FTIA publications
62/2021

Finnish Transport Infrastructure Agency

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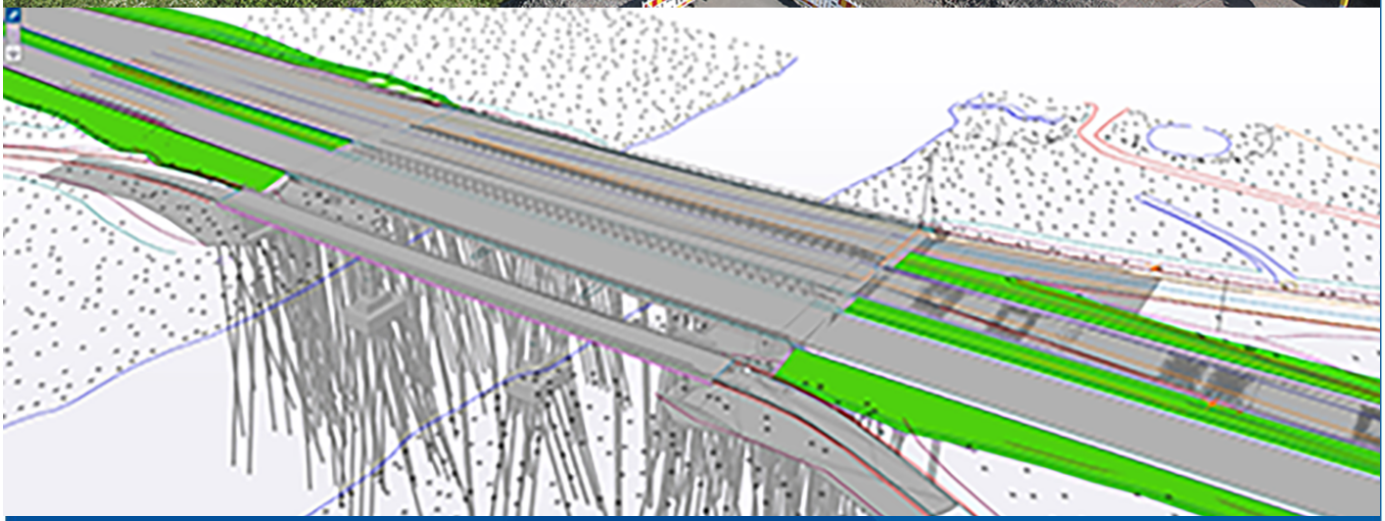
From creation to first projects and related experiences



Pertti Lahdenperä

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From creation to first projects and related experiences

FTIA publications 62/2021

Finnish Transport Infrastructure Agency
Helsinki 2021

Cover photos: FTIA photo archives

Online publication (pdf) (www.vayla.fi)
ISSN 2490-0745
ISBN 978-952-317-910-3

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Pertti Lahdenperä: Design-build with a development phase – **From creation to first projects and related experiences.** Finnish Transport Infrastructure Agency. Helsinki 2021. Publications of the FTIA 62/2021. 32 pages. ISSN 2490-0745, ISBN 978-952-317-910-3.

Keywords: design-build, development, collaboration, construction projects, highways, infrastructure

Abstract

Design-build (DB) is a much-used project delivery system with operational variations for different needs and situations. This publication focuses on a novel DB variation that exploits the parties' collaboration in order to improve the economic efficiency of construction projects: it is called "design-build with a development phase" (DBd). More precisely, this publication presents the DBd procedure and how it was initially constructed to mitigate the drawbacks of conventional DB practices and eventually applied to a few infrastructure projects.

In the DBd procedure, the owner and the selected contractor continue the development of the project solution in cooperation, adhering to the principle of benefit sharing that is enabled by the benchmark solution, formed as a result of the price-inclusive contractor selection. Yet, the procedure does not require the inclusion of the design solution in the proposal. Instead, the owner ensures that the design solution of the chosen contractor meets the set requirements during the contractual development phase that precedes the realization. The development phase ends when the owner makes a decision about exercising its option for the implementation phase, which follows the usual DB contracting practice.

As for the first DBd application projects, the experiences were positive, and the project participants believe that the procedure can be beneficial to many challenging projects with leeway for development. The procedure enables joint development by the owner and the contractor for more economical project solutions. It may be a question of critical evaluation of design principles based on more comprehensive knowledge, but the procedure also encourages the search for better solutions within the set requirements. The production viewpoint is taken better into consideration and no major uncertainties plague the implementation phase since the preceding development work helps eliminate them. It is thought that increased dialogue combines the parties' know-how for the benefit of the project, even if there were very few striking changes.

Pertti Lahdenperä: Suunnittele ja toteuta -urakka kehitysvaiheella – Kehittelystä ensimmäisiin hankkeisiin ja niiden kokemuksiin. Väylävirasto. Helsinki 2021. Väyläviraston julkaisuja 62/2021. 32 sivua. ISSN 2490-0745, ISBN 978-952-317-910-3.

Avainsanat: ST-urakat, kehittäminen, yhteistyö, rakennushankkeet, maantiet, infrastruktuuri

Tiivistelmä

Suunnittele ja toteuta -urakka (ST) on paljon käytetty rakennushankkeen toteutusmuoto, josta on olemassa erilaisia sovelluksia eri tarpeisiin. Tässä julkaisussa keskitytään uudenlaiseen ST-sovellukseen, joka hyödyntää osapuolten tiivistä yhteistyötä totuttua laajemmin hankeratkaisun kehittämisessä. Kyseessä on ns. ”kehitysvaiheen sisältävä suunnittele ja toteuta -urakka” (STk). Julkaisussa käydään läpi STk-menettelyn periaatteet ja miten niillä on ajateltu vastattavan tavanomaisen ST-menettelyn koettuihin haasteisiin. Julkaisussa paneudutaan niin ikään menettelyn käyttöön muutamissa infrahankkeissa.

STk-menettelyssä tilaaja ja valittu urakoitsija jatkavat projektiratkaisun kehittämistä yhteistyössä hyödynjaonperiaatetta noudattaen. Vertailukohta hyödyn määrittelylle luodaan osaltaan hinnan sisältävällä kilpailulla, joka ei kuitenkaan nyt edellytä suunnitteluratkaisun sisällyttämistä tarjoukseen. Tilaaja varmistaa valitun urakoitsijan suunnitteluratkaisun vaatimustenmukaisuuden toteutusvaihetta edeltävän sopimusperusteisen kehitysvaiheen aikana. Kehitysvaihe päättyy, kun tilaaja tekee päätöksen sopimuksen toteutusoption lunastamisesta. Toteutusvaihe noudattaa pitkälti tavanomaisen ST-urakan käytäntöjä.

Ensimmäisistä STk-hankkeista saadut kokemukset olivat myönteisiä ja hankkeisiin osallistuneet uskovat menettelyn olevan hyödyllinen monissa haastavissa hankkeissa, joissa on liikkumavaraa toteutuksen osalta. Menettelyä käyttämällä mahdollistetaan tilaajan ja urakoitsijan yhteiskehittäminen hankeratkaisujen taloudellisuuden parantamiseksi. Kyse voi olla suunnitteluperusteiden kriittisestä arvioinnista kattavammin tiedoin, mutta menettely edistää parempien ratkaisujen hakemista myös asetettujen vaatimusten puitteissa. Tuotantonäkökulma tulee paremmin huomioon otetuksi eikä toteutusvaiheeseen jää merkittäviä epävarmuuksia, kun edeltävä kehitystyö auttaa niiden poistamisessa. Vuoropuhelun lisäämisen koetaan yhdistävän osapuolten osaamista hankkeen hyödyksi, vaikka huomiota herättävät muutokset jäisivät vähäisiksi.

Pertti Lahdenperä: Planera och genomför-entreprenaden i utvecklingsstadiet – Från utveckling till de första projekten och erfarenheterna av dessa. Trafikledsverket. Helsingfors 2021. Trafikledsverkets publikationer 62/2021. 32 sidor. ISSN 2490-0745, ISBN 978-952-910-3.

Sammanfattning

Entreprenaden Planera och genomför (ST) är en ofta använd genomförandeform för byggprojekt, och av denna finns det olika applikationer för olika behov. I denna publikation fokuseras på en ny typ av ST-applikation som utnyttjar parternas nära samarbete i större utsträckning än vanligt för att utveckla en projektlösning. Det är frågan om en så kallad ”Planera och genomför-entreprenad som innehåller en utvecklingsfas” (STk). I publikationen genomgås principerna för STk-förfarandet och hur de är tänkta att användas för att möta de upplevda utmaningarna i det vanliga ST-förfarandet. I publikationen sker likaledes en fördjupning i användningen av förfarandet i några infrastrukturprojekt.

