Innovative approach to repetitive tasks

An exploratory research on exploiting the potential of repetitive tasks in the construction industry

Msc Construction Management and Engineering

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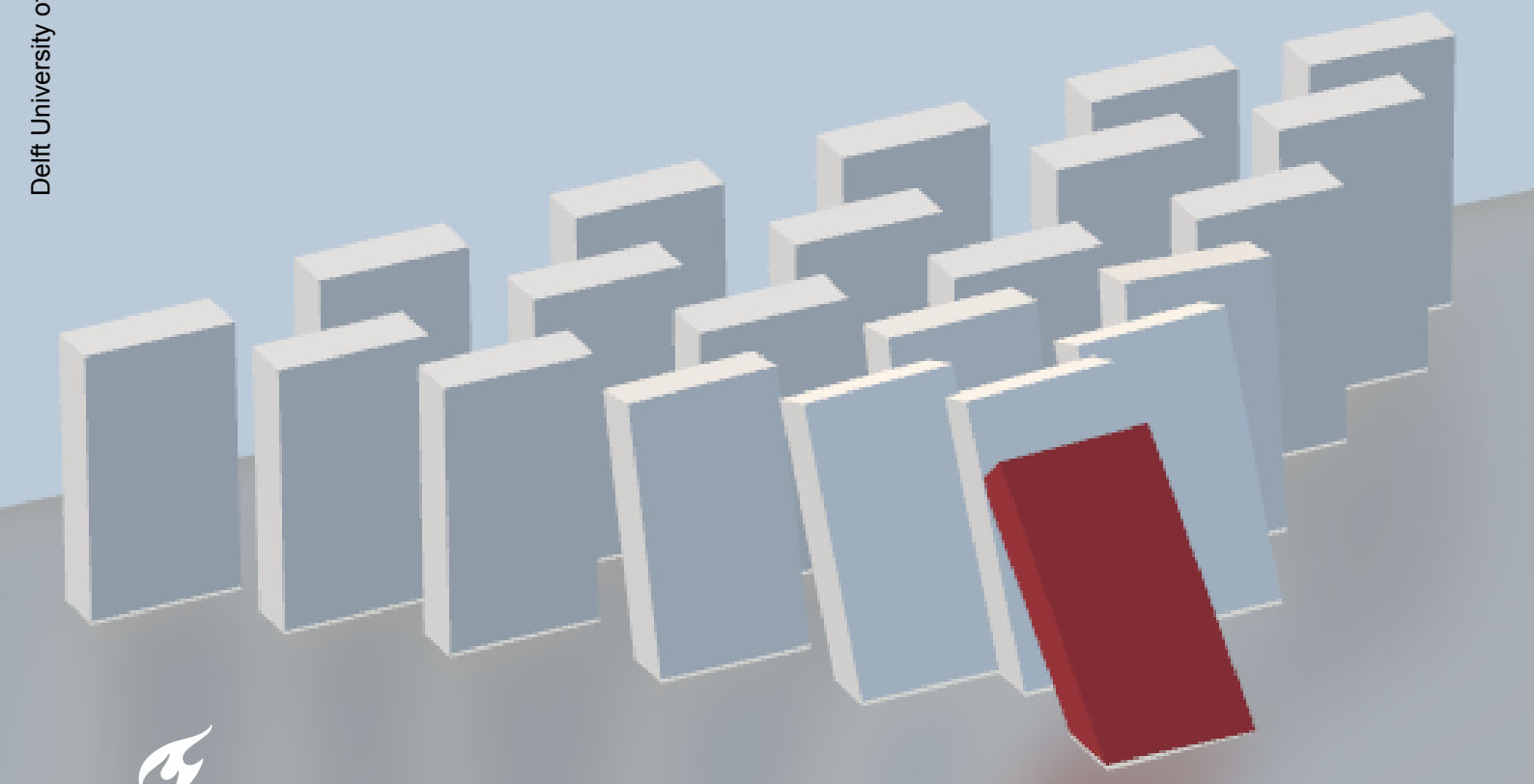

TU Delft

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by

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Preface

Perhaps dominoes, as depicted on the cover, are not the first thing that comes to mind when you read the title of this research. However, dominoes, which are arranged in such a way that when the first one falls, the others follow, can be compared to the subject of my research, namely repetitive tasks in the construction industry. The construction industry is characterised by assignments, projects and programmes in which repetition of processes and activities occurs. The power of repetition is that an improvement is passed on each time, like dominoes passing momentum to the next. At the same time, the strength of repetition can also be a weakness. As well as improvements, mistakes are also passed on, so it is wise to consider the advices and recommendations of this research. In my report, I have tried to contribute to current societal and construction challenges by providing insight into the potential of repetitive tasks and tools to exploit it.

This research would not have been possible without the guidance of my thesis committee members, all of whom were enthusiastic about the subject from the beginning and whose critical questions and comments pushed me to improve. Special thanks to Marleen Hermans and Maedeh Molaei for giving me the opportunity to participate in their beautiful research and for giving me an insight into the world of research. Marian Bosch-Rekveldt for her valuable feedback and Huub de Lange for always clarifying the subject and my questions with practical examples. Finally, I would like to thank all the people I was able to interview, who contributed to the expert evaluations and gave me the opportunity to participate in the meetings of the cases studied.

Before wishing all readers an enjoyable read, and hopefully useful tools for exploiting the potential of repetitive tasks, I would like to take a moment to thank my parents and sister for the support and space they have given me to focus on this research.

Heleen Smit
Utrecht, Wednesday 3rd April, 2024

Summary

Current societal and construction challenges, combined with limited time and the scarcity of people and resources, require solutions in the construction industry. This research focuses on repetitive tasks and contributes to that. Furthermore, this research is necessary because the literature on repetitive tasks is limited and needs to be supplemented.

The research objective is to increase insight and knowledge of repetitive tasks and the design elements aimed at exploiting the potential of repetitive tasks in assignments where public clients and contractors collaborate. The research objective was aimed to be achieved by answering the main research question below.

How can a public client design an assignment that involves collaboration with contractors to exploit the potential of repetitive tasks?

Research methods

Based on the literature review, repetitive tasks and associated potential were defined and a theoretical framework was established. The empirical part of the research builds on this. The empirical research consists of studying three cases, the programmes WL, IPS Schoolgebouwen and WOUW, using case documents and eighteen interviews conducted with public clients and contractors. This provided a picture of repetitive tasks in different construction sectors (residential, utility and infrastructure construction) and at different phases of the asset life cycle (new construction, maintenance and renovation). Separate analysis of the three cases, combined with a cross case analysis and the established theoretical framework, then formed the basis for the ”Innovative approach to repetitive tasks” framework. The framework was evaluated and refined through several expert evaluations with six experts.

Research findings

As a public client and contractor, it is important to be able to identify repetitive tasks. Therefore, repetitive tasks are defined in such a way that they can be widely recognised, not only in projects, but also in programmes and portfolios, and not only in the repetition of activities, but also in the repetition of processes. The following expanded definition allows for the identification of repetition in (1) new construction, maintenance and renovation, (2) preparatory and execution tasks, (3) process and product, (4) tasks executed consecutively or simultaneously, and (5) tasks of (public) client and contractor.

“Construction processes and activities that are executed more than once (repeatedly) on/for the same or different (parts of) structures at one or more locations without the result having to be the same.”

The following step involves improving repetitive tasks, and in this context the following definition of the potential of repetitive tasks has been formulated:

“Repetitive tasks are characterised by one or more repetitions of the same or similar tasks. The potential of repetitive tasks involves the possibility that these tasks – when repeated – will be executed better each time, and that the improvements will then be applied each time and contribute to more efficient and effective achievement of [the goal].”

It is noted that improvement can be achieved in ways such as learning through the acquisition of practical and theoretical knowledge and skills, standardisation and industrialisation. Innovation can refer to a special repetitive task. Special because it is a market-ready task and, by definition, aimed at improvement. In the definition, ”the goal” can vary. The goal can be purely economic (executing the same or similar tasks in less time and money) or it can be complemented or replaced by societal challenges such as sustainability. The research shows that improvement can lead to time savings, cost savings, improved quality, improved (price) estimates, improved procurement of materials and better information for stakeholders. In addition, during the interviews, factors were raised (comments) that hinder the exploitation of the potential of repetitive tasks: repetition of mistakes, less critical thinking, boredom and limitation of choice/flexibility.

