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# **Sustainable project management through project control in infrastructure projects**

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## **Abstract**

Sustainability is becoming increasingly important in the delivery of projects as stakeholders require ethicality, eco-friendliness, and economic efficiency during a project's life cycle. Previous studies focused on the environmental aspects of sustainability in project deliverables, whereas less attention has been directed at sustainable project management during project delivery. The goal of this study is to identify the control practices that a project organization uses for sustainable project management. A qualitative single-case study was conducted on a large infrastructure project in which a road tunnel was constructed in a highly demanding environment, involving multiple stakeholders in an alliance contract. The results reveal that sustainable project management is implemented using not only indicators but a holistic control package in which control mechanisms are used differently for different sustainability dimensions. Internal project control is complemented with sustainable project governance, linking the project to its external stakeholders and regulations. The alliance contract activates the partners to exploit innovation opportunities and, thus, promotes economic, environmental, and social sustainability.

*Keywords:* Sustainability, Project control, Sustainability indicators, Sustainable project management, Public-Private Partnership (PPP), Alliance

## 1. Introduction

Projects may succeed and fail in terms of how they reach their goals and how they are managed (Lehtonen and Martinsuo, 2006). The achievement of project goals requires efficient project control (Nieminen and Lehtonen, 2008). Recently, companies and researchers have become increasingly concerned with sustainability as a project goal and as a characteristic of the process through which the project is managed (Gareis et al., 2013; Silvius and Schipper, 2014). Although much research attention has been directed at sustainability-oriented performance indicators and assessment, less is known about sustainable project management, that is, the practices through which projects are controlled to ensure the achievement of their sustainability goals. This study explores the use of project control in sustainable project management in an infrastructure delivery project.

There is no widely agreed on definition for sustainability or sustainable project management (Aarseth et al., 2017). Most of the literature builds on the Brundtland Commission's definition of sustainable development: "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development, WCED, 1987). Despite the high number of different definitions (over 100 according to Aarseth et al., 2017), there is a common agreement that sustainability can be divided into three individual, but interlinked and equally important, dimensions: economic, social, and environmental sustainability (Elkington, 1997, e.g. 1994). This so-called triple bottom-line approach (e.g. Silvius and Schipper, 2014) encourages treating environmental and social issues in the same way as economic aspects when doing business.

One potential area for practical implementation of sustainability is sustainable project management. In project management, attention is clearly moving from immediate project goals to broader business benefits (Atkinson, 1999; Shenhar et al., 2001) and dimensions of value that are more versatile (Martinsuo and Killen, 2014). Companies need ways to incorporate sustainability into project management processes and shift from focusing on the iron triangle of cost, time, and quality to broader impacts (e.g. Silvius and Schipper, 2014). Acknowledging sustainability is extremely important in delivery projects where the deliverables and processes may have a substantial impact environmentally and socially. It is not enough for the company to evaluate the sustainability of the project deliverable, but the project delivery process has to be sustainable as well.

In the present study, in line with Silvius and Schipper (2014, p. 79), we focus on sustainable project management in terms of the practices of "ensuring profitable, fair, transparent, safe, ethical and environmentally friendly project delivery - aiming at a project deliverable that is socially and environmentally acceptable throughout its lifecycle." As the definition points out, sustainability in projects can be viewed from two perspectives: the sustainability of the project delivery (i.e., the process) and the sustainability of the project deliverable (i.e., the product; e.g. Gareis et al., 2013). The focus of this study is the sustainability of the project delivery. Often, the process and product aspects of sustainability are highly interconnected.

Taking into account the three dimensions of sustainability (the triple bottom-line approach) and the two perspectives (the project delivery and the project deliverable), we study sustainable project management in the context of infrastructure delivery projects that offer value

to their customers over a long period of time and involve many stakeholders (Kolltveit et al., 2004; Smyth and Edkins, 2007). Infrastructure projects are typical examples of large complex projects that involve diverse stakeholders and require collaboration between public and private sectors (van Marrewijk et al., 2008; Walker and Jacobsson, 2014). They are typically carried out in public-private partnerships where public sector organizations are the investors and the projects are delivered by private sector companies or consortia. Alliance contracts have received growing research interest in public-private partnerships and they have been proposed as beneficial for sustainability in project deliveries, but more research has been called for (Walker et al., 2015). Sustainability plays a central role in the stakeholders' expectations for infrastructure delivery projects, and fulfilling these expectations during project execution is vital. The implementation phase may cause stress to the surrounding social community and environment and pose a risk of accidents to the operational workforce, for example.

Sustainability can be managed in various ways throughout the delivery of the project (Aarseth et al., 2017). The early phases of the project are critical for defining the total value generated by the project and putting innovations in place (Klakegg, 2009; Kolltveit and Grønhaug, 2004). Companies make significant sustainability-related decisions even with incomplete information on decision parameters and consequences quite early (Wu and Pagell, 2011). During the execution of the project, such value-innovating activities may continue (Kolltveit and Grønhaug, 2004), information is updated, and decisions are implemented in the material choices, process steps, and resource consumption that are manifested in the project deliverables. Previous research on sustainability has focused on the design and planning phase of projects when key performance indicators are created (Boz and El-adaway, 2015; Fernández-Sánchez and Rodríguez-López, 2010; Hwang and Tan, 2012; Klakegg, 2009; Shen et al., 2011). However, limiting the focus of sustainable project management to the design and planning phases of projects is insufficient; the project execution phase is crucial for ensuring the projects are delivered in a sustainable way.

Project control is a central part of the project execution phase. Project control can be defined as “encouraging behavior that is desirable to achieving the organization’s objectives” (Cardinal et al., 2010). Control is practiced by utilizing different control mechanisms which can be grouped into various control modes and configured into a full control package. The context-specific use of different control configurations is a well-accepted phenomenon in management control research (Malmi and Brown, 2008), but so far previous studies have not taken such a holistic view to project control for the different dimensions of sustainability (Cha et al., 2009; Shen et al., 2011). Different control modes have been considered as useful for different types of objectives (Nieminen and Lehtonen, 2008), implying that the achievement of immediate project objectives and longer-term value goals are not necessarily controlled with the same control modes. This suggests that the current focus of sustainability literature on performance indicators provides an incomplete image of sustainability-oriented project control. To make sustainable project management successful and create sustainable value through the project, a holistic view to project control is needed. Therefore, there is a need for research that shows whether and how project organizations use holistic project control for sustainable project management.

The purpose of this study is to explore sustainable project management through project control especially in the project execution phase. The goal is to identify control practices

through which a project organization implements sustainable project management. The study addresses the following research questions:

1. How does the project organization implement the three dimensions of sustainability?
2. How does the project organization use project control for sustainable project management?

The focus is limited to infrastructure delivery projects, particularly the perspective of the alliance organization delivering the infrastructure, and sustainability practice and its project control and management. The focus is on exploring sustainability control mechanisms during the execution phase of the infrastructure project, but the planning phase is included wherever necessary to maintain a link between the issues in the execution phase.

A case study was conducted to explore sustainable project management through project control. The case is a topical example of a large infrastructure project: constructing a road tunnel to replace an existing road through a project organization with a modern public-private partnership (PPP) contract. The special characteristics of the case project include a central location in the city, use of an alliance model, and the participation of the city and a state-owned transportation agency.

In the following section, previous research on sustainability goals, sustainable project management, and the use of project control practices and contract models in infrastructure projects is reviewed. Then, the case research design is described, and the specific features of the tunnel case and the document and interview-based data collection and analysis are introduced. The results show evidence of the use of different control mechanisms as a control package in sustainable project management, point out the need to complement internal project control with sustainable project governance, and reveal the central role of the alliance contract as an integrative framework for sustainability-oriented project control. Finally, in response to the research questions, the findings are discussed in light of previous research. The contributions of the paper to research on sustainable project management are highlighted, along with key limitations and suggestions for future research.

