580**	**186 155 771**		**98 %**
KAS-vaihe	**6 200 000**	**6 027 277**	**6 027 277**		**100 %**
KAS + TAS YHTEENSÄ	**196 675 754**	**189 352 857**	**192 183 048**	4 492 706	**99 %**
INDEKSITARKISTUS (MAKU 2010=100, lähtöarvo toukokuu 2013 pisteluku 111,4)					
- %-muutos (75 %)		-0,46 %			
- €-vaikutus		-779 254	-791 402		

5 Gainshare/painshare regime

5.1 Structure of the gainshare/painshare regime

The gainshare/painshare regime consists of the target outturn cost and performance incentives related to qualitative performance in key result areas as well as major event modifiers. The gainshare/painshare regime was formulated on the basis of key result targets set by the owner during the development phase, and it is described in Part 5 Gainshare/painshare regime and key result areas of the Rantatunneli alliance project plan (dated 26 June 2013).

The gainshare/painshare regime helped to steer the alliance's operations towards the owner's targets. The owner laid down key targets to monitor performance. The associated measuring system and the scaling of the results were finalised in cooperation with the alliance. Negative and positive modifiers were added to the gainshare/painshare regime during the development phase in order to increase its steering effect and sensitivity. The gainshare/painshare regime was formulated during the development phase, and it is described in Part 6 Gainshare/painshare regime and key result areas of the Rantatunneli alliance project plan (dated 26 June 2013). If the scope of the alliance project changes, the gainshare/painshare regime also affects the scope change.

The target outturn cost, key targets and positive and negative modifiers were measured and monitored regularly at monthly intervals throughout the alliance project. Monitoring involved verifying results and forecasting the most likely final outcome. Steering involved reacting to results continuously by increasing efficiency in order to improve operations and the end result and to prevent major events.

Target outturn cost: The alliance set a target outturn cost during the development phase based on a unanimous view of how much implementing the project would cost. The target outturn cost included directly reimbursable costs, risk provisions and the fees of A-Insinöörit Suunnittelu Oy, Saanio & Riekkola Oy and Lemminkäinen Infra Oy. The difference between actual costs and the target outturn cost is split between the alliance partners in accordance with the gainshare/painshare regime.

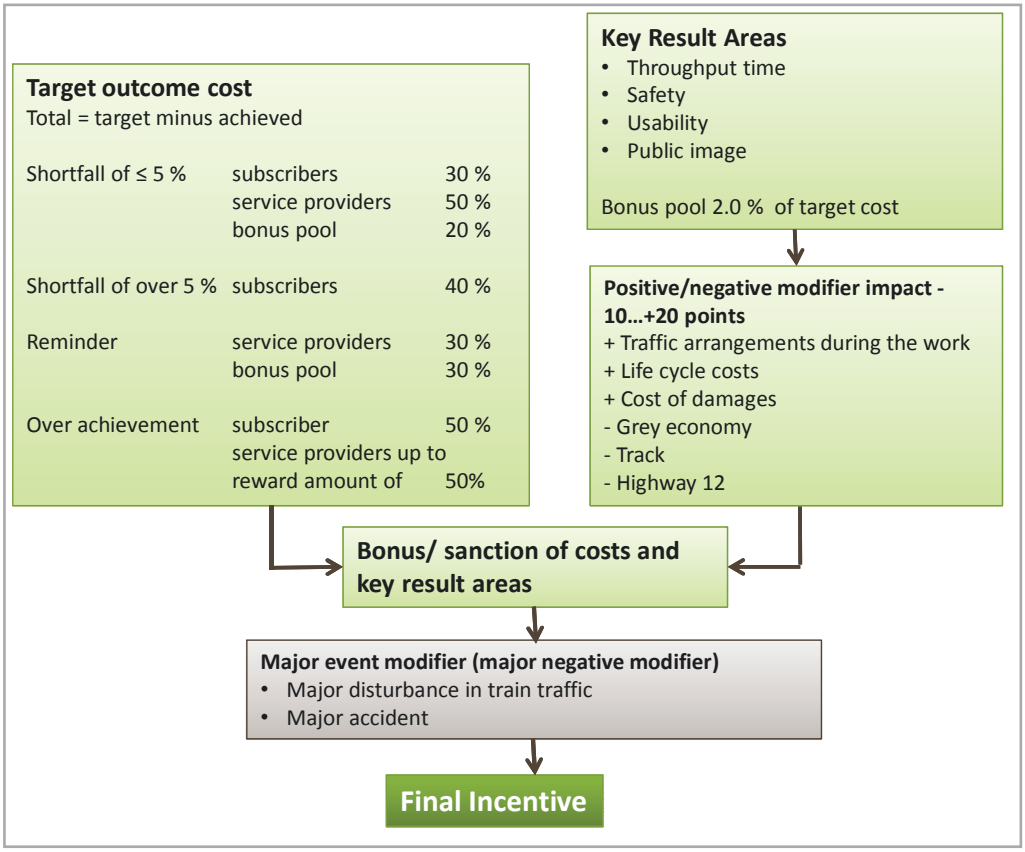
Performance indicators for key result areas: Targets were set for the schedule, safety, usability and public image. The targets were set so that the minimum performance target (0 level) was compared against the average among major infrastructure projects. Bonuses were paid for performance exceeding the minimum level and penalties were imposed for performance below the minimum level.