I STk-förfarandet fortsätter beställaren och den utvalda entreprenören utvecklingen av en projektlösning i samarbete genom att tillämpa principen för nyttodelning. Jämförelsepunkten för att fastställa nyttan skapas delvis genom konkurrens som inbegriper priset, vilket dock inte kräver att en konstruktionslösning ingår i anbudet. Beställaren säkerställer kravöverensstämmelsen hos den valda entreprenörens konstruktionslösning under den avtalsbaserade utvecklingsfas som föregår den genomförandefasen. Utvecklingsfasen avslutas när beställaren fattar beslut om inlösen av avtalets genomförandeoption. Genomförandefasen följer till stor del rutinerna i den vanliga ST-entreprenaden.

Erfarenheterna från de första STk-projekten var positiva och projektdeltagarna tror att förfarandet är användbart i många utmanande projekt där det finns handlingsutrymme med avseende på genomförandet. Genom att förfarandet används möjliggörs en gemensam utveckling mellan beställaren och entreprenören för att förbättra projektlösningarnas lönsamhet. Det kan vara frågan om en kritisk bedömning av konstruktionsgrunderna med mer heltäckande information, men förfarandet kommer också att bidra till sökande av bättre lösningar även inom ramen för de uppställda kraven. Produktionsperspektivet kommer att beaktas bättre och det blir inga betydande osäkerheter kvar till genomförandefasen när det föregående utvecklingsarbetet bidrar till att eliminera dem. Den ökade dialogen upplevs sammanföra parternas kompetens till förmån för projektet, även om de iögonfallande förändringarna förblir få.

Foreword

This publication focuses on a novel design-build (DB) variation called "design-build with a development phase" (DBd). The procedure is a result of the *Petoke* project, focused on the development of various project and service procurement practices for infrastructure and not just for DB. The project was a joint effort by the *Finnish Transport Infrastructure Agency* (FTIA), the *Infra Contractors Association in Finland*, and several Finnish cities (through their collaboration arm called *Kehto forum*). The *VTT Technical Research Centre of Finland*, as the author of this publication, was the consultant for the project.

Regarding the DBd application, all the early phase trials were FTIA projects, while FTIA considers the gained results a success and thereafter has also applied the DBd procedure to many other projects. It is not, however, that simple since the DBd philosophy can be applied in various ways as to details. In addition to the proof of success in general, the work described in the publication has provided food for thought for more recent development of the DBd practice. For instance, the results have been applied in the harmonization of the FTIA's practice and the development of related model contract documents for forthcoming projects.

All in all, it seems that DBd is becoming a solid part of the range of measures in FTIA's procurement strategy, which is why FTIA is willing to bring the procedure and lessons learned up for international debate through this publication. The paper focuses mainly on the stage from the initiation of the DBd procedure to its first trials and related experiences by compressing the DBd-related results from the earlier *Petoke* project. A few additional views are also presented, and remarks on what has happened thereafter are attached to the end of the paper.

Helsinki, October 2021

Finnish Transport Infrastructure Agency

Contents

1 Introduction

1.1 Starting point

The project delivery system determines the division of labor and contractual and operational relations between the major players of a project as well as the scope of related competition. Therefore, it is a high-level organizational means of creating preconditions for the successful realization of a building project. A well-working project delivery system helps avoid problems and is key in attaining project goals.

Design-build (DB) is one of the main project delivery methods. In DB, a contractor (design-builder) under contract to the project owner is responsible for the project's design and construction as an entity. DB is used when the project owner wants to transfer the bulk of risks to a contractor, attain the efficiency benefits from good constructability, or needs speedy delivery or cost certainty but does not need to influence all of the design details.

DB is also actively used by the Finnish Transport Infrastructure Agency (FTIA). DB's share in a cost-based examination is one-fourth of all investments by the agency, but that figure does not shed light on the use of DB alone since the size of DB projects tends to be larger than the average project. Moreover, DB is especially used for road construction (and less for railways and waterways), where most major projects tend to be implemented by DB accompanied by a few project alliances and design-build-finance-maintain/operate projects. Thus, it is of great importance to the FTIA how DB serves in attaining project goals.

1.2 Purpose of the publication

The FTIA considered it reasonable to search for possibilities to improve the performance of DB projects together with contractors and municipalities. This led to a launch of a joint project, where special emphasis was given to the means of exploiting the parties' cooperation more widely than in an ordinary DB project. The work resulted in the "design-build with a development phase" (DBd) procedure. The lower-case "d" attached to the DB acronym indicates that a specific joint development effort is included in the duties preceding the usual DB package.

The procedure is initially based on a competitive selection of the design-builder. Yet the DBd procedure does not require the inclusion of the design solution in the proposal. The owner ensures that the design solution of the chosen contractor meets the set requirements during the contractual development phase when the owner and the contractor continue the development of the project solution in cooperation according to the principle of benefit-sharing. The development phase ends when the owner makes a decision about exercising its option for the implementation phase, which follows the usual design-build contracting practice.

The DBd procedure was applied to a few road infrastructure projects immediately after its development. The projects were major road projects that included motorways and other public roads, interchanges, bridges, and pedestrian and bicycle ways, as the case may be. This publication is aimed first and foremost to shed light on the DBd procedure and the experiences gained from its first applications.

1.3 Structure of the publication

The text proceeds as follows. The next section *(Chapter 2)* briefly introduces the methods and approaches used in the work, or how the joint development effort between the stakeholders was organized, and how the functionality of the emerged DBd procedure was assessed based on trial projects. *Chapter 3* then moves to construction project practices by burying in the conventional DB practice and the reasons it may be considered incomplete. The chapter continues by presenting the developed DBd procedure and modifications completed in relation to conventional DB practice.

Chapter 4 starts by introducing the three DBd trial projects and then proceeds to review their actualization by phase with a special emphasis on the alterations made to project solutions during the cooperative joint development phase. *Chapter 5* changes the view to the assessment by presenting the experiences from the trial projects in terms of various key result areas and general feedback. The impact of the DBd procedure on the economic efficiency of the trial projects is also evaluated by means of previously presented alterations to project solutions.

Chapter 6 attempts to crystallize the scheme of things of DBd practice by itemizing the key elements of the DBd procedure and focusing on their mutual inter-operability in improving the economic efficiency of a project. Further, a summary of the expected benefits is presented. Finally, *Chapter 7* is a summary, which, besides summing up the work of the initial development effort and the results from the first trial projects (i.e. the main purpose of this publication), quickly remarks on other applications of the DBd procedure and its use in more recent projects after the first trials.

2 Approach and methods

2.1 Development of the procedure

The effort presented in this publication is initially part of a wider entity, where infrastructure project owners and contractors developed multifaceted operational practices of the infra sector in collaboration. The development work started at an orientation workshop with about fifty experts in infrastructure as participants. After an introduction to stimulate conversation, the workshop continued in groups. The groups were asked to create or modify a proposal outline for an operating model that could be used as a starting point for further development work. These process outlines (for three application areas, including DB) were presented to the participants, who then voted on which ones should be prioritized for further work.

After the orientation workshop, the development of the DB procedure continued in working groups for just over three months during six development workshops. Each development workshop typically had about ten participants, although the total number of participating owner and contractor representatives was nearly double that number. The working groups resulted in a basic description of the application, which was named DBd. The lower-case "d" was intended to specify the DB variation in question. Other procedures were developed in parallel working groups (design-bid-build, maintenance contracting) and are not dealt with here.

After the basic description of the DBd procedure was completed, documentary work was initiated with the aim of testing the model in a few FTIA road projects. The first project (Hwy 4 Kello–Räinänperä, Project A) mainly tested the process and documents as there were few development opportunities there. After a few months, the first project was followed by three other projects (Projects B–D below) whose acquisitions were initiated almost simultaneously. In these projects, the project solution was also altered as a result of the development phase, and the experiences gained from the projects constitute the starting point for assessing the functionality of the DBd procedure.

2.2 Assessment of functionality

The starting point for the evaluation of the DBd performance is the fact that it is impossible to make an indisputable outcome-based comparison of different projects that takes into account all the different aspects (costs, usability, maintainability, safety, etc.) of various parts in a commensurable way. The same concerns practical decision-making, where the mutual valuing of numerous aspects is largely based on decision-makers' expertise. The realized impacts of alterations are also not found out in detail thereafter.