## **2. Literature review**

### *2.1. Sustainability goals and sustainable project management*

Projects are implemented to achieve a certain goal and selected objectives. In addition to the iron triangle objectives of scope, time, and cost, companies are increasingly concerned with a project's broader benefits and value (Silvius and Schipper, 2014). The strategic value of a project can be considered in terms of various social, ecological, and economic dimensions (Martinsuo and Killen, 2014) that are featured in sustainability. Benefits, value, and value creation may imply different things to the project contractor and the customer (Winter and Szczepanek, 2008) and appear differently during the different phases of the project's and the product's life cycle (Labuschagne and Brent, 2005), thus making the specification of project goals very challenging.

Sustainability in delivery projects can be viewed from different perspectives. Previous research has recognized four aspects of sustainability: product related, process related, organization, and people (Marcelino-Sádaba et al., 2015). Sustainability in project business concerns the process of the project delivery and the project deliverable (Gareis et al., 2013). In

this study, the focus is on sustainable project management, that is, the project delivery side of sustainability. However, as the project deliverable is designed and implemented during project delivery, the project deliverable is also affected by sustainable project management.

Sustainable project management implies the use of practices that ensure social, ecological, and profitable delivery of the project so that the project deliverable is socially and environmentally acceptable throughout its life cycle (Silvius and Schipper, 2014). Sustainable project management involves and builds on stakeholder cooperation (Eskerod and Huemann, 2013), includes life cycle thinking (Labuschagne and Brent, 2005), and balances the three dimensions of sustainability (Silvius and Schipper, 2014, building on Elkington 1997). Klakegg (2009) suggested several reasons for the lack of sustainability in project management: conflict of interest, lack of commitment from key stakeholders, low economic benefits of sustainability compared to the required investment, and changing conditions.

Various practices have been introduced to characterize sustainable project management. For example, Klakegg (2009) proposed clearly expressing sustainability as an evaluation criterion, holistic planning with sustainability included in the bottom line, reviewing relevant stakeholders' concerns and expectations, and ensuring flexibility of the delivery of the project to increase the value of the investment. Saving energy during the construction phase and during the life cycle of a building helps cut greenhouse gas emissions (Zhang et al., 2015). Considering the life cycle perspective in road construction projects helps reduce the greenhouse gas emissions involved (Barandica et al., 2013). Sustainability and project management should be integrated (Marcelino-Sádaba et al., 2015) to make sure that project management is updated and ready to face global sustainability-related problems.

## *2.2. Project control for sustainable project management*

The existing literature on sustainable project management has focused mostly on the design and planning phases of projects. To deliver a sustainable infrastructure project, the project also has to be actively managed toward its goals during the implementation phase, and this management is covered in project control. Project control is defined as “encouraging behavior that is desirable to achieving the organization’s objectives” (Cardinal et al., 2010). In this study, an organization’s objectives include the sustainable delivery of projects, and project control is a way to manage projects towards their sustainability goals.

Achieving project goals during project execution has typically been built upon the definition of clear performance measures and verified through the use of various diagnostic project control tools, such as earned value analysis (e.g., Anbari, 2003) and project health checks (e.g., Jaafari, 2007). In addition, a holistic viewpoint can be taken for project control, following a behavioral science approach and building on organizational control, rooted in permanent organizations and manager–subordinate relationships (e.g., Ouchi, 1979; Simons, 1994). In the holistic view, control can take many forms, and it is typically divided into control modes (e.g., formal and informal control) and control mechanisms (e.g., rules, plans, budgets, schedules, and social control; Nieminen and Lehtonen, 2008).

Organizations utilize different combinations of control modes and mechanisms in different projects (Kirsch, 1997; Liu et al., 2014; Nieminen and Lehtonen, 2008), and this combination may be referred to as a control package. For example (Nieminen and Lehtonen, 2008), the control mode of bureaucratic control includes various boundary mechanisms (rules,

directives, codes of conduct) and diagnostic mechanisms (plans, budgets, resource allocation, schedules, performance measures, incentives, reports). The control mode of clan control may feature belief mechanisms (mission statement, vision, values) and interactive mechanisms (project manager selection, training, team control, culture). The control mode of self-control may include autonomy on three levels (decision power on daily matters, working methods, project goals).

The existing project control literature has focused on understanding the antecedents and the performance effects of different control package configurations in different projects (Liu, 2015). However, regarding the desirable objectives toward which project control is targeted (Cardinal et al., 2010), the existing studies have either taken a broad consideration or, at least implicitly, focused on the iron triangle objectives. None of the existing project control studies cover the use of control mechanisms for sustainable project management. In addition, few studies have focused on infrastructure projects with a holistic approach to project control.

In the sustainability literature, different diagnostic mechanisms, primarily performance indicators, have been reported as the main method for managing and ensuring sustainability (Amiril et al., 2014; Fernández-Sánchez and Rodríguez-López, 2010; Haponava and Al-Jibouri, 2010; Shen et al., 2011; Ugwu et al., 2006). These indicators are typically determined during the initiation and planning phases of the project, and they are then used as key measures for monitoring project status or performance in the project execution phase (Aarseth et al., 2017). According to the literature, these indicators should be case-specific (Ugwu et al., 2006), cover multiple dimensions of sustainability (Amiril et al., 2014), and meet the varying goals of different stakeholders (Fernández-Sánchez and Rodríguez-López, 2010). However, the empirical results of utilizing sustainability indicators vary (Gareis et al., 2013; Haponava and Al-Jibouri, 2010). Shen et al.'s (2011) review pointed out that, in general, the proposed indicator sets fail to meet the stated goals for the three dimensions of sustainability (economic, environmental, social).

Although indicator sets that are holistic exist (Shen et al., 2011), many of the proposed indicator sets focus on a particular dimension of sustainability, for instance, on the environmental dimension. Even if a holistic indicator set is utilized, considering the dimensions separately can lead to trade-offs between the dimensions (Bond et al., 2012). Thus, a systemic approach targeting net sustainability gains should be adopted (Gibson, 2006). Developing new sets of performance indicators for sustainability may be considered simply “yet another new system” by project personnel (Gareis et al., 2013). Instead of having a separate system for sustainability goals, empirical results have shown that sustainability issues and indicators should be an integral part of a company's existing project management model (Gareis et al., 2013).

In comparison with the wide range of control mechanisms identified in the general project control literature, monitoring and use of performance indicators provide an incomplete image of project control when pursuing sustainability goals. The indicator-centric approach to control may be problematic as project performance indicators often lag (Williams et al., 2012) and may not cover the project value and benefits over the project life cycle. Figure 1 concludes the initial framework for this study. The research evidence from the general project control literature would suggest a wider set of control mechanisms (i.e., a control package) also with respect to project sustainability goals, despite the dominant emphasis on performance indicators and

monitoring. This study focuses on the triple bottom-line approach during project implementation, and acknowledges that various stakeholders are involved in the project.