Through collaboration, forces can be combined, and the knowledge and expertise of public client and contractor can be exchanged. Based on the insights gained from the studied literature and cases, nine design elements with associated advices have been formulated to facilitate exploiting the potential of repetitive tasks. These design elements and advices are presented in the ”Innovative approach to repetitive tasks” framework (see Table 1 for a summary and Figure 7.2 for the original). The interpretation of the advices may vary from one assignment to another, depending on circumstances such as laws and regulations, a public client’s portfolio, stakeholders, availability of data, competence of the public client and duration of an assignment. The term assignment is derived from the procurement law and refers to the execution of tasks at tactical level and/or operational level. The framework distinguishes between design elements that are important at the time of defining an assignment (before collaboration) and/or after awarding an assignment (during collaboration). The design elements are not ranked. In addition, the letters after each design element indicate at which organisational level(s) application of the design element and associated advice is recommended. S denotes strategic level, T denotes tactical level and O denotes operational level. It is recommended to involve contractors at both tactical and operational level after an assignment has been awarded in order to make better use of their knowledge, expertise and capacity. Therefore, implementation of the design elements ”at the time of defining & after awarding an assignment” and ”after awarding an assignment” is recommended at both tactical and operational level. The successful implementation of the advices for public clients also depends on the cooperation of the contractor(s), especially in 2. Early involvement contractor, 4. Smart scheduling, 5. Uniformity, 7. Knowledge retention, 8. Knowledge exchange and 9. Evaluation.

If an organisation, whether a (public) client or (potential) contractor, is considering exploiting the potential of repetitive tasks, it is recommended that the first step is to take an inventory of repetitive tasks at portfolio level and determine ”the goal” of improving repetitive tasks. By utilising the design elements and associated advices provided in the framework, the public client can then design the assignment involving collaboration with contractors in a way that facilitates exploiting the potential of repetitive tasks. To exploit the potential of repetitive tasks, a public client can refer to Appendix D.3. This appendix contains the design elements and associated advices, the definition of repetitive tasks and their potential, and examples derived from the cases studied.

Table 1: Summary of design elements with associated advices for public clients to exploit the potential of repetitive tasks. S = strategic level, T = tactical level, O = operational level

Phase	Design element	Advice
At the time of defining an assignment	1. Predictability scope [S, T, O]	Promote continuity and provide clarity on the tasks to be executed and the associated timeframe.
	1.1 Sufficient volume	Promote sufficient volume to increase the likelihood of repetition and provide room for improvement.
	2. Early involvement contractor [T]	Involve the contractor at tactical level rather than just at operational level (preparation and execution) after awarding the assignment.
	3. Facilitating demand specification [S, T]	Formulate the demand specification in such a way as to increase the likelihood of repetition and leave room for improvement.
At the time of defining & after awarding an assignment	4. Smart scheduling [T, O]	Promote that the same (specialised) people execute the same or similar tasks sequentially.
	5. Uniformity [T, O]	Promote uniformity in the tasks to be executed within an assignment where multiple contractors are involved and contractors are executing the same or similar tasks.
	6. Financial incentive (bonus) [T, O]	Promote contractors to (continue to) improve repetitive tasks by applying a financial incentive, for example in the form of a bonus.
After awarding an assignment	7. Knowledge retention [T, O]	Promote building on acquired knowledge and experience and avoid losing knowledge.
	7.1 Continuity parties involved	Promote that people involved in the assignment change as little as possible.
	8. Knowledge exchange [T, O]	Exchange knowledge on repetitive tasks and their potential, and identify whether processes within the organisation hinder the exploitation of the potential of repetitive tasks and adjust them where possible.
	8.1 Knowledge exchange Public client – Contractor	Exchange knowledge about repetitive tasks and their potential, and pay attention to streamlining administrative processes, for example.
	8.2 Knowledge exchange Contractor – Contractor	Promote learning by exchanging knowledge and inspiring each other, even when executing repetitive tasks “simultaneously”.
	9. Evaluation [T, O]	Avoid repeating mistakes and less critical thinking through evaluation. During the evaluation, consider questions such as: what repetitive tasks have we executed, what can be improved, what is needed to improve, and is the standard used still appropriate?

Scientific contribution

This research proposes and substantiates an expanded definition of repetitive tasks, allowing repetitive tasks to be identified also beyond projects. In addition, the identified design elements included in the framework complement the current literature on programmes. Finally, the comments found that hinder the exploitation of the potential of repetitive tasks provide a counterpoint to the current literature that focuses only on the positive side of repetitive tasks.

Recommendations for public clients and (potential) contractors

Public clients and (potential) contractors should consider repetitive tasks at the portfolio (strategic) level, not just at the project level. It is also important to look not only at execution tasks (e.g. mowing and asphalting) but also at preparatory tasks, both at tactical level (e.g. planning and preparation of an annual plan) and operational level (e.g. scheduling and preparation of an execution plan). In addition, public clients and (potential) contractors should be aware that repetition occurs not only when the same or similar tasks are executed consecutively, but also when they are executed simultaneously. To address the comments that hinder the exploitation of the potential of repetitive tasks, it is recommended to use knowledge retention, knowledge exchange, and evaluations within and across assignments. Additionally, a critical attitude towards the use of routines, standardisation, and industrialisation is desirable.

The main supplementary recommendations for public clients at three different organisational levels are:

- formulate a challenge and design the portfolio so that repetitive tasks occur and their potential is exploited. Setting ”the goal” is important for the potential of repetitive tasks (strategic level);
- take a project and assignment-transcending approach to repetitive tasks and make use of the knowledge of other (public) clients and contractors who execute the same or similar tasks when translating the strategy into execution programmes. Additionally, it is important to pay attention to the possibilities and limitations of the internal organisation and to examine whether the bundling of repetitive tasks with other (public) clients offers added value (tactical level);
- when executing projects and activities, it is important to offer the (potential) contractor the opportunity to exploit the potential of repetitive tasks (operational level).

The main supplementary recommendations for (potential) contractors at three different organisational levels are as follows:

- when formulating organisational goals, consider their effects on the occurrence of repetitive tasks and ”the goal” being pursued by improving repetitive tasks (strategic level);
- identify and exploit (the potential of) repetitive tasks across projects and assignments (tactical level);
- when executing projects and activities, provide employees of your own organisation, subcontractors, and suppliers the opportunity to exploit the potential of repetitive tasks (operational level).

Finally, collaboration between public client and contractor(s) at tactical and operational level requires a different way of working, from a transactional model based interaction to a long-term partnership. By following these recommendations, forces can be combined, and the potential of repetitive tasks can be jointly exploited.

Recommendations for future research

It is recommended that future research considers not only the collaboration between public client and contractors, but also, for example, suppliers, subcontractors and collaboration between different (public) clients. In addition, it would be interesting to perform a longitudinal study of the cases studied, so that the design elements and associated advices can be tested, for example in terms of usefulness, and it becomes possible to rank them. Finally, it is recommended not to lose sight of internal commissioning. What improvements should a public client make in his organisation, so that he and the contractor(s) are able to exploit the potential of repetitive tasks.

Samenvatting

De huidige maatschappelijke opgaven en bouwopgaven gecombineerd met beperkte tijd en schaarste aan mensen en middelen, vragen om oplossingen in de bouwsector. Dit onderzoek gericht op repetitieve werkzaamheden draagt daaraan bij. Ook is dit onderzoek nodig omdat de literatuur over repetitieve werkzaamheden beperkt is en aanvulling behoeft.

Onderzoeksdoel is het vergroten van inzicht en kennis over repetitieve werkzaamheden en de inrichtingselementen die gericht zijn op het benutten van het potentieel van repetitieve werkzaamheden bij opdrachten waarin publieke opdrachtgevers en opdrachtnemers samenwerken. Met het antwoord op onderstaande hoofdvraag is getracht het onderzoeksdoel te bereiken.