- Every indicator value of each key result area (points between -100 and +100) was defined as follows:
- The alliance scored +100 points for outstanding or breakthrough performance in accordance with the chosen criteria
- The alliance scored -100 for a total failure to meet the minimum requirements
- The alliance scored 0 for meeting the minimum requirements

Positive and negative modifiers were used to reward or penalise the alliance for results that were critical to success but for which it was not possible or practical to set indicators or indicator values. Positive modifiers could add a maximum of 20 performance points and negative modifiers could deduct 10 points from a score.

Key result area (KRA) performance points were calculated by adding up points weighted according to performance indicators and adding points for positive modifiers and deducting points for negative modifiers.

The bonuses payable to the service providers could be reduced on the basis of **major events**. Should a major event occur, the owner would not pay any moneys from the bonus pool even if the service providers had earned bonuses through their performance.



Performance level	Features
Break through 70-100 points	• A target which has not been achieved in tunnel projects Finland before • Cannot be achieved using previous methods – requires new ways of thinking • The Alliance does not know how it will achieve the target it has set but believes it to be possible and is 100% committed to achieve it.
Exceed 10-70 points	• Has been done before but rarely • The Alliance knows how to achieve the target and is able to use known methods to achieve it but it still requires excellence from the resources/ personnel involved.
Minimum requirement 0-10 points	• Significantly better performance than that of other individual parties in other projects • A performance level reached by the the best operators working together
Partial failure -50-0 points	• A performance level which does not reach the subscriber's minimum performance level
Complete failure -100 -50 points	• The achievement is of an extremely poor performance level

Figure 15. Gainshare/painshare regime and descriptions of performance indicator values.

5.2 Performance in key result areas

The targets of the Rantatunneli alliance project and result targets measuring performance in key result areas were formulated so that the minimum requirement (0 level where no bonuses are paid) was performance above the industry average. The minimum requirements were met or exceeded in all key result areas.

The target outturn cost was undercut slightly, the schedule was cut by six months (which was comfortably better than what had been estimated as the maximum performance), safety and usability were good, and public image improved all through the project. No major events occurred.

The target outturn cost and schedule targets were met without compromising other qualitative targets.