Therefore, in order to overcome obscurity and capture an in-depth understanding of the actors involved in the projects, the study assesses the impact of the DBd procedure, based especially on the three most important alterations to the project solution made in the pilot projects. This naturally presupposes that if an alteration is made, it has to be an improvement. Taking this approach, the interviewee is left with the task of evaluating the different types of benefits and assessing the process

impacts, which is more likely to reflect the decision criteria used in the decision-making of the project.

In addition to alteration-based impact assessment, the project participants were asked to comment on the success of the project from the perspective of general performance indicators. The success criteria used in the study also correspond to those used in general. The third aspect of the functionality assessment was the general acceptability and usability of the process and its various partial solutions.

2.3 Implementation of interviews

The project participants were asked to assess the project in interviews. The interviews were conducted after the projects' development phase when the realization phase had already begun as it is justified to assume that the development of the DBd project solution actualizes during the development phase in particular. Interviews were conducted with the owner's and contractor's project coordinators and principal designers. All the interviewees have extensive experience in the infrastructure sector and comparable projects. It is also notable that the group of interviewees included very few participants from previous DBd development workshops.

The semi-structured interviews were organized around approximately 50 questions. The interviews were mostly between 2.0 and 2.5 hours long, with two longer exceptions. These were preceded by fact-finding sessions with owner representatives to figure out the more detailed contents and impacts of the alterations, as well as the procedures followed, to ensure a full, deep-enough understanding of the underlying factors, which may not have been obvious when studying the relevant parts of the project documents.

3 Renewal of the process

3.1 Conventional DB practice

In design-build (DB), one company, typically a construction contractor, is responsible to the project owner for design and construction as an entity, even though the design and a large part of the work are often subcontracted. The contractor is selected (especially in public projects) against competition that requires the inclusion of a design proposal in the tender in addition to the price quote. Furthermore, factors related to organizing and realization can be taken into consideration in the selection. The contractor who has made the economically most advantageous tender is selected to carry out the project, typically at a fixed price. The parties proceed to construction as straightforward as possible after entering into an agreement, although the supplementing of plans and preconstruction activities precede it. The project is realized primarily according to the proposed solution so that its development is only occasional.

The strengths of the DB are especially the incorporation of the contractor's cost and constructability knowledge in design. The project delivery system is used to promote the innovativeness of service providers when the product and/or performance requirements set by the owner can be met with different design and production solutions. The competition to select a contractor generates different, alternative design solutions, while their economic efficiency will become benchmarked as a whole. From the owner's point of view, the risks will become smaller when the design and realization responsibilities are combined: thus, design delays and errors do not reduce the contractor's responsibility for faultlessly completing the project on schedule at an agreed price. The overlapping of design and construction also makes the relatively quick carrying out of projects possible.

3.2 Change drivers

The DB procedure also includes some challenges, which were highlighted in the workshops. Contractors have to include the project's technical design in their tender, but planning is labor-intensive and expensive. The workload is emphasized when only one offeror is chosen as the contractor of a project. Many offerors' prepared tenders are wasted work from their perspective, even though they provide a valuable comparison to the owner. The labor-intensiveness of preparing tenders may limit the contractors' willingness to tender, which may appear to the owner as a lack of competition.

When technical designs are included in tenders, it is natural that the owner has to assess and analyze the different solutions before making the procurement decision. This becomes a challenge in processes with tight schedules. Another risk related to public procurement is that the overall best option will be eliminated from the competition due to small formalities as it is impossible to postpone even the smallest improvements until after the procurement decision. The possibilities for appeals are emphasized in competition with a design proposal.

Striving for a generally competitive offer drives actors to consider the acceptability of different solutions, which may make it necessary to request the owner's interpretation of the matter. However, the concern is that competitors will be able to identify a new type of solution merely on the basis of the owner's positive opinion since equal treatment of the offerors requires that all competitors be informed of the interpretation. In this case, the contractor has no incentive to ask for the owner's interpretation in advance and opts to wait until the potential contract is signed before presenting the development idea.

However, the normal preparation phase for construction is too short in the case that an idea creates dialogue and subsequent alterations require replanning, a compliance review, or official decisions. The preconditions for the profitable introduction of ideas are already significantly weakened, and the difficulty of economic negotiations can make the situation even worse. Therefore, the original owner requirements are left without a critical economic assessment. A project solution implemented in this way is not as cost-effective as it could be.

This may lead to the parties proceeding with the implementation without having been able to eliminate all ambiguities, contradictions, and shortcomings in the documents or having planned the production with sufficient accuracy. This results in various surprises, many of which lead to difficult discussions about additional work and alterations and often disputes, unfortunately. The planning of production lacks a sufficiently proactive approach, and management is more focused on reacting to and tackling challenges.

Consequently, the challenge of developing a DB project is to take some weight off the competition phase and to delay some of the design work until after a contract has been made. At the same time, the procedure must enable further development of the tendered solution so that the parties have a shared interest in finding better implementation solutions through cooperation, even by questioning the original design criteria. It is also necessary to reserve time for project development both in terms of the project process and resource allocation.

3.3 Renewed procedure

The DBd procedure, intended to rise to the challenges of traditional DB practice, consists of the competition, development, and realization phases (see **Figure 1**). The publication of a procurement notice launches the competition phase (Task 1). The enclosed request for proposals describes aspects such as the product/functionality requirements for the project solution and the boundary conditions for the realization. Potential offerors submit a request to participate (Task 2) to the owner, as specified by the procurement notice. In the request, the offerors demonstrate that they are suitable for implementing the project (in terms of the fulfillment of legal and financial obligations, and in terms of the technical performance). The owner assesses the suitability of the candidate companies (Task 3) and, if necessary, determines their superiority and selects the predetermined number of best contractors as offerors. Formally, this is a restricted procedure, referred to in legislation and European directives.

Candidates selected as offerors are asked to submit a proposal containing the price (Task 4) for the implementation of a solution that corresponds to the request for proposals. The request for proposals may be further specified along with the

dialogue with the offerors. The written tender includes the specified prices and the contractor's assurance that it will realize the contract at the offered price in accordance with the requirements laid down in the request for proposals as no technical plans are attached to the tender (Task 5). In addition, various actions may be required to assess the organization's capability (in terms of organizational structure and staffing, selection workshops, action plans, etc.).

The owner compares the proposals (Task 6), and the contractor who has submitted the most economically efficient proposal is selected as the implementer (Task 7). The selection criterion is either the lowest price or the price-quality ratio referred to in legislation. The owner's procurement is conditional so that, in case of a potential disruption of cooperation, the owner can determine that the original procurement decision has lapsed (and turn to the offeror who was in second place in the original tendering process). The owner and the selected contractor conclude a contract on the development of the project, including the owner's option to realize it (Task 8). The contract specifies the work to be carried out during the development phase and the terms and conditions of the compensation that may be paid for it, as well as the principles for sharing out the benefits from the development of the project solution by means of different type cases and examples.

The development phase starts with a presentation of the proposed solution (Task 9) and its review (Task 10). The owner assesses the conformity of the tendered solution with the requirements and endeavors to specify any alterations required to meet the requirements (Task 11). At the same time, the purpose is to start a dialogue between the owner and the contractor, which continues alongside the development of the plans (Task 12), as the owner and the contractor work together to improve the project solution (even though the actual planning work is the contractor's responsibility). It is expected that especially the contractor is active in presenting development ideas (Task 13), as the owner has already influenced the planning of the previous phase. In addition to structural solutions, implementation details such as the working order and traffic arrangements during construction are issues to be examined during the development phase of a road project.

The development phase ends when the parties have taken the minimum measures defined for the development phase and find that continuing development is no longer economically meaningful (Task 14). At the end of the development phase, the contractor hands over a preliminary technical design to the owner, and the owner makes a decision about the transition to the realization phase (or the discontinuation of cooperation) (Task 15). The owner makes a unilateral decision about whether or not to exercise the option for construction, and a positive decision initiates the realization phase. The contract is updated or supplemented so that it takes into account the work carried out at the development phase and corresponds to the plans at the time (Task 16).