Hoe kan een publieke opdrachtgever een opdracht waarin wordt samengewerkt met opdrachtnemers zo vormgeven dat het potentieel van repetitieve werkzaamheden wordt benut?

Onderzoeksmethode

Op basis van literatuuronderzoek zijn repetitieve werkzaamheden en bijbehorend potentieel gedefinieerd en is een theoretisch raamwerk opgesteld. In het empirische gedeelte van het onderzoek is hierop voortgeborduurd. Het empirische onderzoek bestaat uit bestudering van drie casussen, de programma's WL, IPS Schoolgebouwen en WOUW, aan de hand van casus documenten en achttien interviews afgenomen met publieke opdrachtgevers en opdrachtnemers. Hiermee is een beeld verkregen van repetitieve werkzaamheden in verschillende sectoren van de bouw (woningbouw, utiliteitsbouw en GWW) en in verschillende levenscyclusfasen van assets (nieuwbouw, onderhoud en renovatie). Afzonderlijke analyse van de drie casussen gecombineerd met een cross case analyse en het opgestelde theoretische raamwerk, vormden vervolgens de basis voor het raamwerk "Innovatieve aanpak van repetitieve werkzaamheden". Tijdens verschillende expert evaluaties met zes experts is vervolgens het raamwerk geëvalueerd en aangescherpt.

Onderzoeksresultaten

Van belang is om als publieke opdrachtgever en opdrachtnemer repetitieve werkzaamheden te kunnen herkennen. Zodoende zijn repetitieve werkzaamheden zo gedefinieerd opdat ze breed kunnen worden opgemerkt, niet alleen in projecten, maar ook programma's en portfolio's en niet alleen herhaling van activiteiten maar ook bij herhaling van processen. Met onderstaande uitgebreide definitie is het mogelijk om repetitie terug te vinden in (1) nieuwbouw, onderhoud en renovatie, (2) voorbereidings- en uitvoeringswerkzaamheden, (3) proces en product, (4) werkzaamheden die achtereenvolgens of tegelijkertijd worden verricht en (5) werkzaamheden van (publieke) opdrachtgever én opdrachtnemer.

"Bouwprocessen en -activiteiten die meer dan eens (herhaaldelijk) worden uitgevoerd op/voor eenzelfde of verschillende (delen van) constructies op één of meerdere plaatsen zonder dat daarbij de uitkomst dezelfde dient te zijn."

Vervolgstap is het verbeteren van repetitieve werkzaamheden en in dat verband is onderstaande definitie van het potentieel van repetitieve werkzaamheden geformuleerd:

"Repetitieve werkzaamheden kenmerken zich door één of meervoudige herhaling van dezelfde of vergelijkbare werkzaamheden. Bij het potentieel van repetitieve werkzaamheden gaat het om de mogelijkheid dat deze werkzaamheden - wanneer ze worden herhaald - elke volgende keer beter worden verricht en verbeteringen vervolgens telkens worden toegepast en bijdragen aan efficiënter en effectiever bereiken van [het doel]."

Opgemerkt wordt dat verbeteren kan door manieren zoals leren door het opdoen van praktische en theoretische kennis en kunde, standaardiseren en industrialiseren. Innovatie kan een bijzondere repetitieve werkzaamheid zijn. Bijzonder omdat het een werkzaamheid betreft die gereed wordt gemaakt voor de markt en per definitie gericht op verbetering. In de definitie kan "het doel" variëren. Het doel kan puur economisch zijn (verrichten van dezelfde of vergelijkbare werkzaamheden met minder tijd

en geld) of worden aangevuld met of vervangen door maatschappelijke opgaven zoals duurzaamheid. In het onderzoek komt naar voren dat verbeteren kan resulteren in tijdreductie, kostenreductie, verbeterde kwaliteit, verbeterde (prijs)inschattingen, verbeterde inkoop van materialen en beter informeren van stakeholders. Daarnaast zijn tijdens de interviews factoren aangedragen (kanttekeningen) die het benutten van het potentieel van repetitieve werkzaamheden belemmeren: herhaling van fouten, minder kritisch denken, optreden van verveling en beperking keuzevrijheid/flexibiliteit.

Door samenwerking kunnen krachten worden gebundeld en kennis en expertise van publieke opdrachtgever en opdrachtnemer worden uitgewisseld. Met de inzichten verkregen uit de bestudeerde literatuur en casussen, zijn negen inrichtingselementen met bijbehorende adviezen geformuleerd die benutten van het potentieel van repetitieve werkzaamheden faciliteren. Deze zijn weergegeven in het raamwerk "Innovatieve aanpak van repetitieve werkzaamheden" (zie Tabel 2 voor een samenvatting en Figuur 7.2 voor het origineel). De concrete invulling van de adviezen kan per opdracht verschillen afhankelijk van omstandigheden zoals wet- en regelgeving, portefeuille van een publieke opdrachtgever, stakeholders, beschikbaarheid van data, bekwaamheid van de publieke opdrachtgever en duur van een opdracht. Het begrip opdracht wordt ontleend aan de aanbestedingswet en betreft het verrichten van werkzaamheden op tactisch niveau en/of operationeel niveau. In het raamwerk worden inrichtingselementen onderscheiden die van belang zijn ten tijde van definiëren van een opdracht (voorafgaand aan de samenwerking) en/of na gunning van een opdracht (tijdens de samenwerking). Een rangorde ontbreekt in de inrichtingselementen. Daarnaast geven de letters achter elk inrichtingselement aan op welk(e) organisatieniveau(s) toepassing van het inrichtingselement en bijbehorend advies wordt aangeraden. S staat voor strategisch niveau, T voor tactisch niveau en O voor operationeel niveau. Geadviseerd wordt om opdrachtnemers zowel op tactisch als operationeel niveau te betrekken na gunning van een opdracht zodat hun kennis, expertise en capaciteit beter wordt benut. Zodoende wordt voorgesteld de inrichtingselementen geldend "ten tijde van definiëren & na gunning van een opdracht" en "na gunning van een opdracht" zowel op tactisch niveau als operationeel niveau toe te passen. Een succesvolle implementatie van de adviezen aan publieke opdrachtgevers is mede afhankelijk van de medewerking van de opdrachtnemer(s), vooral bij 2. Vroegtijdig betrekken opdrachtnemer, 4. Slim plannen, 5. Uniformiteit, 7. Kennisboring, 8. Kennisuitwisseling en 9. Evalueren.

Indien een organisatie, (publieke) opdrachtgever of (potentiële) opdrachtnemer, overweegt het potentieel van repetitieve werkzaamheden te benutten, wordt aangeraden allereerst repetitieve werkzaamheden te inventariseren op portfolioniveau en "het doel" van de verbetering van repetitieve werkzaamheden te bepalen. Door vervolgens gebruik te maken van de inrichtingselementen en bijbehorende adviezen opgenomen in het raamwerk, kan de publieke opdrachtgever de samenwerking met opdrachtnemers zo ontwerpen dat benutten van het potentieel van repetitieve werkzaamheden wordt gefaciliteerd. Een publieke opdrachtgever die het potentieel van repetitieve werkzaamheden wil benutten, kan volstaan met het lezen van Bijlage D.3. Deze bijlage bevat naast de inrichtingselementen en adviezen, de definitie van repetitieve werkzaamheden en bijbehorend potentieel evenals voorbeelden ontleend aan de bestudeerde casussen.

Wetenschappelijke bijdrage

In dit onderzoek is een uitgebreide definitie van repetitieve werkzaamheden voorgesteld en onderbouwd, zodat repetitieve werkzaamheden ook buiten projecten kunnen worden opgemerkt. Daarnaast vormen de gevonden inrichtingselementen opgenomen in het raamwerk een aanvulling op de huidige literatuur over programma's. Tot slot vormen de gevonden kanttekeningen die benutten van het potentieel van repetitieve werkzaamheden belemmeren, een tegenwicht tegen de huidige literatuur die alleen op de positieve kant van repetitieve werkzaamheden focust.