Table 19. Key result areas, final results

Key result area	Weight	-100 points	Target (0 level)	+100 points	Result	KRA points	Weighted KRA points
Schedule Commissioning	30%	-240 days	15 May 2017 according to the project plan	+120 days	> 120 days (six months) Commissioning: 15 November 2016	100 points	30 points
Safety Accident rate Absences due to accidents	10% 10%	100 1,000	14–16 200–160	0 0	11.9 56	15.1 points 84.4 points	1.5 points 8.4 points
Usability; traffic disruptions after the construction phase	10%		See indicator definition.	Zero disruptions	Three minor disruptions 2 points each	94 points	
Public image	20%	40	85–90	100	88	0 points	0 points

Table 20. Positive and negative modifiers, final results

Positive modifier	Weight	Target	Result	Weighted KRA points
Traffic disturbances during construction	+ 10 points + 5 points	KVL same as before the project KVL less than a maximum of 7 % compared to before the project	KVL -1 % less than before the project	+ 5 points
Damages	+ 5 points	Total damages below 0,75 ‰ of the target outcome cost	0,2 ‰ of the target outcome cost	+ 5 ponts
Significant accolade	+ 5 points	Reward for accolade	RIL award-winning site 2016 PRY award-winning project 2017	+ 5 points
Life cycle cost	+ 5 points	Impact over 100 000 EUR/year	Below 100 000/year	0 points
Negative modifier	**Weight**	**Target**	**Result**	**Weighted KRA points**
Highway 12 traffic disturbances	- 2 points - 5 points	Traffic stopped for 6-24 h Stopped for over 24 h	None	0 points
Train traffic disturbances	- 3 points - 6 points	Traffic stopped for 6-24 h Traffic stopped for 24-48 h	None	0 points
Grey economy	- 2 points - 5 points	Observed once Observed twice	None	0 points

Table 21. Measures taken to achieve key result targets

Key result area / results	Measures taken
Schedule: The tunnel was commissioned six months early on 15 November 2016	Efficient coordination and interlacing of tunnel excavation, cladding and works relating to technical systems, modular construction
Safety: Accident rate was 11.90 (minimum target was 14–16) Absences totalled 22.8 days/year (minimum target was 160–200)	Encouraging staff to report safety issues, rewarding good performance, communications, immediate intervention in safety issues, systematic training, high occupational safety standards
Usability: Three minor disruptions have occurred after the tunnel was commissioned (minor disruption = both lanes closed for more than 18 minutes outside rush hours)	Careful and thorough testing of the tunnel's technical systems, traffic control and safety systems. Preparations for commissioning included involving, training and instructing operators, maintenance and servicing staff and rescue personnel sufficiently early. The aim was for different parties to be able to influence the commissioning process and practise and achieve readiness at the right time
Public image: 88% of the publicity received by the project was neutral or positive	Information was disseminated and shared regularly and openly to local residents, stakeholders and decision-makers throughout the project by means of a range of different channels, public events, negotiations, meetings, presentations, social media and conventional media All feedback from local residents and citizens was responded to and action was taken as required

Table 22. Measures taken to achieve the targets set for positive and negative modifiers

Positive modifiers / results	**Measures taken**
Traffic disruptions during the works: Traffic volumes (ADT) along Highway 12 remained almost unchanged during the construction phase despite the works (1% decrease since before the project)	Temporary traffic arrangements for the duration of the works were carefully planned and timed so as to minimise adverse effects on traffic and so that the road was only limited to less than 2 + 2 lanes for a short period of time. The most extensive traffic arrangements were made outside rush hours
Liability for damages: Damages resulting from the works amounted to EUR 36,312.47 (0.2‰)	The effects and potential risks associated with the works were studied carefully and maximum vibration limits were determined for each structure and building, for example. The effects of the works, such as vibration, impurities and noise were monitored closely and action was taken if necessary based on the results. All feedback was investigated
Accolades: The project received two major accolades: An award from the Finnish Association of Civil Engineers in 2016 Project of the Year award from Project Management Association Finland in 2017	
Life-cycle costs: At current energy prices, solutions for lowering life-cycle costs are estimated to generate a saving of approximately EUR 16,000 in energy costs per year and certain benefits the monetary value of which is difficult to estimate or measure	Heating the area behind the cladding structure by means of waste heat from electrical systems LED lighting 30% more waterproofing than what was required, less need for pumping water Increasing the efficiency of ventilation ducts by means of suction chambers Over-pressurisation of technical facilities reduced the need for maintenance and technical faults Modular solutions (duplicated solutions) make maintenance and servicing easier
Negative modifiers	Measures taken
Traffic disruptions along Highway 12: There were no traffic disruptions in excess of 12 hours along Highway 12 during the works	Works and arrangements that could potentially affect the usability of the road were planned carefully and timed so as to minimise adverse effects on traffic
Train traffic disruptions: There were no train traffic disruptions in excess of six hours during the works	Works and arrangements that could potentially affect the railway and its usability were planned carefully and timed so as to minimise adverse effects on traffic
Unreported employment: No cases of unreported employment have been detected	Systematic monitoring of contractors' obligations and diligent procurement