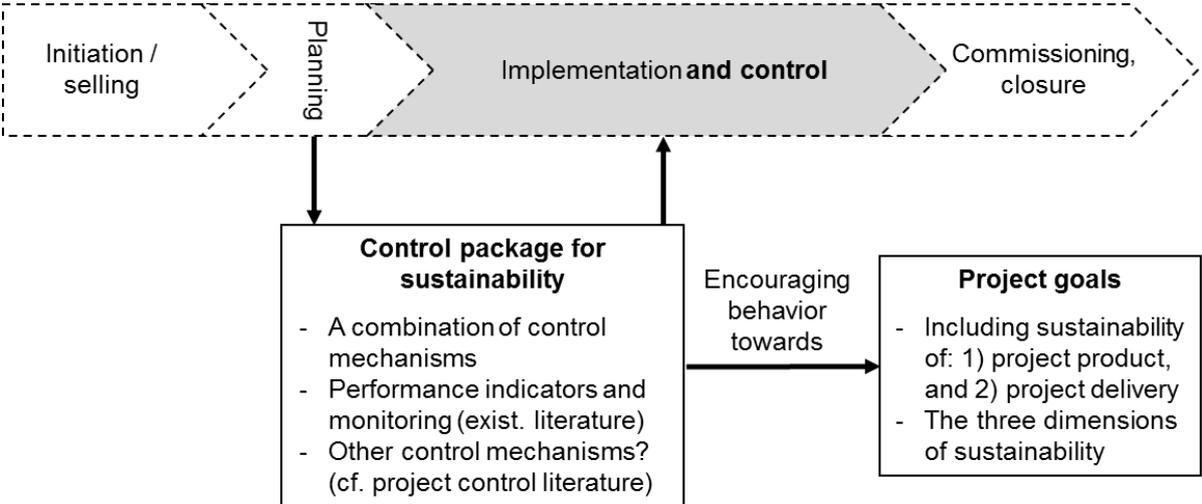


Figure 1. Initial framework: project control towards sustainability goals.

2.3. Contract models guiding project control in infrastructure projects

Infrastructure delivery projects are typically public-sector investments, with long-term goals aimed at creating or improving specific infrastructure, such as roads, residential areas, tunnels, electricity grids, or railroads. Today, instead of direct public procurement, infrastructure projects are often delivered through a project consortium that may involve private-sector firms in the financing, design, delivery, and operation of the infrastructure. These PPPs have become more common during the past few decades and take many forms (Walker and Jacobsson, 2014). PPP good practices are increasingly studied and understood. Some PPP contracts are formal alliances that imply early partner involvement, risk and benefit sharing, and highly collaborative project delivery (Turner and Simister, 2001; Walker and Lloyd-Walker, 2016). PPP projects vary in their complexity and uncertainty, and alliances are seen as particularly suitable for high degrees of complexity and uncertainty (Turner and Simister, 2001).

Alliances in PPP projects have been considered particularly suited for situations where uncertainty about the project deliverable and project delivery and complexity are high, and the customer could contribute to the project (Turner and Simister, 2001). Alliance forms of PPP contracts have been studied, such as in transportation, tunnel, and railway projects (Guo et al., 2014; van Marrewijk et al., 2008; Walker and Jacobsson, 2014), the offshore oil and gas industry (Halman and Braks, 1999), and construction projects (Walker and Lloyd-Walker, 2016). Alliances are perceived as suitable for enhancing value-for-money, reducing risks and costs, and improving project performance (Halman and Braks, 1999; Suprpto et al., 2015; van Marrewijk et al., 2008).

Much of the previous research on PPP projects has focused on approaches to contracting, planning, and negotiating or forming alliances at the front end of the project (Walker and Jacobsson, 2014; Walker and Lloyd-Walker, 2016); assessing, modeling, managing, and sharing risk (Clifton and Duffield, 2006; Grimsey and Lewis, 2002; Guo et al., 2014; Ng and Loosemore, 2007); and managing trust, collaboration, and relationships (Ruuska and Teigland,

2009; Smyth and Edkins, 2007; Zou et al., 2014). Previous researchers acknowledged that infrastructure projects by nature pursue long-term service outcomes (Clifton and Duffield, 2006) and involve long payback periods (Ng and Loosemore, 2007). Thus, the sustainability of a project's deliverable or a product's life cycle must be considered (Lenferink et al., 2013). Walker et al.'s (2015) study revealed that sustainability issues are clearly and well covered in project goals at least in Australian alliance projects.

In sustainable project management of infrastructure delivery projects, the entire life cycle of the project must be considered, especially its impact on relevant stakeholders. Large projects and infrastructure delivery involve and affect many stakeholders (Kolltveit and Grønhaug, 2004; Smyth and Edkins, 2007; van Marrewijk et al., 2008), each of which, particularly in PPPs and alliances, may have its own perceptions of sustainability value. To ensure that a project is sustainably managed, the different perceptions that stakeholders have of sustainability must be understood (Abidin and Pasquire, 2007), and a common sustainability goal should be found among the stakeholders (Fernández-Sánchez and Rodríguez-López, 2010). In addition, cooperation is required among stakeholders to ensure and maintain sustainability (Shen et al., 2007).

Regarding the assessment of sustainability, each project should be examined individually, and stakeholders should be involved throughout the assessment process (Bond et al., 2012). In a study of project deliverable-related sustainability, the inclusion of customers, owner/operators, contractors, and sustainability consultants in the project design phase was reported to lead to lower operation costs and better energy efficiency, durability, and maintainability of the building in question (Wang et al., 2014). In a study of Dutch road infrastructure projects, including partners in design-build-finance-maintenance projects optimized the project's life cycle (Lenferink et al., 2013). The same study found that the reward criteria set during contracting improved the stakeholders' inclusiveness. In a study of infrastructure projects, including stakeholders in the development of the projects yielded a number of benefits, for example, greater access to resources, increased transparency, and increased support among the stakeholders (Arts and Faith-Ell, 2012). Such benefits are helpful in ensuring the sustainability of a project. Nevertheless, various challenges exist in all project phases that can reduce or hinder inclusiveness.

To conclude, sustainable project management has not received enough attention, and the viewpoint of project control for sustainability has been covered merely from the perspective of diagnostic controls (indicators and their monitoring) and dominantly for environmental sustainability. As infrastructure projects are intended to deliver value-creating capacity for their stakeholders over a long time, their sustainability value needs to be built proactively, and their social and environmental impacts need to be controlled already during projects execution. To complement previous research, the present study adopts a proactive approach to sustainability and explores how project control is used in sustainable project management.

### **3. Methodology**

#### *3.1. Research design and case background*

We followed a case study methodology, due to the exploratory nature of the research, the limited amount of previous research in sustainable project management, and the intent to develop knowledge on the phenomenon of promoting sustainability in its real-life context. Case

studies have been considered particularly suitable for how and why research questions and for studying a contemporary phenomenon in its real-life context particularly when the boundaries between the phenomenon and the context are not clearly evident (Yin, 2014, p. 9). To gain access to a case replete with sustainability practice, we designed a holistic single-case study setting in which the intent was to identify a critical case (Yin, 2014, pp. 50–51) of an ongoing and, thus, topical infrastructure delivery project in which sustainability is relevant. We scanned alternative, ongoing public-private partnership projects in search of a case that would be topical, publicly well communicated, accessible, and ongoing so that document data could be complemented with key informant interviews.

The chosen infrastructure project is a road tunnel project in [a European country]. The estimated budget is approximately 180 M€ (excluding VAT), and the execution phase is scheduled to last from October 2013 to October 2017. Considering the project environment, the project is remarkable with a notable impact on the traffic in and around the city where the tunnel is being built. The project has generated 1000 person-years of work and employs 300 persons, on average. The scope of the project includes drilling, blasting, excavating, and building a road tunnel and all the related and needed road re-organization activities and other infrastructure additions and modifications. The project is highly demanding due to its context: The tunnel is located in the middle of a city and is affected by nearby water areas. These two aspects make the project environment quite challenging and complicated: The project must be executed in such a manner that its effects on the inhabitants, buildings, and city infrastructure are anticipated, minimized, and communicated well during construction, and the risks regarding the nearby water areas in terms of environmental effects and threats of flooding are mitigated well. Due to the project's significant influence on the city inhabitants over many years, the project's progress has been communicated broadly in the public media, which enables an in-depth document-based study.