Table 2: Samenvatting inrichtingselementen met bijbehorende adviezen voor publieke opdrachtgevers ten behoeve van benutten van het potentieel van repetitieve werkzaamheden. S = strategisch niveau, T = tactisch niveau, O = operationeel niveau

Fase	Inrichtingselement	Advies
Ten tijde van definiëren van een opdracht	1. Voorspelbaarheid scope [S, T, O]	Bevorder continuïteit en bied duidelijkheid over de te verrichten werkzaamheden en bijbehorende tijdspanne.
	1.1 Voldoende volume	Bevorder voldoende volume zodat de kans op herhaling wordt vergroot en ruimte wordt geboden om te verbeteren.
	2. Vroegtijdig betrekken opdrachtnemer [T]	Betrek opdrachtnemer vanaf tactisch niveau in plaats van alleen operationeel niveau (voorbereiding en uitvoering) na gunning van een opdracht.
	3. Faciliterende uitvraag [S, T]	Formuleer de uitvraag zodanig dat de kans op herhaling wordt vergroot en ruimte wordt geboden om te verbeteren.
Ten tijde van definiëren & na gunning van een opdracht	4. Slim plannen [T, O]	Bevorder dat dezelfde (gespecialiseerde) mensen dezelfde of vergelijkbare werkzaamheden achtereenvolgens verrichten.
	5. Uniformiteit [T, O]	Bevorder uniformiteit van de te verrichten werkzaamheden binnen een opdracht in het geval dat meerdere opdrachtnemers zijn betrokken en opdrachtnemers dezelfde of vergelijkbare werkzaamheden verrichten.
	6. Financiële prikkel (bonus) [T, O]	Bevorder dat opdrachtnemers repetitieve werkzaamheden (blijven) verbeteren door toepassing van een financiële prikkel bijvoorbeeld in de vorm van een bonus.
Na gunning van een opdracht	7. Kennisborging [T, O]	Bevorder dat voortgeborduurd wordt op opgedane kennis en ervaring en voorkom dat kennis verloren gaat.
	7.1 Continuïteit betrokken partijen	Bevorder dat mensen die betrokken zijn bij de opdracht zo min mogelijk worden vervangen.
	8. Kennisuitwisseling [T, O]	Wissel kennis uit op het gebied van repetitieve werkzaamheden en hun potentieel en inventariseer of processen binnen de organisatie benutten van het potentieel van repetitieve werkzaamheden belemmeren en pas deze indien mogelijk aan.
	8.1 Kennisuitwisseling Publieke opdrachtgever – Opdrachtnemer	Wissel met elkaar kennis uit op het gebied van repetitieve werkzaamheden en hun potentieel en geef bijvoorbeeld aandacht aan afstemmen van administratieve processen.
	8.2 Kennisuitwisseling Opdrachtnemer – Opdrachtnemer	Bevorder leren door kennisuitwisseling en elkaar inspireren ook wanneer repetitieve werkzaamheden “tegelijkertijd” worden verricht.
	9. Evalueren [T, O]	Voorkom herhaling van fouten en minder kritisch denken door te evalueren. Tijdens de evaluatie komen vragen aan bod zoals: welke repetitieve werkzaamheden hebben we verricht, wat kan eraan worden verbeterd, wat is voor de verbetering nodig en is de toegepaste standaard nog steeds passend?

Aanbevelingen aan publieke opdrachtgevers en (potentiële) opdrachtnemers

Het is belangrijk dat publieke opdrachtgevers en (potentiële) opdrachtnemer zich niet beperken tot projectniveau, maar ook op portfolio (strategisch) niveau kijken naar repetitieve werkzaamheden. Tevens is belangrijk om niet alleen te kijken naar uitvoeringswerkzaamheden (bijv. maaien en asfalteren), maar ook naar voorbereidingswerkzaamheden zowel op tactisch niveau (bijv. programmeren en jaarplan opstellen) als operationeel niveau (bijv. plannen en werkplan opstellen). Daarnaast moeten publieke opdrachtgevers en (potentiële) opdrachtnemers zich ervan bewust zijn dat niet alleen sprake is van repetitie indien dezelfde of vergelijkbare werkzaamheid achtereenvolgens wordt verricht, maar ook wanneer deze tegelijkertijd wordt verricht. Om in te spelen op de gevonden kanttekeningen die het benutten van het potentieel van repetitieve werkzaamheden belemmeren, wordt aangeraden gebruik te maken van kennisborging, kennisuitwisseling en evaluaties binnen opdrachten als ook opdrachtoverstijgend. Daarnaast is een kritische houding tegenover het gebruik van routines, standaardisatie en industrialisatie gewenst.

De belangrijkste aanvullende aanbevelingen aan publieke opdrachtgevers op drie verschillende organisatieniveaus zijn:

- formuleer een opgave en richt het portfolio zo in dat repetitieve werkzaamheden optreden en hun potentieel wordt benut. Voor het potentieel van repetitieve werkzaamheden is van belang om ”het doel” vast te stellen (strategisch niveau);
- benader repetitieve werkzaamheden project- en opdrachtoverstijgend en maak gebruik van kennis van andere (publieke) opdrachtgevers en opdrachtnemers die dezelfde of vergelijkbare werkzaamheden verrichten wanneer de strategie wordt vertaald naar uitvoeringsprogramma’s. Schenk hierbij aandacht aan de mogelijkheden en onmogelijkheden van de interne organisatie en inventariseer of bundeling van repetitieve werkzaamheden met andere (publieke) opdrachtgevers

meerwaarde biedt (tactisch niveau);

- bied de (potentiële) opdrachtnemer bij de uitvoering van projecten en activiteiten de ruimte om het potentieel van repetitieve werkzaamheden te benutten (operationeel niveau).

De belangrijkste aanvullende aanbevelingen aan (potentiële) opdrachtnemers op drie verschillende organisatieniveaus zijn:

- denk bij het formuleren van organisatiedoelen na over de effecten ervan op het optreden van repetitieve werkzaamheden en welk ”doel” met de verbetering van repetitieve werkzaamheden wordt nagestreefd (strategisch niveau);
- inventariseer en benut (het potentieel van) repetitieve werkzaamheden project- en opdrachtoverstijgend (tactisch niveau);
- bied aan de werknemers van de eigen organisatie en aan onderaannemers en leveranciers bij de uitvoering van projecten en activiteiten de ruimte om het potentieel van repetitieve werkzaamheden te benutten (operationeel niveau).

Tot slot vergt samenwerking tussen publieke opdrachtgever en opdrachtnemer(s) op tactisch en operationeel niveau een andere manier van werken, van een op het transactiemodel gerichte interactie naar een lange termijn partnerschap. Door het opvolgen van de aanbevelingen worden krachten gebundeld en wordt gezamenlijk het potentieel van repetitieve werkzaamheden benut.

Aanbevelingen voor toekomstig onderzoek

Aangedragen wordt om in vervolgonderzoek niet alleen te kijken naar samenwerking tussen publieke opdrachtgever en opdrachtnemers, maar ook bijvoorbeeld naar leveranciers, onderaannemers en samenwerkingen tussen verschillende (publieke) opdrachtgevers. Daarnaast is het interessant om een longitudinaal onderzoek uit te voeren bij de bestudeerde casussen opdat de samenwerkingselementen en bijbehorende adviezen getoetst kunnen worden bijvoorbeeld wat betreft bruikbaarheid en het mogelijk wordt om een rangorde aan te brengen. Tot slot wordt aangeraden het intern opdrachtgeverschap niet uit het oog te verliezen. Welke verbeteringen moet een publieke opdrachtgever aanbrengen in zijn organisatie, opdat hij en de opdrachtnemer(s) in staat zijn het potentieel van repetitieve werkzaamheden te benutten.

