

COOPERATIVE PROJECT DELIVERY IN AN ENVIRONMENT OF STRICT DESIGN-BID-BUILD TENDER REGULATIONS

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ABSTRACT

Lean Construction enhances cooperative project delivery with a focus on customer needs and the optimization of the project as a whole rather than pieces during the design phase, as well as, during construction. Several international case studies have been conducted. The hypotheses are:

- Using the lean approach, project results will be positively influenced by a cooperative project delivery, in the areas of cost, time and quality.
- The full application of the lean cooperative model is limited by strict design-bid-build tender regulations required for public clients.

The existing Lean Project Delivery System in the USA and the corresponding contract - the Integrated Form of Agreement – and, the Australian Alliance Agreements have been analysed. The main focus of the analysis has been to identify the fundamental characteristics and factors of success concerning a cooperative project delivery. As a result, a Lean System which includes the key parts for cooperative project delivery from the client's perspective will be presented in this paper. It identifies which procurement rules are impediments to early cooperation and – hence - would have to be modified. The reasons for those modifications are given on the basis of the case studies.

It was difficult to compare the results of different projects and to allocate the influence of different tools to the outcomes in terms of cost, time and quality. A matrix has been developed that measures qualitative results and correlates it to the use of the tools. The matrix will be presented at the end of this paper.

KEY WORDS

Lean project delivery, Early integration and cooperation, Relational contracting, Integrated form of agreement, Alliancing, Procurement rules, Tender regulations.

INTRODUCTION

Currently, few tools and principles of lean construction are implemented in Germany. There is a need for a holistic approach which enables clients to implement lean construction across all phases of projects for maximum optimization of resources. Furthermore, there is a need for a critical review of current project design and construction practices. German public clients are subject to strict procurement rules

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and regulations by the German legislation, especially German construction contract procedures, called the Vergabe- und Vertragsordnung für Bauleistungen (VOB).

Within the context of international case studies - which were conducted in the USA and Australia - different cooperative delivery approaches (the lean project delivery and the alliancing approach) have been analysed and altogether more than 50 interviews have been conducted with project participants in different roles and with different expertise. To prove the above named hypotheses, the focus was divided into three parts. Primarily, the fundamental characteristics and factors of success for an outstanding performance (in terms of cost, time and quality) by a cooperative project delivery have been identified. Secondly, the Integrated Form of Agreement (IFOA) which supports the lean project delivery has been analysed with focus on how the relational contract supports the cooperative lean project delivery. In the third part, a different delivery approach – the alliancing model – has been analysed with special regard to the underlying concept of the procurement strategy and the project delivery, as well as, the agreement / contract strategy. In the next step, the existing regulations and procurement rules for public clients have been analysed with regard to the identified success factors of cooperative project delivery. Changes within the regulations are proposed in order to eliminate the impediments for the full application of the lean cooperative model. In order to achieve qualitative and comparable results, a matrix has been developed which defines key result areas and key performance indicators which will be measured in terms of time, cost and quality.

MAIN PART

CASE STUDY IN THE USA

The case study was conducted at the Cathedral Hill Hospital (CHH) in San Francisco, USA, a new Acute Care and Women's and Children's hospital with a construction volume of US\$ 1.7 billion owned by the California Pacific Medical Centre, an affiliate of Sutter Health. In 2005, Sutter Health began to change their project management style towards the lean approach – using lean project delivery – and later on combining it with an appropriate relational contract called the Integrated Form of Agreement (IFOA). As the IFOA has been developed over time, the CHH project is the first project using it in its full complexity. Therefore, the CHH project is mostly suited as a reference project for a case study. Supplementary to several interviews with different team members from the CHH project, IPD teams from different American projects have been interviewed to complement the results. While most investigated projects were realised in the American private sector – mainly hospitals – a huge similarity between the projects and their lean approaches could be discovered. Nevertheless, different lean approaches exist in the USA as well as in other countries.

In the USA, the lean project delivery is based on the delivery in an integrated team which includes the client, the architect, as well as, design consultants, the general contractor and further trade partners. They all build one team which develops and performs the project together. In this connection, the partners within the team are equal. Decisions are made by consensus. The overall goal is the optimization of the project as a whole rather than pieces of it. Furthermore, the following tools have been characterised as significantly for the lean approach and its positive outcome: target value design (TVD), value stream mapping (VSM), the last plannertm system (LPS),

building information modelling (BIM) and the continuous improvement process (CIP).