The project involves five main partners, and its PPP contract follows the logic of an alliance. Alliance means a consortium — formed between the customer (investor, owner) and one or more contractors and/or possible public institutions — that shares the risk and benefits of the project at hand. The alliance includes the national transportation agency as the owner of the project, the city as the sponsor, the private-sector main contractor, and two private-sector planning offices as the central delivery partners. In addition to the core of the alliance, the larger project network includes numerous subcontractors and other actors (e.g., authorities). For the project investigated in this study, value-for-money, risk and cost reduction, and mutual performance expectations were the foundation for why an alliance was selected as the contract form. A relational approach (i.e., an alliance) (Hobbs and Andersen, 2001) was used in the front end and in the execution phase of the project.

The case research design included a document-based event study that was complemented with key informant interviews. Due to the sensitive nature of the project context, the project activities have been communicated extensively through public media, which offered a rich source of data for this study. As the project was ongoing at the time of the study, key informant interviews were chosen as a means of adding depth and detail to map the practices of promoting sustainability and to increase the validity of the findings.

### 3.2. Document data collection and analysis

Document-based data were collected mainly from public sources, including the most well-known newspaper in the target city (Newspaper 1), the most well-known newspaper in the target country (Newspaper 2), the Internet archives of both newspapers, and the project's website. The data include documents, such as news articles, the preliminary project plan, and a value-for-money report. A total of 350 news articles were identified starting from late 2007 until September 2016 (307 from Newspaper 1 and 43 from Newspaper 2). Of these articles, 84 were about the tunnel itself, and 266 articles were about phenomena surrounding the project or only partly concerned the tunnel. All the articles were reviewed, and 76 articles were categorized as highly relevant for the sustainability study. The tunnel project has remarkable political significance, as politics was involved in more than one third of the articles (130/350). Fifty-eight articles covered one or more dimensions of sustainability.

The collected news articles were the primary data for sustainable project management, and they were systematically analyzed and categorized under various sustainability dimensions. An issue was coded as "economic" when the newspaper article included a clear specific positive or negative statement about an economic effect, method, result, or need in the project. The issues labeled "social" or "environmental" were coded in a similar way, when social or environmental effects, methods, results, or needs appeared in the news. Table 1 presents the number of articles covering different sustainability dimensions and examples of each dimension to illustrate what types of issues were coded in each category. Some articles covered more than one dimension, and then all dimensions were coded.

Table 1. Summary of articles covering sustainability issues in the media news data.

Sustainability dimension	Newspaper 1	Newspaper 2	Total	Example quote
Economic	8	2	10	"It is likely that we will achieve savings through this way [alliance model] of working, [the director] estimates."
Environmental	10	2	12	"Protective equipment is used to prevent the water in the nearby lake from becoming dirty."
Social	44	2	46	"Today, Tuesday, a public hearing will be arranged for those living on the tunnel line."

A summary was formed from the categorized news articles and selected other documents, categorized into the environmental, economic, and social aspects of sustainable project management. The articles, the value-for-money report, and the preliminary project plan were cross checked to evaluate the consistency of the documents and to find possible new forms of sustainability as part of the project. We cross-tabulated the main findings and selected informative quotes to illustrate and enrich the key findings. When a quotation refers to a document source, the newspaper source is labeled in the quotation. This primary analysis was used as a foundation for developing the outline for the interviews.

As the news articles did not cover the internal control dynamics of the project and the alliance well, the control practices were primarily analyzed from official project documents and the interview data, while the news articles were treated as supportive material.

### 3.3. Interview data collection and analysis

We initially contacted the project manager of the alliance, to gain access to the project personnel knowledgeable about sustainable project management, and this contact person proposed other interviewees. The interviewees were chosen based on their expertise and central role in the project organization. Five key informant interviews were carried out, and the informants' roles and the duration of the interviews are summarized in Table 2. All the interviewees were male, and they have an average of 22 years of experience in project business (range 10...34). To ensure the anonymity of the interviewees, job title information is not provided when quotations are used to support the analysis. For this article, the quotations were translated from [the interviewees' original language] into English.

Table 2. Summary of interviewees and interview duration.

Job title	Partner in the alliance	Interview duration
Project Manager	Contractor	68 min
Project Engineer	Contractor	94 min
Road Engineer	City	75 min
Project Manager	Transportation agency (Customer)	91 min
Section manager for roads (Safety Officer)	Contractor	35 min

The semi-structured interview outline was developed based on the literature review about sustainability and sustainable project management, and the initial findings of the document analysis. The interview outline included topics concerning the role of the interviewee in the project, the PPP contract model, cooperation among the project stakeholders, and the respondent's experiences in the project's sustainability dimensions. The semi-structured approach enabled the interviewees to share their experiences and opinions very openly and broadly, and the interviewer could state further, more detailed questions, depending on the interviewees' responses. The interviews were recorded and transcribed.

The analysis of the interviews followed an ordinary thematic analysis approach and proceeded from reading and re-reading the transcripts to rough content-based coding. With sustainability dimensions, the same thematic approach and cross-tabulation were used as in analyzing the document data. Additionally, the sustainability-oriented properties and implications of the alliance contract were emphasized, and the stakeholders' different expectations were identified. These aspects were summarized. Regarding project control practices, three areas were coded: the activities of the controllers and controllees, the control mechanisms (further divided into planning, regulations, metrics and indicators, and external communication; and mechanisms related to the alliance contract), and the sustainability dimensions associated with each control mechanism. The coded data were grouped to aid in the case reporting, then illustrative quotes were selected, and the findings were summarized and cross-tabulated thematically. When writing up the results, we cross-checked and compared the document data and the interviews repeatedly, as a means of data triangulation.

## 4. Results

### 4.1. *The tunnel project overview*

The delivery of the project relied upon an alliance contract, which is the term used for a consortium formed by the customer and one or more contractors and involving a clear risk- and benefit-sharing scheme. Construction of the tunnel had been discussed for a long time before the actual construction started, with the first idea mooted in the mid-1990s. The tunnel project was used as a tool in local and national politics, and its acceptance (or not) depended on the changing political climate of the time.

Before the project started, the target budget was a controversial political issue. The alliance model was chosen because it was considered the optimal way to achieve the target budget and schedule. No single contractor would have been able to competitively bid on such a large project due to pricing in the risks. With the alliance model, the risks could be mitigated, and the costs brought down. An interviewee stated, “I strongly believe that this project would not have been possible with any other forms of delivery.”

The project was put out to tender, and two-step competitive bidding took place. Two alliance coalitions were invited to the second phase, and their proposals were assessed using a specific set of criteria. When the alliance coalition was finally selected, the planning phase started with a core team that included the contractors, the city representatives, and the national transportation agency. The planning phase continued from the fall of 2012 until the fall of 2013. Through close and open collaboration among the project organization members (i.e., the alliance) in the planning phase, the budget was reduced to an acceptable level. One interviewee explained the process:

“The first estimate [before the beginning of the alliance collaboration] from our planning engineers was 220 MEUR. Over the course of one year [of the alliance collaboration], we made it to 180 MEUR, without altering the scope or reducing the quality.”

After the last round of voting on the tunnel by the city council, the construction phase began in the fall of 2013. The early phases of the project implementation included the excavation, drilling, and blasting of the tunnel. At the time of writing this paper (2016), the tunnel project is nearing completion: the tunnel has just been opened for public use, new traffic routes have been established, and the project is ahead of schedule by six months.

### 4.2. *Sustainability and sustainable project management in the tunnel project*

When the project started, some extreme opinions in the media stated that the excavation and blasting had the potential to cause the collapse of apartment buildings close to the excavation sites. This danger was never real, but it gives an idea of how worried some stakeholder groups were and why they opposed the project. The media took a neutral stance in this debate, publishing articles for and against the tunnel project. Another concern voiced in news articles was that the construction would reduce groundwater levels. However, the media reported that the tunnel project would have a positive local effect on the construction industry in general.