The contractor will typically implement the solution defined at the development phase of the project at a fixed price (Task 17). The project now proceeds as a normal DB contract from the owner's perspective (Task 18). However, regarding sharing out benefits, the same principles are applied to possible alterations during the realization period as stated above in connection with alterations during the development phase. Upon completion of the construction work, the owner receives the resulting structure, and this takeover initiates the warranty phase (Task 19)

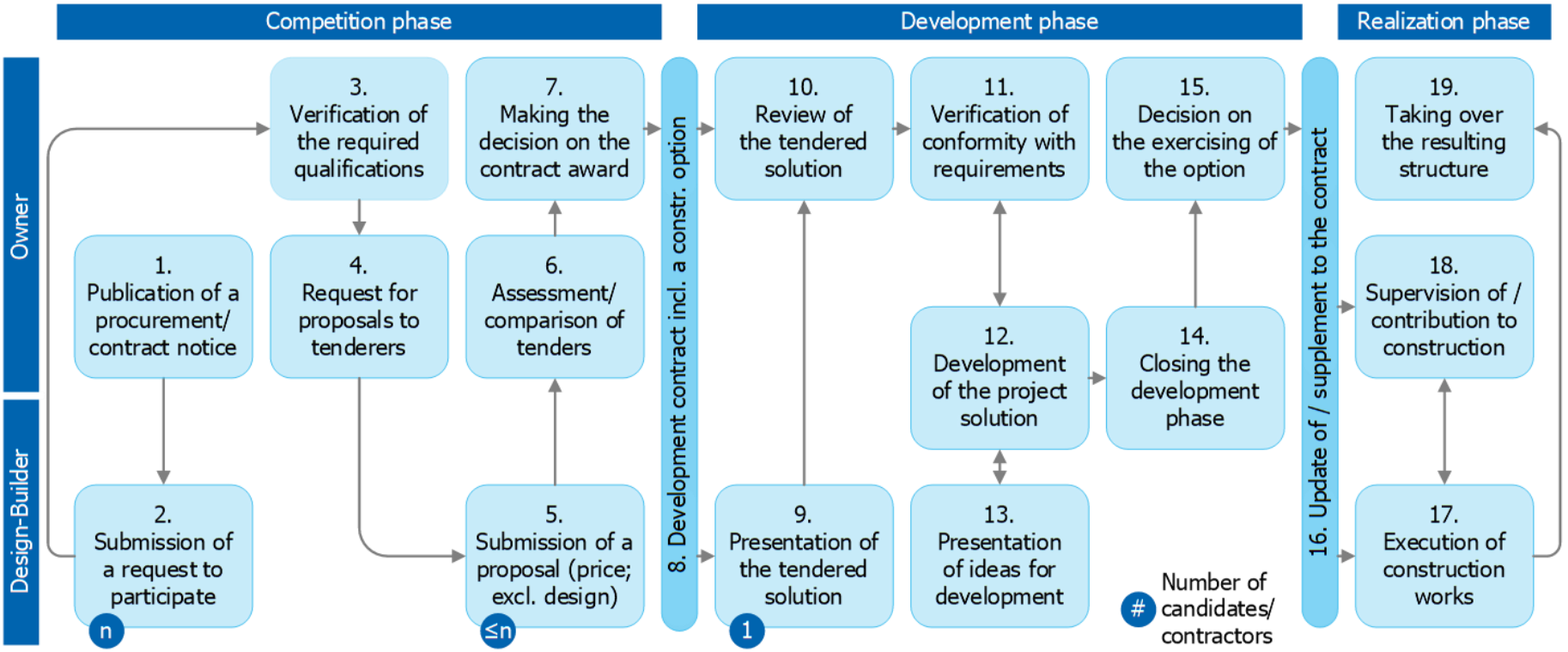

Figure 1. *The DBd (i.e., "design-build with a development phase") process.*

3.4 The upgrade in short

In a DBd contract, the preparation of project documents preceding the tendering process, as well as the realization phase of construction, largely follow the practices of a conventional DB contract. The main differences lie in the selection of the contractor and the new development phase immediately thereafter. Participation in the tendering does not then require submitting a design proposal, nor is it a selection criterion for the contractor. Secondly, unlike usual DB procedures, the selection and the resulting contract do not necessarily lead to implementation if it appears that the tendered technical solution is not compliant and the contractor does not amend it to be compliant at the tendered price or if the parties do not otherwise reach an agreement on the solution to be implemented.

The purpose of the development phase is to enable the development of the project implementation solution in cooperation between the owner and the contractor so that the alterations made improve the technical and economic efficiency of the project. This can be achieved by developing qualitatively better solutions compared with basic solutions or cheaper solutions that are qualitatively equivalent or even solutions that are of slightly lower quality if the cost or other benefits gained from them are significant in relation to the alteration. Risk elimination and proactive planning are also part of the range of tools used during development.

Joint development generates new practices that will also change a project's contracts. In addition to the option for realization, these include the organization, minimum measures, and the operating model of the development phase. The gradual nature of alteration planning and the resolution of related financial issues are also key factors related to the definition of the operating model. Successful development work leads to sharing out benefits, which also requires a framework that has been agreed upon. This framework and the proportional shares or their ranges naturally vary, depending on the type of alteration.

4 Application projects and their results

4.1 The content and scope of projects

Initially, the DBd procedure was tested in a few state-owned road projects. The procurements of the three pilot projects were initiated almost simultaneously in May 2018. These projects are:

- **Rd. 132 Klaukkala bypass (Project B)**. The contract involves constructing a stretch of nearly eight kilometers of a novel single carriageway road in a new terrain corridor. It is a road that bypasses an urban center, and it involves the implementation of four interchanges and the road and street arrangements they require. The contract also includes the improvement of pedestrian routes and public transport stop arrangements in the area and the construction of noise barriers. The value of the realization phase contract is EUR 25 million.

- **Hwy. 4 Kirri–Tikkakoski (Project C)**. The contract involves constructing a stretch of about 17 kilometers of motorway. Almost one-third of this will be constructed in a new terrain corridor. The rest involves upgrading the current road into a motorway, which entails constructing new lanes alongside the current road. A pedestrian route will be built for the road network. The contract also includes the construction of five new interchanges as well as updating one existing interchange. The value of the realization phase contract is EUR 122 million.

- **E18 Turku Ring Road, Kausela–Kirismäki (Phase 1; Project D)**. The entire project involves expanding the existing two-lane ring road into four lanes. The first phase will cover nearly half of the entire 10 km road section (the southeast part). The contract also includes removing old interchanges and replacing them with a new interchange and an overbridge. In addition, a network of parallel roads and a pedestrian traffic system will be built alongside the ring road, and noise barriers will be improved. The value of the first-phase contract is EUR 36 million.

The projects were already fundamentally different in technical content and conditions, but there were many differences in their practices as well. The most significant difference was pricing. In most projects, the tender was presented as a fixed price, and the price was changed on the basis of the alterations made during the development phase based on case-specific cost calculations and the criteria for sharing out benefits defined for each alteration category. Conversely, in Project C, the tender was based on unit prices for the goods/materials and services concerning the road area and road structures. However, a fixed price quote was still determined for the project-level items (joint site costs, central office, fees) included in the contract price in the due course. The contract price was fixed at the end of the development phase in accordance with the volumes and unit prices at the time. The reason for using the unit price procedure was that the road plan for the project (prior to the selection of the contractor) was not prepared with a similar level of detail/diligence as the plans of the other projects under consideration. The plan was also partly outdated due to issues such as regulatory changes since the completion of the plan.

4.2 Competition phase

The interactive competition phase (ranging from the procurement notice to entering the development phase contract) in Project C lasted four months, while the same phase lasted a couple of weeks longer for the other projects. In most projects, the difference between the cheapest offers was at most 2% or 3%, but in Project D, the cheapest offer that was selected was significantly cheaper than the other offers. It is possible that one key factor that explains the difference, especially in this project, is the successful development of the solution at the competition phase. No complaints were made regarding the procurements.

4.3 Alterations during the development phase

The duration of the development phase (ranging from the contract to exercising the construction option) was slightly less than three months in Projects B and D and six months in Project C.

In Project B, the results of the development phase were made concrete in an appendix to the contract agreement that specified ten alterations. Five of these alterations specified the impact on the amount of the contract in euros, and the rest determined the principle of sharing out benefits that would be followed after the more detailed cost impact of the alterations had been determined. The three most significant alterations are presented in more detail in **Table 1** in the order of their benefit, assessed by the owner's project manager. While two of the alterations (B1, B2) reach savings in the range of EUR 100 million, safety and the minimization of disturbances (traffic redirection and stops) were still more significant factors in the planning of the former. With regard to these two alterations (B1, B2), the benefits are shared out equally between the owner and the contractor, but the third alteration (B3), which reduces the scope of the project, mostly brings savings to the owner. All three alterations recorded in the table required changes to the owner's requirements.