Contents

List of Abbreviations

IPM	integrated project management
IPS	Innovation Partnership
KPI	Key Performance Indicator
MYMP	Multi-Year Maintenance Plan
PDM	Project delivery method
PPO	Programmes, Projects and Maintenance
RWS	Rijkswaterstaat
SME	Small and Medium-sized Enterprise
TU	Team Uiterwaarden
WL	Wonen Limburg
WOCU	Values-Driven Maintenance Contract Floodplains (in Dutch: Waardengedreven Onderhoudscontract Uiterwaarden)
WOUW	Values-Driven Maintenance Floodplains (in Dutch: Waardengedreven Onderhoud Uiter-Waarden)

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Part I

Introduction

-Necessity is the mother of invention-

1 Introduction

1.1. Research context

The construction industry, consisting of residential, utility and infrastructure (in Dutch: Grond-, Weg- en Waterbouw, GWW) construction, makes a significant contribution to direct and indirect employment (Kamp et al., 2016) and to the European and global economy, respectively 9% of the EU's GDP (gross domestic product) and 13% of the global GDP (European Commission, 2023; McKinsey & Company, 2020). The impact and scope of the construction industry is large and diverse: the structures it creates provide people with work, living space and shelter, enable movement, and allow businesses and other industries to create economic and social value (Boyd & Chinyio, 2006; Lenderink, 2022; World Economic Forum, 2016). In the last decade, the construction industry is called upon to contribute to climate and energy solutions (European Commission, 2023). These solutions are of great importance due to the construction industry's significant share in CO_2 emissions, waste production and raw material use (Duong et al., 2021; Lenderink, 2022; World Economic Forum, 2016).

The construction industry is known for its project-based approach, where the realisation of one-off, unique projects (PMI, 2021) by a changing composition of actors is central (Adriaanse, 2014; Dave & Koskela, 2009; Vosman, 2020; Vrijhoef & Koskela, 2005). This often results in knowledge gained in projects being taken up only by individuals, evaluation not always taking place, and insufficient use of lessons learned in subsequent projects (Dave & Koskela, 2009). However, this leads to the false assumption that every project is different (Flyvbjerg, 2021) and that repetitive tasks are rare (Cooper et al., 2002; Davies & Brady, 2016; Engwall, 2003; Godsell et al., 2018). A significant number of tasks executed in the construction industry are of a repetitive nature (Pereira & Flood, 2017) and, due to their repetition and volume, can contribute to much needed improvements in the construction industry. The following discusses the current societal challenges, as well as the solutions offered by repetitive tasks.

Current societal challenges

In line with Europe, the Netherlands is currently facing pressing societal challenges such as climate adaptation, energy transition and circularity, to which the construction industry can make an important contribution (Kamp et al., 2016; Rijkswaterstaat, 2021). In addition to societal challenges, the construction industry also faces construction challenges such as the housing construction challenge (combating the housing shortage) and the replacement and renovation challenge, for which it is important to make optimal use of construction capacity (Arnoldussen et al., 2017; Kamp et al., 2016). Therefore, structures built to address the construction challenges should also take into account requirements arising from current societal challenges, such as circular construction and reduced consumption of primary raw materials (Arnoldussen et al., 2017; Groot et al., 2022; Kamp et al., 2016; Ministerie van Infrastructuur en Waterstaat, 2019). With regard to societal and construction challenges, innovation and (new forms of) collaboration can offer solutions. Innovation is seen as essential to tackle these challenges intelligently and quickly (Arnoldussen et al., 2017; Boon et al., 2020; European Commission, 2014; Lenderink, 2022; Ministerie van Infrastructuur en Waterstaat, 2019). In addition to innovation, a different and effective way of collaboration between (public) client and contractor is needed (Arnoldussen et al., 2017; Molaei et al., 2023) to improve the performance of the construction industry (Suprapto et al., 2015). It is desirable to prevent urgent societal and construction challenges from going unaddressed and to seek ways in which the construction industry can best provide solutions to these challenges.

Relevance of repetitive tasks

A large portion of activities in the construction industry has a repetitive character (Pereira & Flood, 2017), and construction projects with repetitive tasks make up a significant proportion of the construction industry (Ioannou Photios & Yang, 2016; Nguyen et al., 2022; Tomczak & Jaśkowski, 2020; Ulusoy

& Hazır, 2021; Yang & Chang, 2005). The expectation is that repetitive tasks contribute to fulfilling societal challenges and optimally utilising building capacity. In particular, by bundling, optimising, standardising and/or industrialising repetitive tasks, it is possible to avoid duplication and to join forces. Rijkswaterstaat (RWS), for example, bundles repetitive tasks into long-term portfolio contracts and has them carried out by a fixed combination of market parties. The aim is to promote learning, optimisation and innovation, and to reduce failure costs (Ministerie van Infrastructuur en Waterstaat, 2021). Although repetitive tasks are common in projects (Biruk & Rzepecki, 2019; Tomczak & Jaśkowski, 2020; Yang & Chang, 2005) and portfolios of (public) clients, they do not receive attention as such in practice and in the literature (Engwall, 2003; Molaei et al., 2022, 2023). Addressing these repetitive tasks at the portfolio level can contribute to benefits such as increased efficiency for organisations.

The current research investigates how a public client can organise the execution of repetitive tasks in such a way that it can work with contractors to exploit the potential of repetitive tasks. The expectation is that this will result in a more effective and efficient use of scarce resources such as people, money and time, and a better contribution to the societal and construction challenges. Collaboration in projects is seen as an opportunity to develop new knowledge, stimulate innovation, improve productivity and exploit the potential of an inter-organisational relationship (Nikulina et al., 2022). Both the formal and relational aspects of collaboration are important and are considered in this research.

1.2. Problem definition & knowledge gap

1.2.1. Problem definition

The construction industry faces various challenges, including those related to new construction, maintenance and renovation, as well as societal challenges. These challenges arise in the context of scarcity of people and resources, and limited time. Public clients and market parties are called upon to address (societal) challenges and to contribute to innovation (Kattel & Mazzucato, 2018; Sexton & Barrett, 2003). At the same time, public clients have to consider efficiency and effectiveness due to the use of taxpayers' money (Hermans et al., 2019). As people and resources are scarce and time is limited, efficiency and effectiveness, cost reduction and speed are important. In this context, there are high expectations for improvements, innovation and scaling up (Boon et al., 2020; Molaei et al., 2023; Spijkerboer et al., 2015).

As the construction industry is currently mainly project-based, improvement and innovation is hampered and (project) knowledge lost due to the fragmentation in the industry (Adriaanse, 2014; Dave & Koskela, 2009; Vosman, 2020; World Economic Forum, 2016). Opportunities for return on investment are low and fragmentation is encouraged, resulting in temporary collaborations (Lenderink, 2022; Rutten et al., 2009). The lack of long-term and intensive relationships hinders knowledge sharing, innovation development and implementation, and optimal use of the learning curve, thus limiting efficiency (De Bouwcampus, n.d.; Eriksson et al., 2019; Rutten et al., 2009). In addition, projects are often considered in isolation (Adriaanse, 2014; Dubois & Gadde, 2001), without reference to the organisation's portfolio (Blismas et al., 2004), with the result that (parts of) projects are regularly mistaken for unique (Engwall, 2003; Vrijhoef & Koskela, 2005). A limited long-term perspective, a focus on individual project results, insufficient use of learning between projects and limited use of innovation also mean that productivity improvements in the construction industry are poorly applied (Ministerie van Infrastructuur en Waterstaat, 2019).

Public clients play an important role in stimulating innovation through their purchasing power and the conditions they can include in tenders and contracts (Blayse & Manley, 2004; Kadefors et al., 2021; Lenderink, 2022). On the other hand, the lack of uniform conditions for innovation and for addressing societal challenges in tenders and contracts makes innovation less attractive and profitable for market parties, as it hinders scaling up (Groot et al., 2022; Xue et al., 2014). The scarcity of similar projects hinders the exploitation of "economies of repetition", and thus learning from repetition, which leads to efficiency and effectiveness (Davies & Brady, 2000; de Ridder, 2011).

Since public clients are insufficiently aware of the repetitive tasks in their portfolio and often view projects as unique, these public clients miss out on the benefits of bundling repetitive tasks, including improvements, innovation and efficiency (Bakker et al., 2011; Molaei et al., 2023; Vrijhoef & Koskela, 2005). In addition, the lack of insight into repetitive tasks means that the knowledge and skills of market

parties are not fully exploited (Molaei et al., 2022, 2023). In light of the problems described above and the sense of urgency felt, research into the design of an assignment involving collaboration between public client and contractors aimed at exploiting the potential of repetitive tasks seems desirable.