The work within an integrated team – involved already at the beginning of the design phase - has a major influence on the construction time and is simultaneously the basis for the implementation of the TVD, VSM, LPS and BIM. Different projects analysed show a reduction in total building time of more than 30% by designing the project in an integrated team. The implementation of TVD facilitates the development of innovative ideas which can improve the project performance with regard to feasibility, time and costs. For this reason, actual costs which lie more than 15% under benchmark have been achieved. The use of BIM has an outstanding impact on the reduction of collisions. BIM helps to discover collisions which usually occur during construction in a high number and therefore, the team is able to resolve those already during the design phase. A huge amount of time, rework and redesign can be eliminated.

The research into the field of relational contracting has shown that the IFOA has an important role to underlie the lean principles. The IFOA is a multi party agreement which includes at a minimum the client, the architect and the general contractor in one agreement and sets all of them under the same rules and contract conditions. The contract negotiations take place within the team, which is a foundation for the upcoming teambuilding and cooperation of the team. The trade partners which join the team during the project will be integrated by a trade partner agreement between the general contractor and the trade partners. They all have the same contract conditions as the partners within the IFOA. The IFOA consists of a commercial strategy – as any type of contract – and additionally includes a behavioural strategy.

The commercial strategy is based on a compensation of reimbursable costs and a fixed percentage for fee and profit. The financial risk is shared via an at-risk pool where a percentage - which is defined in advance – of the fee, is stored. Financial savings are shared as rewards which are defined by an incentive system. Responsibilities will be shared within the team. The behavioural strategy is based on the so-called “Five Big Ideas”, which have been developed by Sutter Health.

As a result it can be shown that a multi party agreement supports the process of building the foundation for collaboration and cooperation within the team. The behavioural strategy of the agreement defines a common language and collective understanding between the project participants. Building on this basis, the team and its own culture can be developed. The commercial strategy is based on a fair compensation model, which limits risks and sets incentives to improve the project outcome. It builds the framework for a safe environment in which innovative thinking and problem solving is supported. To sum up, the IFOA supports the teambuilding process and rewards the cooperation and collaboration within the team. It also aligns the fundamental idea of the lean project delivery – the optimization of the whole rather than any particular piece - by sharing risks and rewards.

CASE STUDY IN AUSTRALIA

In Australia, alliances are widely used in the public infrastructure sector. A case study has been conducted at the West Gate Freeway Alliance in Melbourne. The Victorian highway department, named VicRoads, is currently extending the Monash-Citylink-West-Gate in Melbourne, by an additional lane in both directions and installing a

freeway management system. The West-Gate-freeway section has a construction cost of 630 million AUD.

The delivery within an alliance occurs in an integrated collaborative team in which all partners including the client are equal. The client has two functions within this team. On the one hand the client fulfils its role as an owner who provides directions e.g. describes the scope of work and defines the time limit; on the other hand, the client is an alliance participant. All positions on the project will be appointed on a best person for the job basis, without regard to the company in which the person works. Primarily, the project participants shall belong to the team rather than to their company. The alliance contract is also a multi party agreement which includes the client, the architect and the general contractor. Subcontractors will not be included in the alliance agreement with the exception of sub-alliances which are barely used.

The underlying principle for the alliance is a one-team approach where all voices count the same and with focus on what is best for project. During the selection process, each alliance develops within the team the alliance principles, which are based on the client's values, the specifics of the project and the input of the team. The selection process for the proponents is well defined. There are two different methods for the selection of alliance partners. In the single Target Outturn Cost (TOC) method, the selection of the alliance partners occurs solely on qualitative criteria while in the dual (also referred to as multiple) TOC method, two different proponents will be chosen by the client and both will calculate a target price. The single TOC method is the predominant method, which is also recommended by the Project Alliance Practitioners' Guide (Ross 2009 and DTF 2006).

At first, qualified proponents go through an interview process. In the next step a two-day workshop will be held with the teams of two proponents in order to find out which team offers the best potential to achieve outstanding project results. During this two-day workshop, the client will develop with each team the alliance principles. This process is very important for the implementation of the principles later on in the project, because it strengthens the identification of the team members with the principles.