5.3 Final results of the gainshare/painshare regime

The total bonus payable to the alliance's service providers stood at EUR 4,681,509 on 2 November 2017. EUR 1,878,078 of the amount is due to undercutting the target outturn cost and EUR 2,803,431 is due to the successful attainment of performance targets.

Table 23. Final results of the gainshare/painshare regime and bonus distribution between service providers

Kannustinten jakaminen palveluntuottajien kesken		LMK Infra Oy	A-Insinöörit	S&R Oy
Tavoitekustannuksen alitus (50 %)	1 878 078	1 727 446	100 711	49 921
Bonus	2 803 431	2 372 852	230 297	200 281
	4 681 509	**4 100 299**	**331 008**	**250 202**

6 Alliance administration and insurances

6.1 Management system

The management system is described in Section 9 of the project plan. Practically no changes were made to the management system. The project manager's decision-making powers regarding the alliance's purchases were revised at the beginning of the development phase. With regard to the composition of the Alliance Leadership Team, the head of transport from the Pirkanmaa Centre for Economic Development, Transport and the Environment was invited to also attend the ALT's meetings in addition to the actual members of the ALT. The Planning Steering Group was amalgamated into the Project Team during the implementation phase when plans had progressed to the point where planning steering was no longer necessary. The organisation was expanded during the implementation phase approximately one year before the tunnel was commissioned in order for the organisation to be able to take primary responsibility for steering the implementation of the commissioning plan. The handover process was revised as a result of the project being completed in stages.

6.2 Procurement

The alliance's procurement plan is described in Section 9.1 of the project plan. Practically no changes were made to the procurement plan. A new principle was adopted according to which any suppliers of works carried out or outsourced by the alliance's construction partner (Lemminkäinen Infra Oy) would be chosen according to the "best interests of the project" principle and the soundness of the choice would need to be demonstrated. In order to steer subcontractors towards the targets, contract incentives had to be in line with the alliance's key targets. The alliance also had discretion to incentivise the most important subcontractors in terms of the alliance's performance by paying up to 1.5% of the value of the subcontract in additional monetary bonuses. Subcontractors who made a significant contribution to the alliance's targets were paid a total of approximately EUR 600,000 in discretionary bonuses, which ranged between 1% and 1.35% of the value of the subcontract.

6.3 Insurances and securities

The main contractor was obligated to take out liability insurance which would pay out a maximum of at least EUR 20,000,000 towards damages during the development phase. Consultants' liability insurance had to cover all parties and subcontractors and pay out at least EUR 5,000,000.

The security required for the construction phase of the project was 10% of the estimated value of the service provider's share of the construction works excluding value-added tax (reimbursable costs + fee), i.e. EUR 18,029,910.60. The security was revised each year to match the remaining value of the contract.

The security for the warranty period is 2% of the final value of the service provider's share of the construction works excluding value-added tax (reimbursable costs + fee), i.e. EUR 3,605,982.12.

7 Approvals and regulatory compliance

7.1 Approvals

The process for seeking approvals required on the basis of the Finnish Highways Act and the environmental impact assessment procedure for the general plan, road plan and zoning plans was initiated before the alliance project was set up, but the associated appeals processes meant that some of the approvals were only confirmed or became legally binding during the development phase of the project, before construction works began.