1.2.2. Knowledge gap

In the academic literature, research has primarily focused on one-off (large) projects which are considered unique due to varying locations, stakeholders and customer requirements and wishes (Engwall, 2003; Flyvbjerg, 2021; Halman, 2004). In addition, projects are commonly defined as: ”A unique endeavor undertaken to create a unique product, service, or result” (Nicholas & Steyn, 2017; PMI, 2021, p. 31). Likewise, in the case of repetitive tasks, the literature focuses on the project level and often uses the term repetitive (construction) project(s) (Agrama, 2011; Ammar, 2020; Bakry et al., 2014; Baqerin et al., 2016; Simonaitis et al., 2023; Tomczak & Jaśkowski, 2020, 2022; Tran et al., 2018; Ulusoy & Hazır, 2021). The term ”project” can be misleading when referring to repetitive tasks. This is because it is not the project itself that is repeated, but rather the individual tasks that make up the project. Even if a project is completed with a unique result, repetitive tasks may occur because the same or similar tasks are repeated in the project itself or in another project. Inventorying repetitive tasks at the project level can result in repetitive tasks being overlooked. However, in practice and in the literature on portfolio management, little attention has been paid to a strategic, top-down approach to bundling repetitive tasks (Godsell et al., 2018). Knowledge is lacking on how best to bundle these repetitive tasks by public clients, and how to design the collaboration between public client and contractors so that learning, improvements and innovation occur (Molaei et al., 2022, 2023). Taking all these findings together, it seems worthwhile to investigate which elements in the design of an assignment involving collaboration between public client and contractors contribute to exploiting the potential of repetitive tasks and to making the best use of contractors’ knowledge, expertise and capacity.

1.3. Research design

1.3.1. Research objective

In order to achieve the (societal) challenges, there is an emphasis on the need for new ways of collaboration between (public) client and contractor (Boon et al., 2020; Rijkswaterstaat, 2021; Spijkerboer et al., 2015; Vosman et al., 2022). The literature suggests that not only tendering can be used as an instrument to stimulate improvements and innovation, a so-called demand-side instrument, but also collaboration between public client and contractor plays an important role (Callens et al., 2022; Carbonara & Pellegrino, 2018; Eriksson et al., 2019). In particular, through interaction and knowledge sharing, innovative outcomes are more likely to be realised (Callens et al., 2022; Eriksson et al., 2019). The objective of this research is to increase insight and knowledge of repetitive tasks and the design elements aimed at exploiting the potential of repetitive tasks in assignments where public clients and contractors collaborate.

1.3.2. Main research question & sub-questions

In order to achieve the research objective described, answering the main research question below is central:

“How can a public client design an assignment that involves collaboration with contractors to exploit the potential of repetitive tasks?”

In order to answer the main research question, the following sub-questions were defined.

1. How can a project-based approach and a programmatic approach help unlock the potential of repetitive tasks?
2. How does the (intended) design of an assignment in which a public client collaborates with contractors promote the exploitation of the potential of repetitive tasks in practice?
3. What lessons can be learned from the different assignment designs analysed in practice?
4. What elements of an assignment design should public clients consider in order to exploit the potential of repetitive tasks in collaboration with contractors?

1.3.3. Research methods

As both current theoretical and empirical knowledge on the combination of (the potential of) repetitive tasks, and collaboration between public client and contractors is scarce, and the main research question and sub-questions are explanatory and exploratory in nature, qualitative research and an inductive approach were used to answer the main research question and achieve the research objective (Creswell & Creswell, 2018). The research design and the different research methods comprising it, are discussed below.

Part II - Literature review

After introducing the central topic of this research in Part I, a literature review is conducted to gain a theoretical understanding of repetitive tasks. Based on the findings, a definition of repetitive tasks is developed and used throughout the rest of this research. The potential of repetitive tasks and the role that collaboration between public client and contractors can play in this is then discussed. Furthermore, the project-based approach and the newer programmatic approach are discussed, as well as the implications of both for their ability to exploit the potential of repetitive tasks. Finally, an answer to sub-question 1 is given and a theoretical framework concerning repetitive tasks is presented, which will serve as input for the empirical research in Part III.

For the literature search, databases such as Google Scholar, TU Delft repository, Scopus and various keywords (both separately and in combination) were used (see Appendix A.1). In addition, the snowball method was applied to find articles (Verschuren & Doorewaard, 2010).

Part III - Case study

Subsequently, a multiple case study is used in the empirical research. The use of case studies is an appropriate research method for an exploratory qualitative study and allows for in-depth and contextual knowledge gathering (Creswell & Creswell, 2018; Verschuren & Doorewaard, 2010; Yin, 2018). The following five selection criteria were used for the selection of the three cases used in this research: (1) each case belongs to a different sector of the construction industry, (2) each case involves repetitive tasks, (3) in each case collaboration between public client and contractors is central, (4) each case is in the realisation phase and (5) each case is a programme, however each programme consists of activities belonging to a different phase of the asset life cycle. With this strategic selection of cases, the case study allows for the examination of different assignment designs involving collaboration between public client and contractors, and their impact on exploiting the potential of repetitive tasks. The hierarchical method is used to study the cases, which means that the cases are first studied separately and then compared (cross case analysis) (Verschuren & Doorewaard, 2010).

In order to gain a comprehensive understanding of the cases, the first step was to study the (publicly available) case documents, followed by semi-structured interviews with the public client and contractor staff involved. Semi-structured interviews allow to learn about informal structures in addition to formal structures and to leave room for new input and ideas from the interviewees. At least six stakeholders are interviewed per case, three of whom are people involved from the public client and three from the contractor. Once the interviews were conducted, they were transcribed and coded using Atlas.ti software. After analysing the cases separately, a cross case analysis was carried out to identify similarities and differences between the different assignment designs applied in the cases, in order to better understand the impact of design on exploiting the potential of repetitive tasks. Answering sub-questions 2 and 3 is the focus of this part.

Part IV - Framework development & evaluation

After completing the empirical research, the framework ”Innovative approach to repetitive tasks” was developed, which includes the design elements that a public client should consider at the time of defining and after awarding an assignment, in order to facilitate exploiting the potential of repetitive tasks. Due to the exploratory nature of the research, expert evaluations were used to assess and refine the developed framework. The final framework is then used to answer sub-question 4.

1.3.4. Research scope

This research is part of a study conducted by Dr.ir. Maedeh Molaei and Prof.dr.ir. Marleen Hermans on an evaluation system for public clients to measure and improve collaborations with market parties.

Although the cases are the same for both studies and it was decided for practical reasons to conduct the interviews together, the following boundary is used in this research to ensure a feasible and manageable scope. The research examines various collaborations between a public client and contractors designed by public clients in the Netherlands to carry out an assignment with repetitive tasks using a programmatic approach. The further supply chain is not taken into account in this research and only assignments in the construction industry that fall under the categories of ”works” or ”services” are considered (excluding consultancy) (European Commission, 2014). The construction sectors covered are residential, utility and infrastructure construction. The procurement procedure used is not taken into account when examining the various forms of collaboration.

1.3.5. Research outline

A schematic representation of the research structure, based on the research design described above, is shown in Figure 1.1. Part I introduces the central subject of the research and the rationale for its investigation, followed by the research design and an overview of the structure of the report. Part II then focuses on a literature review and answering sub-question 1, the results of which serve as input for Part III, the empirical research. Part III analyses three cases, the results of which provide input for answering sub-questions 2 and 3 and for designing a framework containing design elements that contribute to facilitating the potential of repetitive tasks. Part IV then supplements the designed framework with insights from the expert evaluations and provides input for answering sub-question 4. Finally, Part V first discusses the main research findings, validity of the research design and limitations of the research, after which the conclusion specifically answers the main research question and provides recommendations for public clients, (potential) contractors and future research.