All decisions are based on a best for project basis and are made unanimously i.e. no one can be forced into a single decision. The alliance partners are collectively responsible. Within the team all partners are equal and they implement a "no fault – no blame" culture. The agreement is written in the first person. This emphasises the commitment to a cooperative behaviour. The compensation is based on the reimbursement of all direct costs and a pre-agreed profit which is typically below business as usual. This is supposed to give an incentive to improve the project result and therefore to increase the contractors and trade partners profit. An incentive system consisting of two components rewards outstanding project results with financial regard as well as with regard to other areas such as quality, time and stakeholder management. The rewards will be shared between all partners (usually 50:50 between the client and the other alliance partners).

On the West Gate Freeway Alliance following results can be demonstrated before the project is completed. Due to the cooperation within the team during design, the access to the existing Freeway could be allocated at a different place as originally planned which is much more convenient with regard to the whole construction

performance. In this project, the alliance team was responsible for the land acquisition with the overall goal to reduce its amount to a minimum. Therefore, the design was done considering the necessary amount of land acquisition, as well as, the minimisation of involvement of adjacent businesses. The new lane of the freeway has been moved in the area of existing business and adjusted in order to perform the project with a minimum of disruption. This change has had a major influence on the realisation of the project as well as on the costs for land acquisition. The focus on the stakeholder management has resulted in good cooperation and relations with the nearby owners, who have been well informed over the whole time of the project. As a result no claims or disruptions occurred. Also, this applies to the construction of an adjacent project, the Melbourne Exhibition Centre. Another important area for the client is the reduction of traffic disruption during construction. This achievement further reinforced the positive total outcome of the alliance.

The Alliancing Association of Australia has conducted a study together with RMIT University of Melbourne which demonstrates the result of a survey with a scope of 30 Alliances in Australia that more than 80% finished the project below target cost. Also 80% of the projects could be finished ahead of schedule (AAA 2008). These results are also supported by a study conducted by Sean Sweeney who has compared the results of different project delivery methods (by analysing almost 300 projects) with regard to time and cost. His study shows that 82.5% of the surveyed alliances finish within or below target cost while at traditionally delivered projects just 16.7% deliver within budget. The comparison with regard to schedule shows that 39% of traditionally delivered projects compared to 100% of alliances finish within time (Sweeney 2009). This result demonstrates the huge potential alliances offer.

COMPARISON OF THE TWO DIFFERENT APPROACHES

The comparison between the two relational contracts, the IFOA and the Alliancing Agreement, shows a high degree of parallelism. Both are multi party agreements which consist of a commercial and a behavioural strategy. As a main difference the IFOA explicitly names and describes the lean project delivery by including several tools which support the idea of a cooperative project delivery and its implementation. Furthermore different (sub-) contractors are also involved in the team. While the behavioural strategy of the IFOA is based on the lean principles, demonstrated by the 5 big ideas, the behavioural strategy of alliances is based on the client's values, the specific project and the input of the team incorporated during selection workshops. The IFOA specifies a process for the resolution of conflicts. However, the overall goal is to avoid conflicts, but if they occur, they should be resolved within the team where they occurred. If a solution cannot be found, different steps can be taken before the parties are free to pursue legal remedies, which shall absolutely be avoided. The alliancing agreement takes a step forward by limiting legal resource to willful default or insolvency. The selection process for the alliance partners is well defined in order to select the team which is best able to reach outstanding performance. The target price will be checked by independent financial auditors.

PROPOSED CHANGES WITHIN THE REGULATIONS FOR GERMAN PUBLIC CLIENTS

According to the VOB, projects are usually delivered by a design-bid-build or a design-build method. The VOB and in particular those two delivery methods have been analysed with regard to the characteristics of the lean project delivery, the criteria from the IFOA and the alliancing agreement. As a result the following changes are proposed to enable public clients to implement cooperative lean delivery with its full potential.

The VOB prescribes a separation between design and construction; this would need to be removed. The key elements of cooperative project delivery have been defined as early integration of an interdisciplinary team, this is currently impeded by the VOB. The early integration of different project participants has a main influence on the optimization of the design and therefore also on the construction as processes become more consistent with less rework. The involvement of different project participants adds knowledge to the design process and enables the team to generate creative ideas and innovations early on, at the point of time when the biggest influence on costs can be taken. Collisions and design errors can be detected at an early stage. Usually, these would not appear until construction. This would cause changes in design which would be expensive and time-consuming. Furthermore, the early integration enables to implement the lean tools with its full potential.