The identified possible negative effects of the construction work on the environment included noise, dust, vibration, and exhaust gas emissions. In addition, waste pile-up in nearby bodies of water was reported in the media to have happened. The location of the project in the

city center and close to large bodies of water meant that the surrounding area was very vulnerable to negative environmental effects. According to the preliminary project plan, the damage to and the effects on the environment during the construction phase should be as low as possible. The expectation of minimizing environmental effects was targeted through many little actions protecting or preserving the surrounding environment, for example, monitoring the groundwater levels and acting accordingly, preventing the water in the nearby lake from becoming dirty, and measuring multiple, predefined attributes from vibration to air quality.

In the alliance model, the actors make decisions jointly, and they try to find the best possible outcome through joint idea creation, a bonus system, and shared risk management and opportunity exploitation. The alliance model is based on mutual interests and clear plans that are agreed upon by all the partners in the alliance. The interviewees felt that one of the biggest advantages of the alliance model was the collaborative spirit, reflecting the social dimension of sustainability. When all the actors involved in the project organization worked together toward a common goal, many unnecessary debates and even quarrels were avoided. Building mutual trust between the actors helped them reach the full potential of their collaboration and avoid sub-optimization, thus contributing to the economic and environmental sustainability dimension of the project as well. In general, all the interviewees were very happy with the collaboration in the alliance model. An interviewee from the contractor company praised the alliance's collaborative spirit: "There's no fighting with the customer [in the alliance model], which is a rather remarkable and stressing part of traditional contracting. Here, the energy is allocated correctly and in a productive way without extra effort."

An important social issue in addition to the collaborative spirit among the alliance partners was the location of the tunnel site. With the construction taking place in the backyards of many inhabitants, some inhabitants were worried about the effects of blasting and drilling on their houses, and others were annoyed by the restrictions placed on boating on the nearby lake. Before the construction phase started, people were angry and hostile toward the project. However, as the project proceeded, they became interested in how the work was being done and how it would affect their daily lives. One interviewee highlighted the change in the atmosphere of the public hearings:

"In the planning phase, the focus of the public hearings was basically on resisting the project. However, when the project then actually got under way, the nature of the events shifted to genuine worries about and interest in the effects of the project."

According to the preliminary project plan, the alliance would help manage the project risks and better capture potential opportunities. The interviewees felt that this was the case. The project was ahead of schedule. The success was due to, among other things, the 76 innovations (potential opportunities) identified in the planning phase. Of these innovations, 39 were applied during the planning of the project, 20 were implemented during the construction phase, and only 17 were rejected. Having a common goal helped the alliance come up with innovative ways of working. Newspaper 1 stated, "Because we had a common goal, it brought many new aspects to the ways of treating risks, capturing opportunities and solving problems, the vice-project manager says."

These innovations and ideas saved money and speeded up the project, thus enhancing economic sustainability. As many of the ideas also had positive effects on the surroundings and those who live near the construction site (not just on the project budget and schedule), the

collaborative process of decision making and idea creation promoted the sustainability of the project in all three dimensions. For example, one proposal in the preliminary project plan was to “dramatically reduce the disturbance experienced by the inhabitants.” As the duration of the project was cut, it directly improved sustainability because every day that the construction was under way had negative impacts to the surrounding environment and the local inhabitants affected by the project. Table 3 summarizes the findings of the interviews and document data on how sustainability and sustainable project management were implemented in the tunnel project.

Table 3. Summary of sustainability and sustainable project management in the tunnel project.

Dimensions of sustainability	Economic	Environmental	Social
Evidence from the interviews	<ul style="list-style-type: none"> <li>+ Costs were cut thanks to the alliance model, mainly because of the joint planning phase</li> <li>+ Compensation model is likely to provide savings for each party</li> <li>+ Multiple innovations in the planning phase and some in the execution phase</li> </ul>	<ul style="list-style-type: none"> <li>+ Dust-binding and noise-reducing work methods</li> <li>+ Comprehensive environmental effects measurement</li> <li>+ Environmental metrics are indirectly linked to the compensation model</li> <li>+ Open discussions and joint development with environmental authorities</li> </ul>	<ul style="list-style-type: none"> <li>+ No fighting between the alliance actors</li> <li>+ Collaborative spirit</li> <li>+ Fast decision making through working side by side with the customer</li> <li>+ Public hearings about the project</li> <li>+ Public image of the project is a key result objective</li> <li>+ Public project plan, transparency</li> </ul>
Evidence from the documentation	<ul style="list-style-type: none"> <li>+ Using local sub-contractors boosts the local economy</li> <li>+ Cost savings were achieved through the alliance model</li> <li>- Alliance model and its bonus system can cause sub-optimization favoring the economic dimension of sustainability</li> </ul>	<ul style="list-style-type: none"> <li>- Small waste pile-up in the nearby lake</li> <li>- Decreased groundwater level</li> <li>+ Follow-up of the vibration levels through continuous measurements, and before and after follow-ups</li> </ul>	<ul style="list-style-type: none"> <li>+ Strong presence in media throughout the project</li> <li>+ Ahead of schedule</li> <li>- Political weapon</li> <li>- Many inhabitants opposed the project at first</li> <li>+ The public atmosphere improved during the project (public hearings and media presence)</li> <li>+ Public documents, e.g., project plan</li> </ul>

According to the interviewees, the alliance as the delivery model ensured that the full potential of all relevant contractors could be utilized, in the area of sustainability. In traditional delivery models, a contractor might be reluctant to innovate or put forward ideas, as they might not benefit the contractor. In addition, much sustainability-improving potential might not be fully utilized, and the contractor might not have access to specific information or the resources needed to realize ideas and proposals. In the alliance model, these problems were overcome by bringing the core project organization members around the same table and by binding the shared bonus system to common goals. The openness and transparency of the actions were found to be good on the customer side. Newspaper 1 reported:

“According to the [director of the future owner of the tunnel], the alliance model is the best possible delivery model to carry out a construction project, as all invoices, subcontracts, and other payments run through the same

bookkeeping. -- No actor can take advantage of another. It is likely that we will achieve savings through this way of working, [the director] estimates.”

However, the strong bonus system focus of the alliance model might also lead to sub-optimization when considering sustainability. Even with the two public organizations involved, the alliance was accused of not choosing the most environmentally-friendly solution in the tunnel’s ventilation and exhaust gas cleaning because it was too expensive.

#### *4.3. Control mechanisms for sustainable project management*

The interviewees emphasized the importance of the financial incentive model of the alliance contract as a key control mechanism in sustainable project management. The interviewees described how the main goals of the project were included in the incentive model. A preliminary version of the incentive model was utilized by the project customer during the bidding phase of the project. This model included goals similar to those in the final incentive model and, therefore, enabled the customer to consider sustainability issues during the early phases of the project. When the main contractor for the project had been chosen, the final incentive model was developed in a collaborative manner within the alliance coalition. This collaboration made it easier for all the actors to commit to the project goals, including sustainability. Furthermore, all the various measurements and the key performance indicators (KPIs) of the financial incentive model were finally connected to the financial bonuses and sanctions. These bonuses and sanctions affected all members of the alliance coalition; therefore, the alliance coalition was motivated to implement sustainable project management collaboratively.

Table 4 summarizes key findings concerning the incentive model of the alliance contract and its role in sustainable project management. According to the interviewees’ experiences and the project documentation, the incentive model takes into account all three dimensions of sustainability to some extent. The main focus is economic sustainability, to which all the components of the incentive system are connected. By promoting environmental sustainability and social sustainability, the alliance partners can also benefit in financial terms. This financial benefit was considered a motivation by the interviewees. Following the logic of the alliance contracts, the target values for the KPIs were set based on the typical good performance in the industry.

Table 4. The ways of using the incentive model of the alliance contract for project control in sustainable project management.