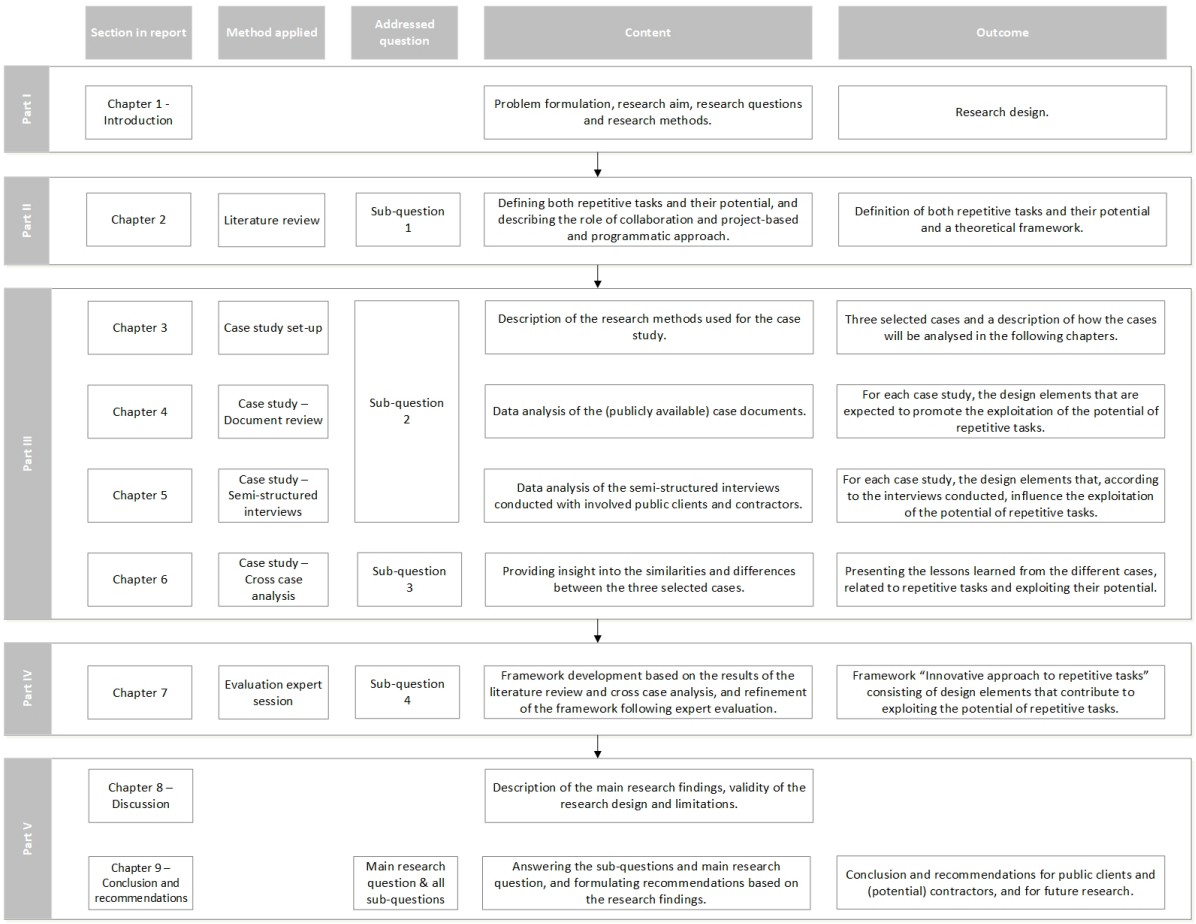

Figure 1.1**:** Research outline

Part II

Literature review

-In doing we learn-

2

The potential of repetitive tasks

This chapter uses a literature review to provide a theoretical understanding of repetitive tasks and their potential. After discussing repetitive tasks in the automotive industry, a definition of repetitive tasks in the construction industry is formulated based on the literature (section 2.1). The potential of repetitive tasks is then discussed (section 2.2), as well as the role that collaboration between a public client and a contractor can play in this (section 2.3). Subsequently, the ways to bring about change, specifically a project-based approach and a programmatic approach, and their ability to exploit the potential of repetitive tasks are considered (section 2.4). The conclusion answers the first sub-question by using the theoretical insights gained: *How can a project-based approach and a programmatic approach help unlock the potential of repetitive tasks?*. Additionally, a theoretical framework concerning repetitive tasks is presented (section 2.5).

2.1. Repetitive tasks

2.1.1. Introduction

In the production of the T Ford in 1908, one of the first mass-produced cars, the aim was to produce the car at ever lower cost without compromising on product quality (Maas, n.d.). To achieve this, Ford used manpower, materials and machinery in the most efficient way possible and made clever use of repetition in the production process. Consequently, he was able to improve the production of each subsequent car, meaning that the car could be produced with the same quality at lower and lower costs and using fewer and fewer resources. Spencer and Cox (1995, p. 1282) define repetitive manufacturing as ”the production of discrete units in a high volume concentration of available capacity using fixed routeings. Products may be standard or be assembled from standard modules. Production management is usually based on the production rate.” This definition provides a starting point for studying repetitive tasks in the construction industry. It refers to construction processes and activities that are executed repeatedly, which may lead to routines and standardisation to improve resource utilisation (Denicol & Davies, 2022).

So-called repetitive tasks in the construction industry are often mentioned in the literature in connection with the optimisation of construction schedules inspired by the manufacturing industry (Huang & Sun, 2005; Ulusoy & Hazır, 2021). Davies et al. (2009, p. 122) distinguish between unique and repetitive tasks as follows: “A unique task usually involves experimentation with uncertain results, whereas repetitive tasks enable predictability and the formation of institutional routines.” The following provides a closer look at where repetitive tasks may occur in the construction industry according to the literature and the definition of repetitive tasks.

2.1.2. In the construction industry

In 1965, the report of the Economic Commission for Europe drew attention to the benefits of repetitive tasks in the construction industry, in particular increasing labour productivity and reducing costs (Gottlieb & Haugbølle, 2010). The report was written with the aim of increasing productivity so that new buildings could be built faster and existing ones could be maintained faster (Economic Commission for Europe, 1965). The commission was inspired by the industrial production process (Economic Commission for Europe, 1965).

An organisation has a portfolio consisting of programmes (see definition in subsection 2.4.2), projects (see definition in subsection 1.2.2), and/or operations. Programmes, projects and operations are ways of organising (realisation of) specific tasks, partly with a view to an organisation’s strategic objectives. As Davies and Brady (2016, p. 318) point out: “Whilst every project is unique in some respect, all projects involve some degree of repetition”. Repetition can occur and be found at different levels in

construction: in portfolios (see subsection 2.1.3), in projects (see subsection 2.1.4) and in maintenance and operations (see subsection 2.1.5) of both public client and contractor.

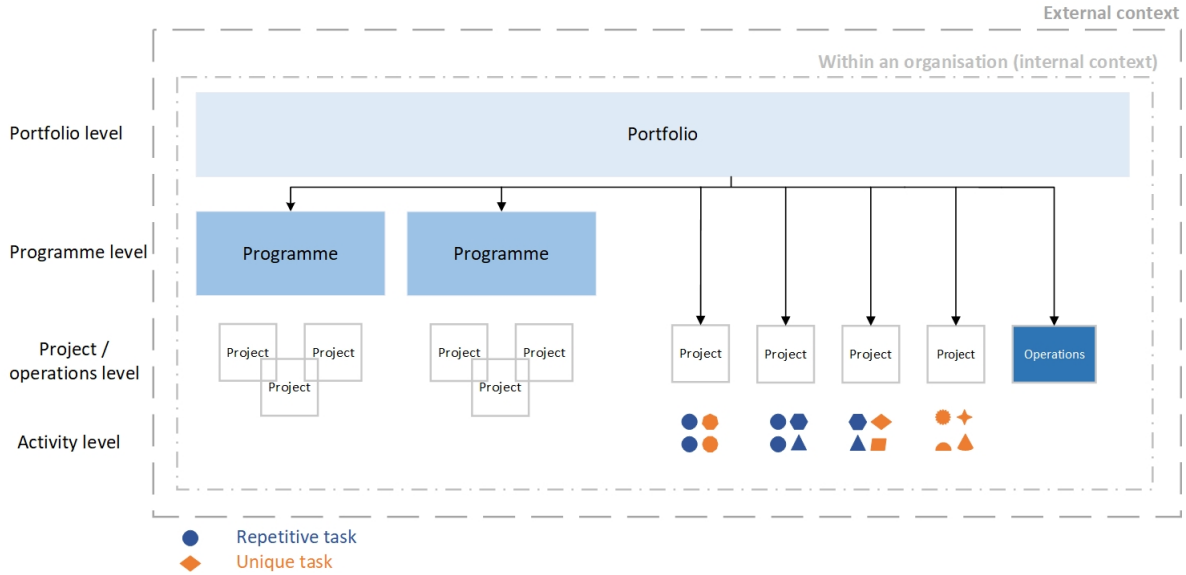

Figure 2.1**:** Different levels at which repetition can occur, where the portfolio can belong to a (1) public client or (2) contractor (adapted from Martinsuo and Geraldi (2020))