At present, the awarding of the contract is mainly dominated by the price. The analyses have shown that the team needs to be found, which is best able to reach outstanding performances. To find this team, different qualitative criteria need to be defined before procurement. Therefore the VOB would need to allow new award procedures which allow a selection of the contract partner by evaluating qualitative criteria. Such a selection would focus on the competence of the proponent, the ability to use lean methods and their willingness to bring innovations into the process. In the end, this will positively influence the project in terms of cost, time and quality.

When cost cannot be clearly determined, the VOB allows a cost plus fee contract as long as this is not possible. At the time when the cost can be exactly determined, the compensation method has to change to a measurement contract. The VOB would need to allow a cost plus fee contract generally. This would be the basis for a fair compensation and would limit the risks for the contractor. The research has shown that a confident basis for the contractors supports and mainly influences the innovation process, which also leads to cost savings for the project.

THE NEWLY DEVELOPED LEAN SYSTEM

Based on the surveys of different project delivery methods, as well as, innovative and relational contracts, a lean system has been developed which consists of three parts: the project organization based on lean principles, a contract strategy and a procurement strategy. Success factors are defined for each part. These are classified and recommendations are given for each classification. Furthermore necessary changes (cf. previous section) within the German regulations are outlined in order to implement a cooperative lean project delivery also in the public sector. Additionally to the three parts of the lean system, recommendations for the internal organization from the client's perspective are given, which will not be discussed in more detail within this paper.

In principle, the lean system applies for any type of project. Even so, it is especially recommended for complex projects whose scope of work cannot be precisely determined in advance and which benefit mostly from the integrated approach.

The success factors of the lean project organization are the performance within the integrated team, the early integration of the project participants, the involvement of the clients and different tools for the integration and implementation of lean principles. The work within the integrated team is outlined by different subjects. Hereunder recommendations are given for the establishment of the team, the integration of team members in general and the involvement of new team members into the team in particular. Furthermore the changing role for different project participants is discussed. As trust is the most important factor for the team establishment and also for the work within the team, it is outlined in detail. As project participants will be involved early in the design phase, there will be more costs early during design which have to be considered for the financing of the project (those early costs will be saved later on due to reduced final costs). Another point with regard to the early integration is the fact that contractors usually earn their money during construction. To attract those already involved in the design phase, incentives should be given. Additionally it has to be assured that their knowledge given during design will not be misused by the client. The client needs to be prepared for the new requirements which result of his changed role in the delivery process. Different tools should be implemented in order to support the cooperation within the team and the development of a target price.

Within the procurement, different processes are necessary. The first step when implementing a new delivery method should be the information of potential project participants before tendering by introducing the new approach. Internally, the selection process has to be defined and the selection criteria including their weighting in the selection process (optionally for each step in the process) have to be determined. Thereby, a selection on solely qualitative criteria can be chosen, as well as, a combination of qualitative criteria and a competing price element. A pure price competition is counterproductive for this approach.

The contract in connection with the lean approach is supposed to establish a safe environment in which creative and innovative ideas can be developed and in which the team members are encouraged to work together cooperatively to achieve one common goal: the optimization of the project as a whole. The commercial strategy of the contract should be complemented by a behavioural strategy. The behavioural strategy builds the foundation for integrated team approach by defining a common language and a collective understanding within the team. It should be based on lean principles and the client's philosophy. For achieving a high identification of the defined principals within the team, the team members should be included in this process. The commercial strategy consists of a fair compensation model which is added by an incentive system. The rewards can be based on financial achievements as well as on positive outcomes in other areas e.g. safety, quality, environment. A cost plus fee compensation underlines the cooperative approach and helps to provide the basis for a fair environment in which innovation will be created. An independent financial auditor guarantees value for money. This is especially important for the case

where the selection was exclusively based on qualitative criteria. Furthermore within the contractual strategy, the share of risks has to be incorporated.

MATRIX FOR THE QUANTITATIVE MEASUREMENT OF PROJECT RESULTS

The conducted case studies have shown positive project results in the areas of cost, time and quality. 1) Project results were measured differently from project to project; 2) different tools were used on different projects. In retro perspective, it was difficult and not always possible to allocate the outcomes to the specific tools, whereby qualitative results were hard to demonstrate. In order to generate qualitative and comparable data for future use, a matrix has been developed which identifies key result areas (KRA) and its key performance indicators (KPI).