The three most significant alterations in the development phase of Project C are described in **Table 2**. The redesign of the interchange (C1) is the most significant one. In the variable terrain, the solution represents the optimization of excavation and filling within the permissible longitudinal gradients of a motorway as well as the optimization of land use, as the area surrounding the intersection is planned to become a business and industrial area. The alteration results in a more functional way to access the area. The alteration is linked to the construction of a parallel road (C2) that is located fairly far away from the perspective of using blasted stone. The parallel road can now be finished quickly with purchased blasted stone, which facilitates the implementation of the rest of the project. This results in additional costs, but the project will probably be ready for traffic about one year earlier with these alterations. The underpass alteration (C3) is an improvement from the perspective of future use, but it also avoids the construction of roads alongside waterways, shortens the corresponding bridges that will be built as part of the project, and improves user safety during work with regard to pedestrian traffic.

***Table 1**. Major alterations in the development phase of Project B (Rd. 132 Klaukkala bypass).*

	Description of alteration	Benefits achieved
B1.	*Edge blasting at the interchange*	
	The road section is connected to the existing highway with an interchange, where the road area is narrowed partly to reduce the amount of blasting. Due to the narrowing, road railings will be built for this section.	The project produces excess blasted stone and the alteration brings cost savings. Blasting in the vicinity of the road that is in use is reduced, as are interruptions to traffic. There is a positive safety impact.
B2.	*Underpass alteration*	
	The cantilever slab bridge to be cast on site is altered to be a prefabricated arch bridge. Implementation of the alteration requires a more general type approval for the bridge type. There are no known obstacles to this.	The alteration brings cost savings. A prefabricated arch bridge is also more aesthetically pleasing, and the disturbance to traffic caused by its construction is shorter. The type approval also serves other projects.
B3.	*Alterations to private roads*	
	The municipality is in the process of procuring land and plans a road network in the area. Several private roads connected to the planned road are removed from the plan as they are estimated to become unnecessary.	The alterations create concrete cost savings in the implementation of the project.

Three of the many development ideas in Project D progressed into alterations (**Table 3**). The most significant alteration concerns the placement of the surplus blasted stone off the current phase of the project. The blasted stone was meant to be taken to the area of the second phase being constructed later under a different contract in order to meet its blasted stone needs. By making excavations and placing blasted stone directly in the future structure, extensive subgrade reinforcements are avoided due to the preloading of the base with the early placement of the blasted stone. In the overall review of the phases, the net savings are on the scale of EUR 1 million, even though a new railing solution is required since the location is close to the current road. The alteration to the underpass height of the bridge (D2) is mainly functional and is achieved with a very small additional investment. New traffic arrangements (D3) provide safe and functional conditions for both traffic and construction with virtually no cost impacts.

***Table 2**. Major alterations in the development phase of Project C (Hwy. 4 Kirri–Tikkakoski).*

	Description of alteration	Benefits achieved
C1.	*Interchange arrangements*	
	In the road plan, the planned motorway is crossed by a perpendicular road. The crossing road is moved below the motorway, which traverses the rock cutting. This reduces excavation while increasing noise protection.	The amount of rock to be excavated is significantly reduced, and the repositioning of the crossing road facilitates land use in the area. (The blasted rock for building a parallel road is now acquired from outside the project; see C2.)
C2.	*Traffic arrangements during construction*	
	The motorway requires the construction of a parallel road on a certain section. With reduced excavation (see C1), the blasted stone for the parallel road is purchased from outside the project, so it can be built right at the start of the project.	With no bypassing traffic, work on the site is easier, and the roadway located in the construction area does not require constant adjustments. Safety is improved and construction as a whole is significantly faster.
C3.	*Pedestrian routes and private roads*	
	Two waterway bridges are located within one kilometer of each other. A private road has been planned in connection to one and a pedestrian route to the other. A new underpass is made between the bridges to connect these routes.	The new underpass serves the flow of pedestrian traffic better than the original solution. Traffic does not interfere with the construction of the bridges. The water bridges are shortened, which compensates for the additional costs of the underpass.

Two of the alterations made in the projects (C1 and C3) were so significant that they required a change in the administrative road plan and making the plan available to the public as well. Otherwise, the alterations mainly consisted of matters that were within the owner's decision-making power.

4.4 Exercising the realization option

The owner exercised the realization option in all the projects, and the projects progressed to the realization phase. The realization phase was estimated to last more than two and a half years in projects B and D and four and a half years in Project C. In most of the projects (B and D), it was obvious early on that the owner would exercise the option to realize the project, and therefore it was a natural continuation of successful work done during the development phase. The realized duration of the development phase, just under three months, was essentially what had been planned for these projects.

***Table 3**. Major alterations in the development phase of Project D (E18 Turku Ring Road, Kausela–Kirismäki, Phase 1).*

	Description of alteration	Benefits achieved
D1.	*Placement of blasted rock in later-stage structures*	
	The project produces excess blasted stone. Instead of the planned intermediate storage, the surplus is placed in the structures of a road in a follow-up project. Transfers are only made in due course in the case of overfilling due to subsidence.	The constructed embankment promotes the subsidence of the soil, and extensive ground reinforcement measures are not needed. Transport is reduced in the follow-up phase. The alteration results in additional costs, but the net savings are high.
D2.	*Increasing the underpass height of a bridge*	
	A bridge's underpass height is raised to allow for larger outsize loads on the ring road. Due to provisions on the longitudinal gradients of the crossing road, this had not succeeded in the past.	The bridge in question is critical as it is not possible to go around it using interchange ramps like with other bridges. Oversize transports would have had to use the road and street network of the area otherwise.
D3.	*Traffic arrangements during construction*	
	With a change in requirements, the speed limit of a site's temporary routes is reduced, making it possible to design an alternative route to be built outside the road area and have it correspond to the selected speed category.	The construction of a detour outside the road area becomes profitable, and a certain part of the construction site can be entirely closed off from passing traffic. This reduces risks and improves safety.

However, the situation was more challenging for Project C than for the other projects. The planning of the project did not proceed as hoped, partly due to its delayed start, the challenging nature of the initial data, major alterations, and insufficient resourcing. There were major challenges in the submission of the preliminary technical design and, correspondingly, in the calculation of sufficiently unambiguous quantity data. In this project, the owner also had to question whether they wanted to exercise the realization option, which was why the service provider's resourcing was also adjusted. In the end, the realization option was exercised, but instead of the planned development period of about four months, the phase lasted six months. The duration of the phase had no impact on alternative implementation resources because the development phase agreement concluded for this project already ended the validity of other tenders.

5 Functionality in the test projects

5.1 Experiences in general

The parties' interviews did not reveal any real opposing force to the application of the procedure, even though the interviews addressed various factors much more extensively than is possible in this summary, which focuses on the general eligibility of the model.

Excluding the technical design from the proposal and reviewing it based on the principle solutions do not make it more difficult to select a contractor, and this practice is particularly preferred by contractors. In the absence of a complete design, the motivation for alteration planning is also maintained, and at best, the result is a development effort where both parties work together. In this way, there is higher confidence in the project solution and its feasibility at the time of the final contract (exercising the realization option). The realization option procedure is a safeguard for the owner, and as a result, the owner is now consulted more readily than in a traditional DB contract.

The need for resourcing and commitment to a prolonged uncertain situation (the development phase) appears challenging for the contractors, but it is partly compensated for by the less labor-intensive tender. Companies are particularly interested in projects where the offer is based on unit prices as this will further reduce the workload of preparing the offer as it leaves out quantity surveying and risk pricing.

The uncertainty of progressing to the realization phase is also limited so that it does not become an overall steering factor. Having progressed to the development phase, the owner has a strong interest in implementing the project and, for public sector projects in particular, discontinuing cooperation is only a real threat in cases where the service provider is unable to fulfill their basic obligations, that is, they are unable to allocate competent resources to the project, to participate in discussions with the owner in order to progress the development, and are unable to supplement their tender solution with regard to further planning.

Moreover, the development phase does not significantly increase the experienced workload as it now largely consists of work traditionally done in the competition phase. Of course, the owner's involvement and more extensive examinations of alternative solutions are a new element, but these additional tasks are mainly only carried out if there are improvement opportunities whose realization benefits both parties. However, anticipating the amount of work is now more challenging than in the traditional process.

Participants also did not feel that the completion of the project is slowed down by a separate development phase. The development phase takes months of dedicated time, perhaps even slightly longer than the shortest instances in the pilot projects. However, a significant amount of time is only used up when there are meaningful improvements to explore. In large complex projects, these improvements will often speed up the realization phase more than the delay caused by the development phase. So, the development phase is a small investment since altering solutions may significantly speed up the deployment of a facility.