7.2 Regulatory compliance

The road plan required under the Highways Act and the associated road tunnel, street and environmental structures were designed and implemented in accordance with the instructions of the Finnish Transport Agency and the City of Tampere. The road plan also factored in Directive 2004/54/EC of the European Parliament and of the Council and the associated tunnel safety guidelines as well as the Finnish Dam Safety Act, as the effects of the construction works extended to the Tammerkoski dam.

The tunnel runs under a body of water (Tammerkoski) and partially below the groundwater table, and the construction works had an impact on groundwater. Rock excavated at the works site was also deposited in water (along the shores of lake Näsijärvi). Applications for permits required under the Finnish Water Act were submitted approximately two years before construction works began, and applications for rock crushing permits and authorisations required during construction, such as noise and vibration notices, were filed and approved during the development phase and the implementation phase of the project.

The terms of approvals relating to design and construction, permit decisions and associated instructions as well as the requirements laid down in the Directive were complied with.

8 Lessons learnt, research and success factors

8.1 Lessons learnt by the owners

The owners of the Rantatunneli alliance project, the City of Tampere and the Finnish Transport Agency, have continued to use alliance contracting in multiple projects based on the lessons learnt from the Rantatunneli project. The City of Tampere is currently building the new light rail system by means of alliance contracting. The services of Tesoma health centre were also put out to tender in the form of service alliancing. The possibility of using alliancing to develop the Tammela football stadium has been investigated in so far as the project is funded by the City of Tampere.

The Finnish Transport Agency has used alliance contracting in seven transport infrastructure projects, one maintenance project and six investment projects that are either being planned, in progress or completed. The projects also involve testing new solutions. In addition to the above, the Finnish Transport Agency is presumably the first Finnish organisation to use its alliancing know-how to put ICT services out to tender (road network surveys and plans to develop an investment cost calculation service).