	Economic sustainability	Environmental sustainability	Social sustainability
Incentive model of the alliance contract	<p>The alliance partners had commonly decided on a set of KPIs that formed a financial incentive model.</p> <p>The incentive model consisted of:</p> <ol style="list-style-type: none"> <li>1) the target cost of the project,</li> <li>2) the KPI set, and</li> <li>3) exceptional incidents (and related bonuses and sanctions; e.g., decreased life-cycle costs (positive) or big accidents (negative))</li> </ol> <p>The KPI set included four indicators: 1) schedule, 2) work safety, 3) usability of the tunnel, and 4) public image</p> <p>A financial incentive was based on the achievement of the KPI targets, increased/decreased by the achievement of the target cost and affected by exceptional incidents (positive or negative)</p> <p>By delivering the project at less than the target cost, the alliance partners receive predefined shares of the cost savings.</p> <p>The achievement of the KPIs and positive incidences increases the bonus pool, paid in predefined shares to the alliance partners.</p> <p>The incentive model motivates the alliance partners to seek cost savings and promotes cost efficiency, thus promoting economic sustainability.</p>	<p>No environmental indicators were included in the KPI set.</p> <p>Poor consideration of environmental issues would probably have led to negative publicity (KPI 4), thus affecting the KPI set as well.</p> <p>Some environmental issues (e.g., soil transportation) were measured in the project budget, thus affecting the achievement of the target cost.</p>	<p>Two KPIs of the KPI set (work safety and public image) promote social sustainability.</p> <p>Work safety was measured with the accident rate and accident-related absences.</p> <p>Public safety was measured by evaluating the development and the nature of the media coverage of the case project.</p>

In addition to the financial incentive model of the alliance contract, the majority of the interviewees emphasized the role of project planning and the use of performance measures in controlling the progress of the project, including the achievement of the sustainability requirements. As described in Table 5, the interviewees shared an understanding that by building the sustainability issues into the different levels of project planning, the sustainability goals are achieved by “just implementing the plan” and “following up on a monthly/weekly basis.”

**Table 5. Other identified control mechanisms for sustainable project management.**

	Economic sustainability	Environmental sustainability	Social sustainability
Planning	<p>The interviewees emphasized heavily the importance of different levels of project planning. By including sustainability issues in different plans, the sustainability goals are achieved by following the plans.</p> <p>“To start from the beginning, the project plan is ‘the bible.’ We try to include all the things in the project plan as well as possible.”</p> <p>“It is just that...we follow the goals [e.g., the incentive model] and plans [e.g., the project plan], and they result in sustainability—the plans and the goals are the rules, and by following them, sustainability will happen.”</p> <p>“Well, yes, control is based on the project plan.”</p>		
Measurements and indicators	<p>Target cost (budget) and schedule were measured as part of the incentive model.</p> <p>“We have a budget, which is followed on a monthly basis.”</p> <p>“There are over 600 project cost accounts, to which costs are allocated.”</p>	<p>Although no environmental indicators were included in the alliance KPI set, several other indicators were in place.</p> <p>The majority of the environmental indicators were boundary values.</p> <p>The majority of these indicators were based on city government regulation.</p> <p>“Of course, many environmental issues were measured [gives examples related to water, air, pollution, and vibration].”</p>	<p>Safety aspects and public image were measured as part of the incentive model.</p>
Regulations	<p>Many decisions in the project were based on or restricted by existing regulatory decisions, e.g., legislation and city planning.</p> <p>Compliance was required with at least 10 different sets of regulations.</p>		
	N/A	<p>“I don’t even remember how many environmental permits we had to get. Approximately once a month, we had a meeting with the [environmental] authorities.”</p> <p>“The authorities follow several environmental indicator values.”</p>	<p>“The most important regulation is the allowed work time.”</p> <p>“We were allowed to do noisy work from 7 a.m. to 10 p.m.”</p>
External communication	N/A	N/A	<p>To promote a good public image, the construction company invested in external communication, particularly toward the municipality inhabitants.</p> <p>This included, for instance, a person responsible for answering stakeholders’, especially inhabitants’, worries and inquiries and organizing different information events.</p>

The hierarchy of different plans was important in project control for sustainability. As Table 5 and Figure 2 illustrate, the tunnel project was strongly influenced by national, regional, and municipality regulations that set constraints for the alliance organization and the case project. Naturally, a number of plans were written within the tunnel project; the more detailed lower-level plans built on the broader higher-level plans.

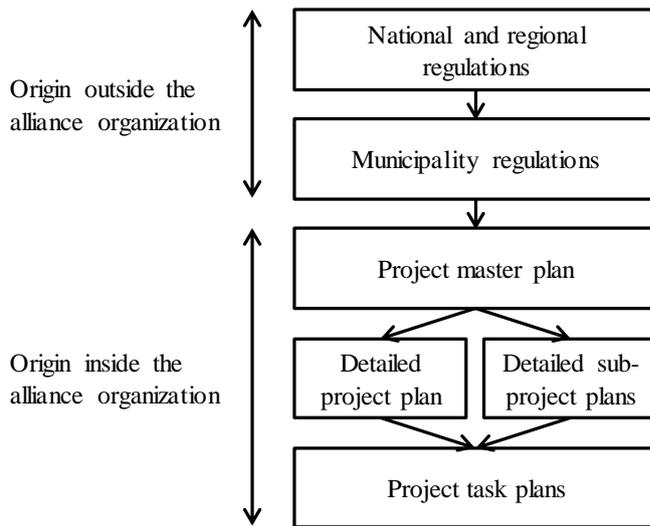


Figure 2. Different levels of plans as guidelines for project control in the tunnel project.

## 5. Discussion

In this study, we explored how a project organization used project control for sustainable project management in a road tunnel infrastructure delivery project. The case project is an example of a highly demanding project context in which the stakeholders are actively involved, and politics and regulatory requirements play a central role. Below, we discuss the responses to the research questions, in light of the empirical findings and previous research.

### 5.1. Implementing the three dimensions of sustainability in an infrastructure project

The first research question inquired how the project organization implemented the three sustainability dimensions in the infrastructure project. The empirical findings showed that the social dimension of sustainability in the case project was evident everywhere. The project was highly political, the inhabitants were first worried and then curious about the project, the alliance model eased interaction between the project actors, and safety and public image were key performance indicators. As the project location was very challenging in terms of the environmental effects, the environmental issues were highlighted through regulations and in the project plan and implemented through grass roots task and work instructions. The economic dimension of sustainability was linked to the bonuses and sanctions of the alliance model (i.e., the financial incentive model) and was strongly affected by actions for the environmental and social dimensions.

Among the key results in this study is the identification of dependencies between the environmental, social, and economic dimensions of sustainability, particularly in alliance projects with risk and benefit-sharing schemes. The balancing of the three dimensions supports previous research (Silvius and Schipper, 2014), but our findings contribute to the literature by showing how the alliance contract can enhance this balance. Previous researchers emphasized the environment dimension over the social and economic dimensions of sustainability (Drexhage and Murphy, 2010). The nature of social sustainability, in particular, is less well understood (Edum-Fotwe and Price, 2009). The findings in the present study indicate that certain project conditions increase the pressure to move the focus from environmental issues (which are more regulated and, thus, self-evidently implemented) to the social dimension of

sustainability (which are not necessarily regulated but attract public attention), or at least to consider the two dimensions equivalent. In the case project, the central location in the city, publicity about the project, and the high number of stakeholders involved may have increased the importance of social sustainability. The findings also showed that as environmental and social issues were included in the shared incentive model of the alliance contract, all stakeholders had a financial incentive to carry out and manage the project in a sustainable way.

This unique case also showed that the alliance model encouraged innovativeness in order to achieve mutual sustainability benefits and avoid risks. In the case project, innovations in the front end and during the execution phase of the project took an important position in achieving sustainability. The findings, thus, contribute to the previous research on value innovations in the front end of delivery projects (Kolltveit and Grønhaug, 2004) by showing that value innovations also take place regarding sustainability. We discuss these innovations more in a later section. We did not purposefully investigate sustainability-oriented innovations, but they emerged from the data. Therefore, exploring their drivers and mechanisms further in future research would be interesting.