It is also clear that there were more development ideas presented now and/or the ideas concerned more significant alterations than before (in conventional DB). Naturally, there were differences between the projects. In addition to clear technical alterations, the work done during the development phase also improves the manageability of the project's realization. Good advance planning frees up some of the site management's capacity to prepare future tasks when work is being carried out. Instead of a reactive approach, the likelihood of more proactive management is now greater.

5.2 General effects

The interviewees were also asked to rate the impact of the procedure on the achievement of general performance targets (see **Figure 2**). These ratings concerned the realization of the application project under review (*Project realization* in the figure). In addition, interviewees were asked to separately assess how the established use of the DBd procedure will improve the overall value-for-money output in the future (*Established use* in the figure). In all cases, the reference was the result of a traditional DB procedure, and the rating scale ranged from a significant negative impact [-3] ("*significantly weakens | adds | slows down*") to a significant positive effect [+3] ("*significantly improves | decreases | speeds up*").

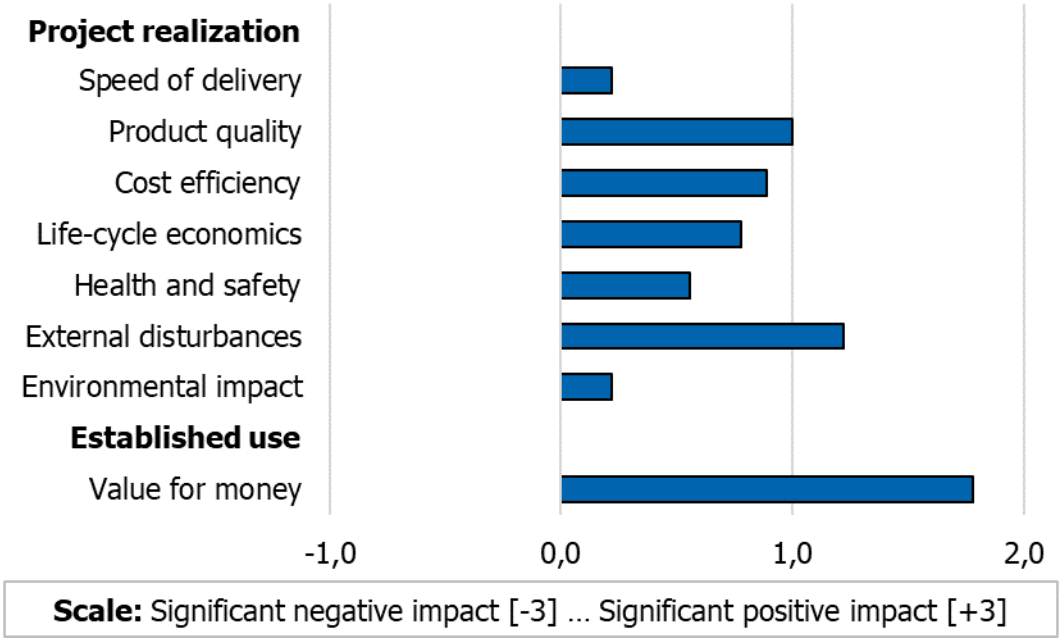

***Figure 2**. Assessments of the realization of the general performance targets (Projects B–D).*

Different aspects were emphasized in different projects, but the alterations can generally be seen to have produced some savings that subsequently improve the quality and the life cycle economy through reinvestments. The interviewees felt that additional planning, better risk management, and clarifying objectives with mutual interaction had a positive impact on many aspects. In fact, all the respondents' assessments were neutral or positive in terms of targets other than speed. Thus, in projects B and D, the impact on speed remained unclear, but the

alterations made in Project C may have sped up the completion of the project, even though the start of construction was delayed compared with the traditional DB procedure. It is also noteworthy that the contractor cannot make binding procurements at the development phase before the realization option decision, so some opportunities will be lost.

The question of the overall functionality of the procedure included the presumption that the procedure was already well established, which was intended to ignore the potential challenges related to the early adoption of the procedure. It was also assumed that the DBd procedure would be used consistently in projects where it was appropriate. A summary of the answers to the question is found under the value for money section in **Figure 2**. The potential was seen to be slightly higher than the experienced benefit in the implemented projects.

5.3 Itemized alterations

The functioning of the DBd procedure was also assessed by examining the alterations made during the development phase. The three most significant alterations of each project were examined (see **tables 1–3**), and the interviewees were asked to consider what kinds of conditions would have allowed their implementation in a traditional DB project. The interviewees were asked to give a numerical assessment of two aspects:

- **The likelihood of adoption**. How likely is it that the alteration in question would have been implemented in a traditional DB process? The value 0% indicates the certainty that the alteration would not have been implemented, and 100% indicates the certainty for the opposite. All intermediate values are in use.

- **Relative net benefit**. What would have been the net benefit achieved by the owner in a traditional DB process (taking all impacts into account) in relation to the net benefit achieved now? The value 100% refers to the benefits of the DBd project. More than 100% is also possible in this instance.

Summaries of the responses are presented in **Figure 3**, where each individual value always represents the average of nine responses calculated in the following alternative ways:

- **by party** (owners, contractors, designers), encompassing all responses by an actor in a certain role regardless of alterations' ranking and project;

- **by project** (Project B, etc.), encompassing all responses for a certain project regardless of alterations' ranking and role of a respondent;

- **by alteration** (Alteration 1, etc.), encompassing all responses for a certain ranking of alterations regardless of project and role of a respondent.

There is a great deal of variation in the *likelihood of adoption*. For one alteration (C1; **Table 2**), the interviewees strongly believed that the alteration would not have been implemented in a traditional DB process. One significant factor of an alteration like this is whether the alteration is a prerequisite for another one, as

was the case here (C1 → C2). On the other hand, even the top three alterations of each project contained an alteration where at least one of the respondents assessed that it would have been implemented in a traditional DB project as well. However, the respondents only agreed on the implementation of one alteration out of the nine (D3; **Table 3**).

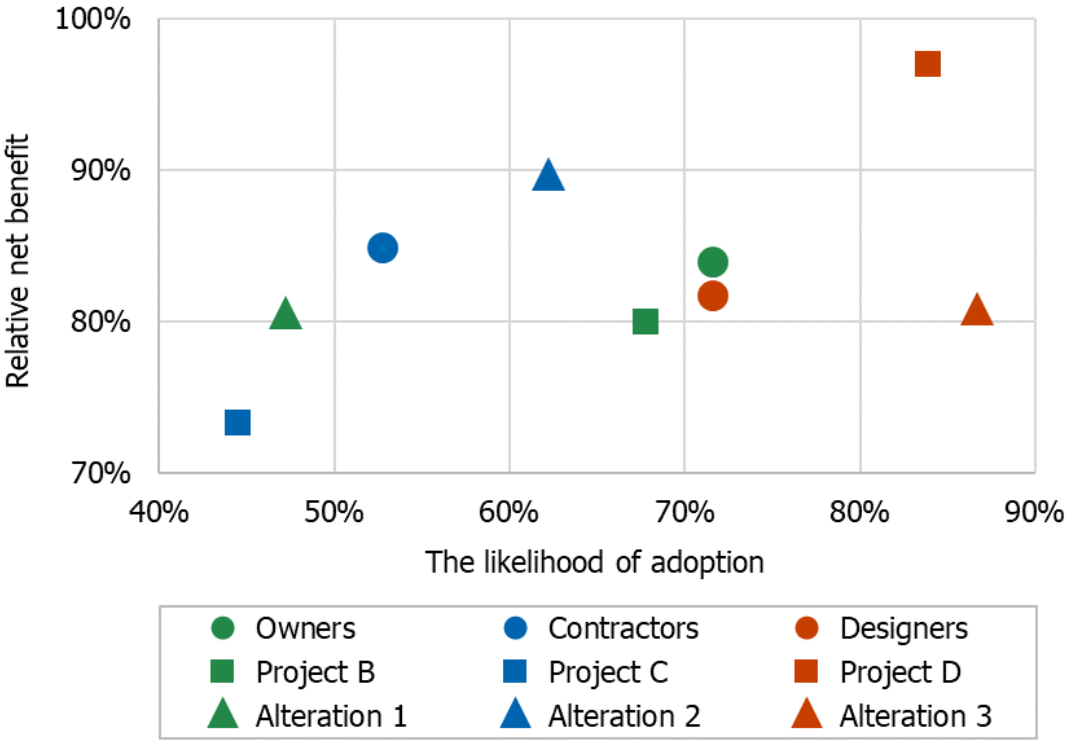

***Figure 3**. Assessments of the likelihood and relative net benefit of adoption.*

When asked about the obstacles to implementation, respondents brought up project scheduling. In a traditional DB project, it is no longer possible to consider major alterations in the realization phase. The expected sharing out of benefits may also have the effect that contractors do not present their ideas if it is assumed that the entire benefit will be directed to the owner.