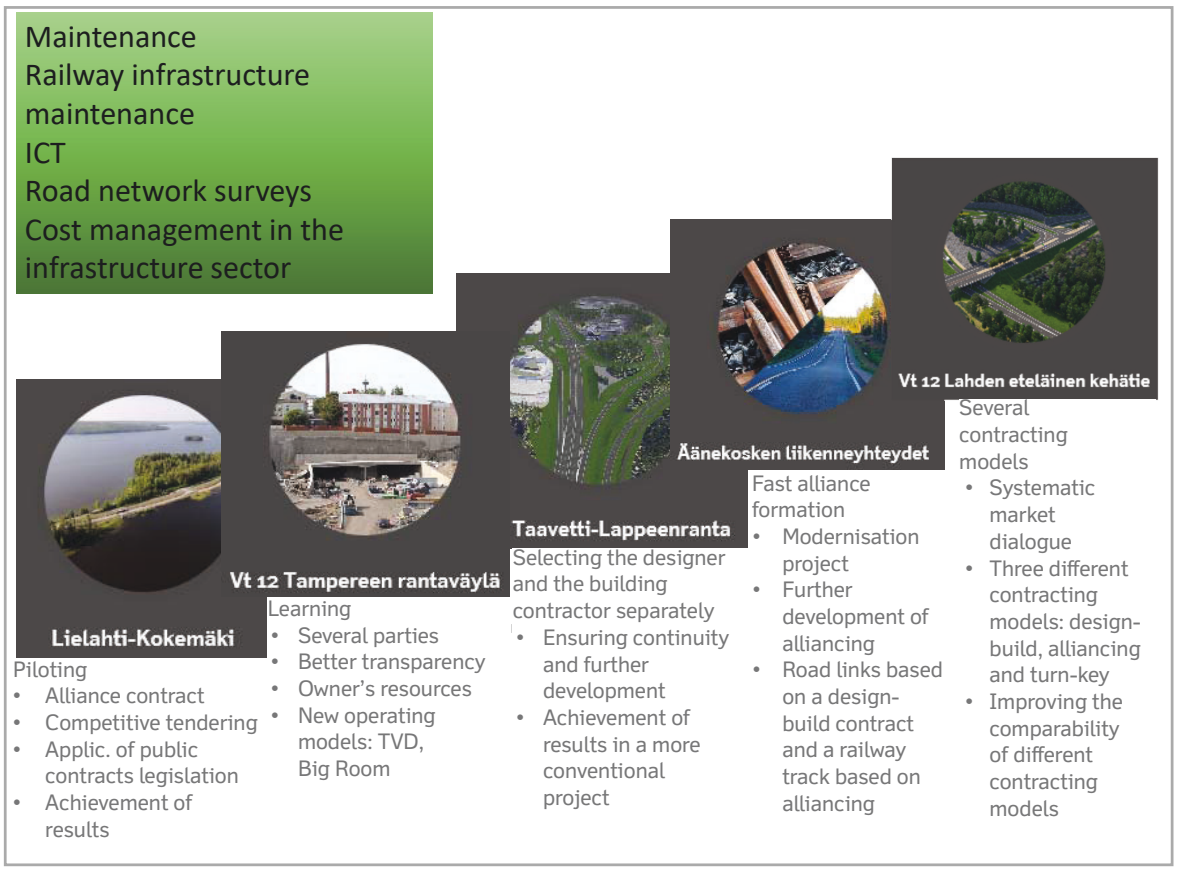


Figure 16. Finnish Transport Agency's use of alliancing

The Rantatunneli project has taught the City of Tampere and the Finnish Transport Agency in particular to form alliances in compliance with public contracts legislation. Lessons learnt from the Rantatunneli project concerning the practical operation of alliances during the development phase and the implementation phase have also been shared within the organisations of the City of Tampere and the Finnish Transport Agency. The most important of the new operating models learnt include the Big Room concept, the Target Value Design (TVD) process and transparent management and operating cultures that reinforce trust. The Finnish Transport Agency aims to also apply the lessons learnt from the Rantatunneli project to more conventional implementation models.

The Rantatunneli project has encouraged several Finnish contracting authorities to test alliancing in their own projects. In practice, this refers to integrated development projects that pool together several Finnish contracting authorities (IPT https://www.ipt-hanke.fi/ and RAIN http://lci.fi/blog/category/ajankohtaista/). The application of lessons learnt from alliancing to conventional models is promoted by participating in the PATINA project, for example.
http://www.vtt.fi/sites/patina/projektiallianssi-väylähankkeiden-toteutuksessa-(patina)

8.2 Studies and academic theses

Alliancing and the associated need for new operating models have been studied extensively in Finland over the last five years. The operation of the Rantatunneli alliance has been studied as part of VTT Technical Research Centre of Finland's research project on alliancing (PATINA), in a doctoral dissertation written for the University of Oulu and in several articles and conference documents as well as academic theses for various educational institutions. A history of the Rantatunneli project was also drawn up, in which the alliance model is extensively discussed and analysed.

The following are some of the most important studies and academic theses:

- Allianssiurakan arvontuoton mekanismit. [Value-creation mechanisms of alliancing.] VTT Technical Research Centre of Finland, Pertti Lahdenperä
- Allianssiurakan taloudellisuus. Infrahankkeen toteutusmuotojen innovaatio-kyvykkyyksien vertailua. [Economic efficiency of alliancing. Comparison of the innovation capabilities of infrastructure project delivery systems.] VTT Technical Research Centre of Finland, Hannu Koski and Pertti Lahdenperä
- Towards a coherent theory of Project Alliancing: Discovering the system's complex mechanisms yielding Value for Money. VTT Technical Research Centre of Finland, Pertti Lahdenperä
- The beauty of incentivised capability-and-fee competition based target-cost contracting. Pertti Lahdenperä
- Towards quantification of the economic efficiency advantage of alliancing in complex infrastructure projects. Pertti Lahdenperä, Arto Saari and Pekka Huovinen
- Kyvykkyydet allianssiprojektin hallintaan. [Capabilities for managing project alliances.] Doctoral dissertation, University of Oulu, Anna-Maija Hietajärvi
- Projektiallianssin käytänteiden soveltaminen perinteisissä urakoissa. [Application of project alliancing practices to conventional projects.] Academic thesis, Toni Tikkanen

- Projektin aikataulun, kustannusten ja niihin liittyvien riskien hallinta. [Management of project schedules, costs and associated risks.] Academic thesis, Arttu Forss
- Allianssimalli siltasuunnittelijan näkökulmasta. [Alliancing from a bridge engineer's perspective.] Academic thesis, Janina Lähteenmäki

A book titled *Tunneli tasaiselle maalle* ("A tunnel on level ground") written by PhD Marko Nenonen, university lecturer in Finnish history, was published in the autumn of 2017.