5.2. Sustainable project management in an infrastructure project through project control

The main goal of this research was to identify the control practices used by the project organization in implementing sustainable project management in an infrastructure project. To meet this main goal and answer the second research question, we identified various control mechanisms and their connections to the three dimensions of sustainability. We based our enquiries on a literature-based framework (Figure 1), and a revised version based on the empirical findings is illustrated in Figure 3.

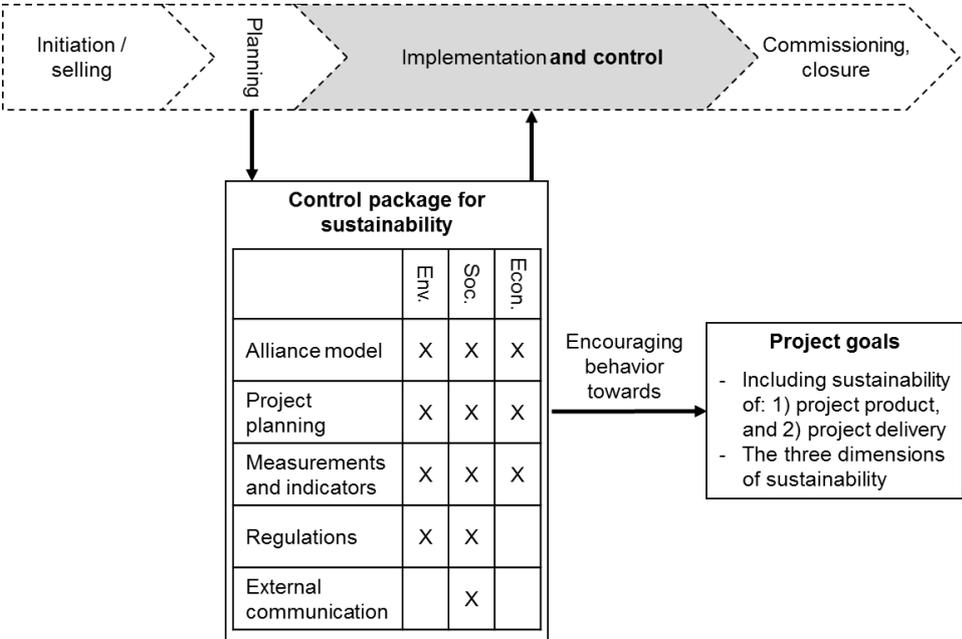


Figure 3. Control package for managing sustainability during project implementation in the case project.

Figure 3 (and Tables 4 and 5) shows that different control mechanisms were identified related to the three dimensions of sustainability. The findings offer four main contributions regarding project control: They 1) show evidence of the control package in sustainable project

management in an infrastructure delivery project, 2) map the use of different control mechanisms for the different dimensions of sustainability, 3) confirm the need to integrate sustainability into the ordinary project control routines (instead of developing separate routines), and 4) propose project sustainability governance as a novel avenue for research.

The results showed that the case project included a unique configuration of control mechanisms (i.e., a control package, cf. Malmi and Brown, 2008). In the project control literature, the plurality of different control modes and control mechanisms is a widely accepted phenomenon (Kirsch, 1997; Liu et al., 2014; Nieminen and Lehtonen, 2008). However, the literature on sustainable project management has focused mostly on the role of different performance indicators in controlling sustainability (Amiril et al., 2014; Fernández-Sánchez and Rodríguez-López, 2010; Haponava and Al-Jibouri, 2010; Shen et al., 2011; Ugwu et al., 2006). Performance indicators had a focal role in the case project, although the interviewees discussed several problematic issues related to the indicators, such as the lagging nature of some of the indicators (Williams et al., 2012) and issues in demonstrating a link between employee-level construction work and the indicators. Although project planning and performance measurement are typical diagnostic mechanisms of project control (Nieminen and Lehtonen, 2008), this study contributes to the literature by showing that the case project employed a wider range of different control mechanisms in controlling sustainability. The findings also showed that the mechanisms were clearly linked with each other, and particularly to the incentive model of the alliance contract.

The identified control mechanisms differed from each other in their origin: some mechanisms came from outside the project organization, whereas others were developed inside the project organization. A clear majority of previous research on both general organizational control and project control focuses on internal control, particularly control practiced by a director, a project manager or, as the main exception, a customer (e.g. Liu et al., 2014). The findings in the case infrastructure project revealed a control package involving control mechanisms from both within (internal control, e.g. project planning) and outside the project organization (external control, e.g. regulation). External control may offer new avenues for further research.

As an important contribution, this study has mapped how the project organization used the different control mechanisms to manage the three dimensions (i.e., economic, environmental, social) of sustainability (Tables 4 and 5). Where the alliance model, planning, and certain regulations were used to control all dimensions of sustainability, certain measures and indicators, certain regulations, and external relations were specific to each sustainability dimension separately. The results of this study demonstrate a division between the sustainable activities (Section 4.2) and project control of these activities (Section 4.3), and show tentative links between them, thus building on and lending support to Gareis et al.'s (2013) findings. The variety of mechanisms in the chosen project control package led to many of the sustainable activities. We anticipate that different projects need to consider their control packages individually, in line with the project's specific conditions (in line with Hobbs and Andersen, 2001).

The findings confirm the need to integrate sustainability into ordinary project control routines, thereby supporting the findings of a previous study (Gareis et al., 2013). In line with previous research (Hwang and Tan, 2012), the case project had few pure sustainability metrics; the majority of the sustainability indicators were built into the project's traditional control

framework (particularly the financial incentive model and project planning). The findings suggest that sustainability can be added to existing tools and methods of project control and that project actors would prefer this approach, instead of adding separate sustainability-oriented control mechanisms. As the control mechanisms considered most important by the interviewees were not really sustainability-specific but were rooted in the general goals of the financial incentive model, general project control guided the alliance coalition to consider sustainability issues.

Where much of the previous literature on project control has focused on internal project control (e.g. Cardinal et al., 2010; Kirsch, 1997; Nieminen and Lehtonen, 2008), the present findings show a very clear link to external project control and, thus, suggest a need to explore sustainable project governance as well. The general control research has its roots in intra-organizational manager–subordinate relationships (e.g. Ouchi, 1979; Simons, 1994), as does the majority of project control research (e.g. Liu and Wang, 2016), particularly between a project manager and project team members. Where the literature review in this study emphasized that the stakeholders’ views on sustainability and collaboration must be taken into account in projects and their goals (Abidin and Pasquire, 2007; Fernández-Sánchez and Rodríguez-López, 2010; Shen et al., 2007), the present study emphasizes the centrality of the alliance contract and regulations at the local, regional, and national levels as key aspects that influence project control. Findings in the case project showed that sustainability is clearly governed through environmental laws and regulations, the public voice has an important role in setting social sustainability requirements, and the incentive model of the contract guides the economic control and, through that, many aspects of the internal control package. As previous researchers have covered project governance in various ways (Ahola et al., 2013; Klakegg, 2009), we suggest that project sustainability governance should be explored more and modelled more clearly, and its context-specific requirements should be explicated, to guide sustainable project management in future projects. General frameworks of project control may need to be adjusted to account for sustainability sufficiently, and particularly in infrastructure projects involving multiple stakeholders and influenced by regulations, the frameworks need to be complemented with a comprehensive idea of sustainable project governance.