For *relative net benefit*, the responses did not vary as much as the responses to the *likelihood of adoption*. If adoption is possible, traditional DB contracts will not necessarily fall far behind the owner benefit generated by the DBd procedure. However, the actual impact varies greatly case by case as there are many variables. Sharing out benefits in a unit-priced contract may also differ significantly from the shared-out benefits in a fixed price contract.

In terms of *relative net benefit*, the views expressed by representatives of each role are consistent. Yet, contractors estimated the *likelihood of adoption* to be smaller than others. On the other hand, the contractors' views should be emphasized because, when assessing the initiative behind the alterations, the contractors clearly brought up ideas more often than the others. There were more differences between the projects, which is natural because of the differences between the projects and the alterations made in them. When assessed by alteration (in order of importance), there is specifically a difference in how likely the alterations would be implemented in a traditional DB project.

Figure 4 illustrates the *expected benefits* of a DB contract (as a percentage of the 100% benefit achieved with the DBd procedure) as the product of *relative net benefit* and *likelihood of adoption*. As a whole, there is no major difference between the parties other than what is directly caused by the contractors' lower assessments of the *likelihood of adoption*. The comparison of projects highlights large-scale alterations in Project C, whose preconditions for implementation in a traditional DB project are relatively low. Further, the analysis by alteration on the right-hand side of the figure indicates the most important thing: the more significant and more useful alterations you aim for, the more important it is to use the DBd procedure instead of the traditional DB process.

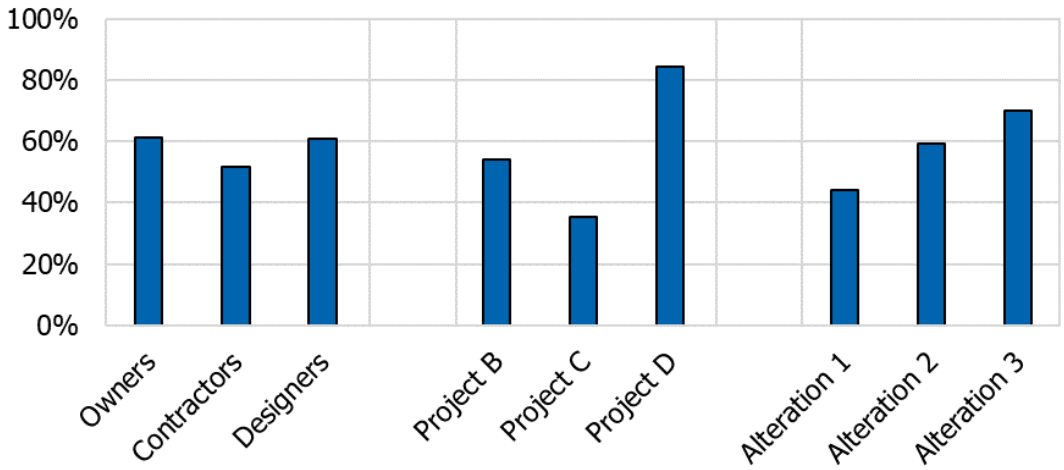

***Figure 4**. Expected relative benefit for a traditional DB project.*

6 Discussion on the functionality

6.1 Internal logic of the renewed practice

The DBd process was described above together with the positive results gained to shed light on the practice and how it can be applied in a construction project to improve its economic efficiency. However, the presentation does not yet thoroughly explain why DBd is expected to be remunerative. This first requires that focus is transferred to key characteristics (i.e., Key Elements [KEs]) of the DBd practice. They can be deduced from the above presentation and are the following:

I. **The proposal contains price information to determine the total price**. The tender price is an essential part of the contractor's selection criteria, albeit typically not the only one. In addition, the offeror assures that the tendered price concerns the delivery of a project solution in accordance with the requirements of the request for proposals.

II. **The technical design solution is not included in the proposal**. The offerors carry out design work for their internal use only to the extent required by the pricing process; there is no formal need for it to exist at this stage. In the absence of technical plans, the selection emphasizes the candidates' capability and the measures needed to assess it.

III. **The realization phase is preceded by a separate joint development phase**. The owner concludes a contract with the winning contractor. The proposed solution is verified for its conformity with requirements during the contractual development phase while the owner and the contractor continue to develop the project solution.

IV. **The benefits of development work are shared between the contracting parties**. The sharing out of benefits is included in order to provide a continuing incentive. The development work is concretized as different kinds of alterations, which is why the largely predetermined principles of the sharing out of benefits vary by type of alteration.

V. **The transition to the realization phase requires a new decision by the owner**. The contract covers the tasks of the development phase and, as an option, the realization phase at the offered price. The price is adjusted in accordance with the results and sharing out of the benefits of the development phase. The owner makes the decision unilaterally.

However, the determination of the Key Elements is just the first step in the process of pondering the procedure's functioning, since the DBd practice is a coherent whole, which is more than just the sum of its components. No component works alone, but all key components are needed and made productive by means of other components. Therefore, to emphasize the holistic nature of the procedure, it is reasonable to summarize the overall logic of the DBd procedure by focusing on the interoperability of its KEs, as follows:

- The pricing (KE I) included in the proposal made during the competition phase already utilizes competitiveness in promoting efficient realization. At the same time, the price recorded in the contract constitutes a necessary

benchmark for the later pricing and assessment of economic efficiency when the project solution is developed in cooperation between the parties in the joint development phase following the contract (KE III). The shared benefits (KE IV) linked to development require that the benefits and the more general impacts of the alterations can be defined in a sufficiently unambiguous manner, and the tendered price (KE I) included in competition plays a key role in this as an enabler.

- The lack of a technical design in the proposal (KE II) also means that the owner cannot fully commit to the project at the moment the contractor is selected. It requires a separate development phase to specify the plans (KE III) and the freedom to take any necessary decisions that may even lead to a termination (KE V). The required new owner decision (KE V) is also a means of defining the development phase (KE III) and making it a genuinely separate part of the project that works according to its specific rules before transitioning to the realization.

- In many cases, the development work enabled and encompassed by the development phase (KE III) entails changing the plans, in which case it is naturally not meaningful to finalize the tender design as part of the proposal (KE II). On the other hand, development is not automatic; it must be promoted by various means. Some of these means include the sharing out of development benefits based on predefined principles (KE IV) and, in part, the owner's unilateral decision on the realization (KE V). Combined with the development phase (KE III) and the related obligation to present alternatives, they (KEs IV and V) help improve the economy of the project.

The overall logic of the DBd procedure is also outlined in **Table 4**.

6.2 Supposed benefits of the renewed practice

The process of developing the DBd procedure was aimed at removing factors previously found problematic, while some identified opportunities also acted as drivers of development. These factors and the related effect chains processed in the group work stage are summarized in **Table 5**. The factors were also explored with the actors involved in the pilot projects. They have generally confirmed the views including the benefits of the DBd procedure presented in the table.

By and large, excluding the technical design from the proposal makes the tendering process (a) and the comparison of proposals (b) less labor-intensive. This is reasonable especially in projects where the entire development potential is difficult to unlock through tendering, for instance, due to the difficulty of setting requirements (d). At the same time, the element of subjective assessment is minimized, and remediable errors in formalities do not limit the choice of the best proposal (c). The absence of a design in the proposal supports development efforts (f) while enabling the optimization of requirements and project solution as one entity (e). With dialogic interaction, parties arrive at a shared interpretation (h), and the development can be extended to production and its arrangements (g).

In general, the procedure has not been found to involve insuperable weaknesses as long as it is used in projects where its strengths are mobilized and the ground rules and practicalities are fine-tuned to be appropriate and serving project goals.