Measurements will be taken in the areas cost, time and quality, whereby savings in cost will be measured in percent and separated into three categories: design, construction and operation/removal of the facility. This enables control of the whole life-cycle costs of a facility. The time is measured in months and will be in relation to the planned building time by the end of the project. Quality is measured according to the predefined standard and can result in below, equal or above standard.

Table 1: Overview of key performance indicators and their influence on the measurements

		MEASUREMENTS			
		COST [%]	TIME [month]	QUALITY [level]	
KEY RESULT AREAS	KEY PERFORMANCE INDICATORS				
	VSM	process improvement	x	x	○
		involvement customer	x		x
	TVD	innovation	○	x	x
		optimization design	x	x	○
		optimization of construction (processes)	x	○	x
		optimization of product and amount	○		x
	LPS	consistent design	x	x	
		consistent flow of work	x	○	x
		just in time delivery	○	x	x
	BIM	elimination of design errors	○	x	x
		elimination of impediments during construction	○	x	x
		elimination of rework	x	x	○
		elimination of claims	○		
		improvement in quantity calculations	○		
CIP	new standards	○	x		

Caption: ○ = main influence
x = influence

The main influence factors for the three KRAs cost, time and quality have been identified as VSM, TVD, LPS, BIM and CIP. Each KRA is characterized by different KPIs which are shown in table 1. In practice, each KPI will be measured in the three

areas. Furthermore, the importance of delivery in an integrated project delivery team, the early integration, as well as, trust has to be evaluated. Therefore, their influence has to be rated between high, medium or low (cf. table 2). In table 1, the influence on the measurement of each KPI is shown.

After the matrix has been used over the total time of the project, the following results are qualitatively measured: the savings in cost – differentiated over the life-cycle phases - and in time. The level of quality has been controlled for each change. Also, the influences of the key characteristics of cooperative project delivery (integrated project delivery, early integration and trust) are measured. This enables one to allocate positive outcomes to different tools and demonstrate the relationship between the three characteristics and the outcomes. The final matrix in table 2 is used to demonstrate the summarized project results.

Table 2: Final matrix for summarized project results

	MEASUREMENTS				INFLUENCE								
	COST				TIME	QUALITY			IPD	EAR	INT	TRUST	
	[%]				[month]	level			level	level	level	level	
	design	construction	operation	total		b	s	a	l	m	h	l	m
KEY RESULT AREAS	VSM												
	TVD												
	LPS												
	BIM												
	CIP												

Caption b = below standard l = low
s = equal to standard m = medium
a = above standard h = high

At this stage, the matrix has been validated through interviews with project participants. They were asked about functionality of this matrix, the applicability as well as the value of the result.

CONCLUSIONS

This research demonstrates a cooperative design phase including cross functional team members will lead to a highly successful project which can be measured by outstanding performances regarding cost, time and quality. There was difficulty in comparing some of the qualitative data. Also, the outcomes reinforce that lean project delivery needs to be supported and supplemented by a corresponding contract and a procurement strategy. A selection based on pure price competition does not meet the required criteria for the creation of a successful team. Additionally to the commercial terms which are defined in any type of contract, the contract should include defined behavioural aspects. This must be based on lean principles, on the core principles of the client’s organization and the project goals. The behavioural strategy builds the foundation for the attitudes and behaviours within the team. The commercial strategy should contain a fair compensation for the involved companies combined with an incentive program.

The Lean System which has been developed within this research builds the foundation for a holistic implementation of Lean Construction by describing the corresponding project organization, the client's internal organization, the procurement strategy and, the contractual framework. It is developed by clients who want to implement Lean Construction on their projects. This system applies to large, complex projects with an indefinable scope of work, due to the fact that those projects profit most from the cooperative approach. The necessity for change is evident after reviewing the German contract procedures, the characteristics of lean project delivery and relational contracts. The main changes have been highlighted. This would be necessary for a complete implementation with its full potential.

The matrix enables the establishment of qualitative and comparable results in the areas of life-cycle costs, time and quality. For future work, the following hypothesis can be tested with the present matrix by using it through the entire project. Early integration of the project team and the delivery within an integrated team are the foundation for the successful implementation of lean tools. Trust was defined as the key enabler. Projects with outstanding results in the areas of cost, time and quality will also show high results in the following areas: integrated project team, early integration and trust.

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