### *5.3. Alliance contract in supporting sustainable project management*

As the contract form guides how project control is exercised during project execution, we explored the particular ways in which the alliance contract supports sustainable project management. As alliances have been studied in similar kinds of projects (Guo et al., 2014; van Marrewijk et al., 2008; Walker and Jacobsson, 2014), we particularly wanted to understand whether and how they can enable sustainable project management. Based on the findings, the alliance contract contributed to sustainable project management in two primary ways: 1) The contract enabled openness and encouraged innovativeness, and 2) the contract framed the entire control package through its incentive model and integrated different control mechanisms to guide the organizations toward the shared sustainability goals.

The interviewees emphasized how the alliance model enabled an open discussion among the different parties (in line with Silvius and Schipper, 2014), limiting the unnecessary “fighting” often present in traditional, more competitive contract models. The interviewees also perceived that decision making was quicker and easier. This was especially linked to

environmental sustainability. Different permissions and approvals given by different authorities are a central aspect of ensuring environmental sustainability. The representatives of the private-sector contractor experienced that the participation of the city and the national transportation agency in the alliance made these discussions significantly easier. The findings, thus, lend support to previous research (Arts and Faith-Ell, 2012; Bond et al., 2012).

All the research data (interviews, media data, and document data) provided evidence of innovations in the case project, many of which were linked to the alliance contract. The innovations focused on all the dimensions of sustainability, particularly the target cost of the project and, thus, economic sustainability. Regarding the economic sustainability, two groups of innovations were identified: innovations at the front end of the project aimed at decreasing the target cost of the project and innovations during the execution phase of the project aimed at delivering the project under budget. Many interviewees even thought that the project would have been financially impossible to implement with a traditional contract model and without these innovations. The findings, thus, contribute by highlighting the role of innovations in achieving sustainability and by offering additional evidence to studies in other contexts (e.g. Lenferink et al., 2013; Wang et al., 2014).

The alliance contract in this case study took an integrative role regarding the variety of control mechanisms and toward the multiple stakeholders. As the findings showed, the incentive model in the alliance contract practically guided the entire control package, created guidelines for the primary control mechanisms, and offered a justification for everyone to work toward the shared sustainability goals. Thus, the findings offer evidence of a crucial link between sustainability governance and project control. The relational approach was central for the case project, in the front end and during the execution phase of the project (in line with Hobbs and Andersen, 2001). Although the main scope of the project was defined solely by the customer, many details were agreed on collaboratively within the alliance. Following Klakegg's (2009) terminology, the results of this study suggest that an alliance contract can be a potential way to make a project relevant and sustainable.

## **6. Conclusion**

### *6.1. Theoretical contributions*

This paper contributes to the discussion on sustainable project management, particularly in large infrastructure projects that have long-lasting effects on society. We showed evidence from a road tunnel construction project that took place in a central environmentally and socially sensitive context and had a significant influence on various stakeholders. Complementing the dominant indicator-centric view of sustainable project management, the findings show that a more holistic control package is used in sustainable project management, different control mechanisms are used differently for the different dimensions of sustainability, sustainability control needs to be integrated as part of general project management, and internal project control needs to be complemented with effective project sustainability governance. The findings follow the generally agreed idea of unique control packages in project control, but show the unique configuration of the control package in line with the project's sustainability goals. Where project control literature typically focuses on intra-organizational control or dyadic control relationships, the findings highlight the central role of external control – i.e. need for sustainability governance.

Through regulatory requirements and an alliance contract driving benefit and risk sharing, sustainability becomes the concern of not only the project team but also the project partners, thus enabling innovations and an integrated view of project control. Traditionally, PPPs and alliance as delivery models have been seen primarily as ways to manage uncertainty and control negative risks. The alliance as the project delivery model was shown in a positive light as a means to promote sustainability in a multi-partner setting, thus providing mutual benefits in addition to sharing of (negative) risks. The alliance contract provides a tool for public investors to promote broad stakeholder benefits and avoid the opportunism of single contractors, not just in monetary terms but also in terms of social and environmental issues. Large infrastructure projects involving multiple stakeholder interests are susceptible to public and political debate. This study provides a positive example of how the intense planning required in the alliance contract during the early phase of the project assisted in proactively resolving the public's social and environmental concerns and eventually promoting the project's economic success.

### *6.2. Managerial implications*

This study proposes that the contract model selected in public investment projects partly or possibly largely governs the project's sustainability practices. Public investors can consider alliances as an alternative to traditional models of project contracting, as the alliance in this study proved to be very successful. In particular, public investors can use alliances as an integrative device to promote sustainability. Coordinating and understanding multiple stakeholder viewpoints is part of social sustainability. Managers need to understand that these viewpoints are as important as ecological issues that are the traditional focus when sustainability is considered. Our results suggest that the logic of controlling for the different dimensions of sustainability is somewhat different and driven by different factors (regulations, publicity, incentives). To complement and implement the alliance contract, managers need to create a holistic control package to manage the dimensions of sustainability. They also need to consider practices for project sustainability governance, as the involvement of key alliance partners, regulators and other stakeholders toward sustainability needs to be specified and agreed.

In addition to embedding sustainability in the contract and the performance indicators of the project, the present study has drawn attention to good sustainability-oriented plans, the customer's boundary control, and incentives. In large investments, intensive and collaborative planning is beneficial not only for the project's deliverables but also for enabling innovativeness and sustainable practices throughout the implementation of the project. Incentive models are an important part of alliance contracting. In the case project, their key content was specified together during the planning phase. The incentive model helped to promote sustainability throughout the implementation of the project. Incentive models with built-in sustainability could also be considered in other PPP models as a means of promoting sustainable practices.

### *6.3. Limitations and ideas for further research*

This study is limited by the qualitative single-case design, as well as the method and data choices. We purposefully sought an exemplary case of an infrastructure project with clear sustainability challenges and requirements, and we have summarized its basic properties, to enhance the credibility of the findings. As such, however, single case findings cannot be

generalized to infrastructure projects more generally, but the developed frameworks can assist further research and enable replication. As alliance models are new in infrastructure projects [in the target country], the results likely would be somewhat different in areas where such alliances are more common.

The data collection methods are another limitation of the study. News documentation is limited by the media's choices, and the documentation does not necessarily describe all aspects of sustainability practice. The limited number of interviewees and the focus on manager-level experiences limit the findings, too. The employee level or a broader sample from different stakeholders might have revealed new issues concerning sustainable project management, or more subtle forms of control that were not clearly covered, such as certain aspects of informal and social control (Nieminen and Lehtonen, 2008). To improve the validity of the research, we used two complementary methods, a structured coding outline for the document data, knowledgeable key informants as interviewees, and a consistent interview outline for the interviews, and cross-checked between the different data sources.

As the pressure to manage projects sustainably will undeniably increase in the future, there is a need for further studies to find suitable practices to help companies manage their projects and evolving stakeholder networks in a sustainable manner. The limitations in the sampling suggest that further attention could be directed at the employee-level practices and experiences of sustainable project management, to verify and enrich the findings. Our findings called attention to sustainable project control as a holistic control package and showed evidence particularly for selected categories across the sustainability dimensions. Further research could map the use of control mechanisms for sustainability across different types of projects, and also investigate the possible drawbacks of sustainability control. In addition, the focus was on the triple bottom-line sustainability dimensions and control mechanisms related to those three dimensions. The control of other aspects of sustainability, such as stakeholder aspects and lifecycle thinking, could be on the focus of further research. The identified control package revealed a potential division into internal and external control, which could also be studied further.

As innovations emerged in an important role in framing the sustainability potential of the project, we suggested sustainability-oriented innovations and their drivers and mechanisms to be covered in future research. In addition, we pointed out the unique character of and further research needs concerning sustainable project governance, as regulations at various levels affect and cause requirements for infrastructure projects. The alliance model may be a possible answer for ensuring greater benefits to the broader public especially in multi-stakeholder projects. However, the division between the financial incentive model and the alliance contract remains partly blurry, which requires additional research, to analyze how sustainability-oriented incentive models could be built into other types of PPP models as well.

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