8.3 Success factors

The Rantatunneli project was a successful project in all respects. The project has attracted an unusual amount of interest among researchers. The following can be identified as the key success factors of the project:

Successful procurement: The procurement process was implemented in a way that increased all parties' trust in each other and willingness to cooperate. The procurement process ensured that the competence of the chosen tenderer's key personnel was at the required level. The service providers' fees were very reasonable. Enough tenderers submitted bids, and the bids were of a high standard.

New operating models: The Rantatunneli alliance invested in the creation and adoption of new operating models. The Big Room concept was adopted at the very beginning of the project, and efforts were made to improve it during the project. The Target Value Design (TVD) process yielded excellent results. The ideas and innovations process was a big part of it and a key element in allowing the target outturn cost to be set below the budgeted appropriations without compromising the scope of the project or standards.

Production efficiency: The phasing and interlacing of tunnel excavation, cladding and works relating to technical systems by means of modular construction resulted in high production efficiency. Another important finding in this context was the fact that increasing the efficiency of production did not compromise occupational safety or quality.

Investing in the commissioning process: Even though the schedule target for the implementation phase was shortened by six months, no cuts were made to the time reserved for testing technical systems. Detailed planning of commissioning began more than a year before the tunnel was due to open, and all stakeholders contributed to the process.

Cooperation and trust: The Rantatunneli alliance managed to create a positive team spirit between all the key parties involved in the project. The Rantatunneli alliance engaged in extensive preliminary planning and dialogue with various authorities. Cooperation between the owners was proactive and aimed at eliminating problems. Cooperation between the different engineering teams within the Rantatunneli alliance worked well and the teams trusted each other, and the same also applied to subcontractors.

Leadership, risk management and problem-solving and decision-making skills: The Rantatunneli alliance was well managed. The alliance set itself challenging targets, which were achieved. The Alliance Leadership Team took a systematic approach to risk management and responding to risks. Project management staff boasted good problem-solving and decision-making skills, and they were able to apply the "best interests of the project" principle even in the face of difficult problems and decisions.

Learning and continuous improvement: Alliancing and lean construction training was provided especially during the development phase. Technical competence was boosted by visits to similar works sites, for example. The organisational model was revised during the project according to the needs of each phase. Several different kinds of events were organised during the alliance project to reinforce team spirit and promote learning as well as a culture of continuous improvement.

8.4 The alliance's competence relative to the requirements

The owner's objective during the procurement phase was to recruit key alliance partners with the resources and competence required for success. Based on the attainment of the targets, the alliance's resources and competence met the requirements effectively.

Additional expertise and resources were recruited through the networks of each of the parties involved in the project as necessary during the development phase and the implementation phase. The groundwork for efficient implementation and especially its launch was laid during the development phase. The most important solutions had been investigated and chosen and plans and conditions for implementation created before the end of the development phase. The cost estimate for the development phase was EUR 6.5 million, which was undercut by approximately EUR 0.3 million. In terms of the implementation phase, the estimated cost of design was exceeded but the estimated cost of construction was undercut by a larger margin.

8.5 Successes and failures of the alliance

Based on the targets and results of the Rantatunneli project, the alliance succeeded and met its targets in open cooperation and problem solving, trust and efficiency. The owners' impact targets were also met.

There was a fine line between efficient use of resources and understaffing at certain critical points of the project. The organisation was designed to be efficient but also relatively thin. Bottlenecks developed, as the operating model also called for open-minded exploration of new ideas. This put a lot of pressure on the organisation at times and sometimes translated into shortages in design resources.

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