***Table 4**. Internal logic of the DBd procedure. The relationship between two key principles presented on the diagonal can be understood by going clockwise from one principle to another through the intersecting cells of each row and column.*

I. The proposal contains price information to determine the total price	...which, combined with the owner's requirements, already makes it possible to compare contractors, so...		...so that the benefits produced by the development work can be defined as a starting point for the factor that...	
...since owner's requirements constitute an unambiguous comparison point for development when...	**II**. The technical design solution is not included in the proposal	...because a comprehensive design process is not sensible if the solutions will be altered in any case when...		..., so the owner cannot without reservation commit to a realization at the time contract is being concluded; instead, ...
	...during which the project solution is optimized in cooperation, so it is natural in the lead-up that...	**III**. The realization phase is preceded by a separate joint development phase	...but that alone does not drive development enough unless development activities are boosted by the factor that...	
...but in order to define development benefits, you need a reliable benchmark, which is why, among other things, …		...encouraging the parties to develop a project solution that will actually become possible only if...	**IV**. The benefits of development work are shared between the contracting parties	...but ensuring that parties truly put effort into the development work presumes that, among other things, ...
	...since the owner cannot commit to a solution in the first contract phase when...		...which is an additional incentive to the fact that, especially in the development phase...	**V**. The transition to the realization phase requires a new decision by the owner

***Table 5**. Drivers and effects of change and assumed benefits of the DBd procedure.*

	Drivers	Effects	Benefits
a.	Tendering is expensive when contractors have to attach a project technical design to the proposal, which may limit willingness to tender.	The tendering process for projects becomes significantly lighter when an initial technical design does not need to be made/finalized for the proposal.	Willingness to tender is increased, which upholds competition and eventually reduces the tendering overhead in the industry to be paid by owners.
b.	The procurement process is labor-intensive when the owner has to read over several different proposals and to assess their comparative advantages.	The difficulty of comparing parallel plans and the related work is eliminated, which minimizes the subjective element in a process with a tight schedule.	Decision-making becomes faster and more objective, and the work input of the owner's experts can be focused on the joint development phase in projects.
c.	A formal (public) procurement process involves risk when the winning solution has to fulfill all the posed formal requirements.	The risk involved in the choice of the best contractor and possible rejection is reduced with less uncertainty related to handling formalities.	Remediable errors do not require rejection; the burden caused by rejections and contesting, and the related frustration and costs are reduced.
d.	Contractor's ideas are left unused due to a reluctance to reveal them or the inability to safely include them in the solution during the competition phase.	The contractor's expertise and ideas can be included in project development more extensively than is possible in the competition phase.	As the project solution is developed, its economy and functionality are improved for all parties, and/or the disruptiveness of its realization is likewise reduced.
e.	Posing balanced requirements that make sense as a whole is difficult without in-depth investigation of various implementation solutions.	When necessary, requirements and the solution can be optimized as a whole by specifying and making slight adjustments to individual requirements.	The solution becomes more profitable in a technical and economic sense, and single ill-suited requirements do not steer the realization to an excessive extent.
f.	In the context of the process, technical design fine-tuned in the competition phase is wasted if the plans are altered at a later stage.	The technical design is finalized only when it is apparent that there will be no further substantive alterations to the project solution.	The procedure minimizes the fine-tuning of superfluous plans, and parties' willingness to develop is not hindered by already produced plans.
g.	The planning of production lacks a proactive approach, and management is focused on reacting when there is relatively little rigorous advance planning.	There is enough time for construction preparations and production planning when the development phase enables thorough planning in advance.	The change from reactive to proactive management improves the steering of implementation and reduces risks related to construction work.
h.	Project documents are mainly produced by one party, so parties may have divergent interpretations of the content when concluding the contract.	The content of documents can be processed in cooperation to ensure a congruent interpretation of the content before proceeding to the realization phase.	There are fewer surprises, additional work, and potential disputes during the realization phase, which improves the likelihood of a successful project.

6.3 Suitability of the practice for various projects

The DBd procedure is applicable to projects offering some degree of freedom in development. The procedure is at its best in projects that involve several options for technical implementation, where the plan is to try something new or where request-for-proposal plans are unambiguous enough for a tendering even though they will need to be updated before a final contract can be concluded. For example, road plans are sometimes made well in advance without immediate funding for the investment, causing the project to start after a long delay following completion of the road plan, which is an obvious cause for updates.

The extent of freedom and the possibility for alterations asked for by the DBd procedure are naturally greater with larger projects, so it is likely that the larger the project, the more appropriate it is to use the DBd procedure. This is also because years-long construction projects are not delayed by a development phase in the same way that smaller projects might be. With large projects that are acquired and realized in stages, there is likely to be much development potential between phases as well. The development phase included in the procedure and its dialogic nature also supports developing and testing entirely new solutions, taking into account stakeholders' views and minimizing project risks.

Similarly, the benefits of the DBd procedure may be minimal if there is no real potential for development. For road projects, using the procedure is questionable, for example, in a case where a road will be improved by using the existing structure with no difficulties posed by the roadbed or ground conditions. In the same way, constructing a new carriageway next to an existing one involves few freedoms compared to a stretch of road constructed in undeveloped terrain. In urban areas, there are also often more limiting conditions since projects are more strongly linked to town planning, land use, and existing structures.

Generally speaking, the application area of the DBd procedure overlaps with traditional DB to a large extent, unless the owner's motive for using DB is to have an effortless project, avoid detailed planning, or have the responsibility generally fall in one place. Similarly, aiming for fast completion may support more traditional DB, as the development phase does involve an intrinsic delay at the start of construction, even though, in some cases, solutions found in the development phase may shorten the total length of the project, especially in larger projects where the time taken by the development phase is relatively short compared to the total project duration.

In addition to traditional DB, another point of comparison is a project alliance where parties share the risks in a joint organization. Similar to the DBd procedure, this model involves developing the project solution cooperatively by the contracting parties before moving on to the realization phase. In view of this, DBd is a more likely choice in situations where competition enables unambiguous proposal pricing and where it is possible to define the project solution more confidently and minimize the risks more securely during the development phase so that the realization phase does not involve an unreasonable amount of uncertainty, in which case risk-sharing is not necessary. These projects do not involve issues such as significant uncertainties caused by external factors to the extent that is typical for alliance projects.

7 Summary

Conventional DB practice is burdened, for instance, by laborious competitive tendering and contractor selection and a kind of hasty realization of the technical proposal by the selected contractor without the possibility to optimize the combination of pre-set requirements and the solution as an entity. This is why FTIA came along to develop a novel application for projects applying DB, which enables the further improvement of the technical and economic efficiency of the project by means of collaboration and increased dialogue between the parties.

The solution found was the DB with a development phase (DBd). The procedure is initially based on a price-inclusive competitive selection of the design-builder. Yet, the DBd procedure does not require that the design solution is included in the proposal. The owner ensures that the design solution of the chosen contractor meets the set requirements during the contractual development phase when the owner and the contractor continue the development of the project solution in cooperation according to the principle of benefit sharing. The development phase ends when the owner makes a decision about exercising its option for the implementation phase, which follows the usual DB contracting practice.

The procedure was initially applied in a few road infrastructure projects. The experiences were positive, and the project participants believe that the procedure can be beneficial to many challenging projects with leeway for development. The potential of the procedure is indeed seen as still bigger than what was actualized in the trial projects. In most cases, there are so much uncertainty and alternative solution possibilities involved in projects that their examination jointly between the parties early enough in relation to design and realization will be profitable.

Joint development between the owner and the design-builder may focus on a critical evaluation of design principles based on more comprehensive knowledge, but the procedure also encourages the search for better solutions within the set requirements since the competition phase is seldom able to seize all of the existing potential. The production viewpoint is taken better into consideration and no major uncertainties plague the implementation phase since the preceding development work helps eliminate them. Increased dialogue combines the parties' know-how for the benefit of the project, even if there are very few striking alterations.

In conclusion, DBd seems to rise to the challenges of conventional DB practice while it follows the prevailing general trend towards more collaborative and integrated contracting. Together with the positive experiences gained, this supports the idea that the novel DBd solution is a reasonable method for future projects, although it is not aimed at all cases — other project delivery methods and even other DB variations will have a role in future projects as well.

Accordingly, FTIA has already applied the DBd procedure in another, even bigger, bunch of projects since the first ones reported here. The projects utilize different applications. For instance, the basic idea has been applied to projects that follow the open procedure in contractor selection instead of the restricted one described above as the default practice. Furthermore, the realization option has been turned around to a comprehensive contract with the owner’s right to discontinue the contract under certain conditions. Moreover, some other public owners have also adopted DBd, which has already extended its use to diverse types of projects.

Finnish Transport
Infrastructure Agency

ISSN 2490-0745
ISBN 978-952-317-910-3
www.vayla.fi