2.1.3. Repetition in portfolios

A portfolio is defined as an organisation's collection of operations, projects and programmes to which scarce resources are committed, shared (Winch, 2010) and managed with a view to achieving strategic organisational goals (Geraldi et al., 2022; Nicholas & Steyn, 2017; Petit, 2012; PMI, 2021). Blismas et al. (2004) note that clients in the construction industry often have large portfolios consisting of several projects. Repetition at the portfolio level of public clients and contractors occurs when the same or similar processes or activities are performed (in different operations, projects, programmes) (Brady & Davies, 2004; Davies & Brady, 2016; Engwall, 2003; Molaei et al., 2022). However, unlike the T Ford example mentioned earlier, the result of these projects and programmes in a portfolio may differ (Davies & Brady, 2016; Delisle, 2019; Engwall, 2003).

2.1.4. Repetition in projects

Construction projects involving repetitive tasks make up a significant proportion of the construction industry (Ammar & Elbeltagi, 2001; Ioannou Photios & Yang, 2016; Nguyen et al., 2022; Tomczak & Jaśkowski, 2020; Ulusoy & Hazır, 2021; Yang & Chang, 2005). The tasks executed by project organisations can be divided into unique (one-off) and repetitive (repeatedly) according to Lundin and Söderholm (1995). The report of the Construction Task Force (1998) states that repetition of construction processes and activities occurs in both new construction and maintenance. As mentioned in this report: "The parallel is not with building cars on the production line; it is with designing and planning the production of a new car model" (Construction Task Force, 1998, p. 18). This suggests that the outcome (end result) of any project is unique, but parts of a project may involve repetition (Davies & Hobday, 2005a). In this way, "building blocks" consisting of processes and/or (sub-)products can be repeated and improved. This is also evident in Figure 2.2 by Davies et al. (2009). Davies and Hobday (2005a) note that even with a unique project result, there may still be repetitive tasks involved. El-Rayes (2001) and Tomczak and Jaśkowski (2022) also note that projects can consist of both non-repetitive and repetitive activities. Besides the parts of projects, Huang and Sun (2005), Lundin and Söderholm (1995) and Davies and Hobday (2005a) note that projects can be both partially and fully repetitive, meaning that the project is partially or fully repeated. Godsell et al. (2018) and Davies et al. (2009) point out that repetition occurs in both execution tasks and preparatory tasks. In preparatory tasks, repetition may involve the repeated application of (part of) a design (Davies et al., 2009) or the preparation of an exe-

cution plan (Godsell et al., 2018). This research defines preparatory tasks as processes and activities that are executed after contract award in preparation for execution tasks.

It is worth noting that when a project is described as unique, one should be careful not to rule out repetition in advance (Flyvbjerg, 2021). Davies and Hobday (2005a) point out that even in the construction of the unique Channel Tunnel between England and France, there were likely repeated processes and activities.

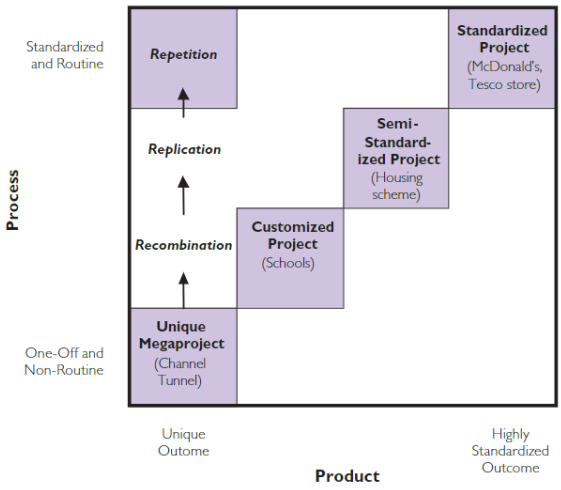

Figure 2.2**:** Visualisation of repetition in ”unique” construction projects (Davies et al., 2009)

In the literature, the term ”repetitive (construction) projects” is often used for repetition within a project and between projects in connection with optimising the scheduling method for this type of projects (see Table 2.1). Based on the definitions provided in various articles included in Appendix A.2, a repetitive (construction) project is a construction project in which ”working units” comprising construction processes and activities can be distinguished, for the purpose of scheduling. This involves repetition in that the working unit and the construction processes and activities it comprises are repeated sequentially, even if the construction processes and/or activities in a working unit would differ from one another (see Figure 2.3) (Agrama, 2011; Ammar & Elbeltagi, 2001; Bakry et al., 2014; Baqerin et al., 2016; Biruk & Rzepecki, 2019; Nguyen et al., 2022; Simonaitis et al., 2023; Tomczak & Jaśkowski, 2020, 2022; Tran et al., 2018; Ulusoy & Hazır, 2021). In the literature, the term repetitive (construction) project is often defined in the plural. Distinguishing between a project that involves (part or all of) the construction processes and activities occurring more than once (which may also be a ”one-off” project) and a project that is partially or completely repeated after realisation (copy pasting), is therefore difficult. As noted by Tomczak and Jaśkowski (2022), the term ”repetitive construction project” can be confusing, because it does not necessarily refer to repetition that results from the complete copying of a project. The term ”project” may be misleading when referring to repetitive tasks. It is not solely about the repetition of projects, but rather the repetition of tasks within a project.

Figure 2.3 illustrates the principle of a repetitive construction project and its implications on the type of task. A task can be unique, similar, or identical (see working unit 1). However, even one-off (unique) tasks can become repetitive by repeating a working unit. A similar phenomenon can also be observed if ”project” is replaced by programme or portfolio. Examining repetition at the portfolio level, rather than the project level, can reveal previously unidentified repetitive tasks.

Table 2.1**:** Characteristics of repetitive (construction) projects according to the literature

Characteristics of repetitive (construction) projects		**Source and explanation**
Common in construction industry		A large proportion of construction projects consist of activities that are repeated successively at different "locations" on the same or similar (parts of) structures (Ammar & Elbeltagi, 2001; Biruk & Rzepecki, 2019; Ioannou Photios & Yang, 2016; Nguyen et al., 2022; Simonaitis et al., 2023; Tomczak & Jaśkowski, 2020; Tran et al., 2018, 2019; Ulusoy & Hazır, 2021; Yang & Chang, 2005). "Most construction projects are at least partly repeatable" (Tomczak & Jaśkowski, 2022, p. 432). Highways, pipelines, tunnels, high-rise buildings, houses, bridges are mentioned examples of repetitive (construction) projects (Agrama, 2011; Altuwaim & El-Rayes, 2018; Baqerin et al., 2016; Biruk & Rzepecki, 2019; El-Rayes, 2001; Hegazy et al., 2014; Huang & Sun, 2005; Hyari & El-Rayes, 2006; Ioannou Photios & Yang, 2016; Nguyen et al., 2022; Simonaitis et al., 2023; Tomczak & Jaśkowski, 2020, 2022; Tran et al., 2018; Ulusoy & Hazır, 2021; Yang & Chang, 2005).
Scheduling optimisation		Develop scheduling techniques that match the characteristics and exploit the potential of repetitive tasks (Agrama, 2011; Altuwaim & El-Rayes, 2018; Ammar & Elbeltagi, 2001; Bakry et al., 2014; Baqerin et al., 2016; El-Rayes, 2001; Hegazy et al., 2014; Hyari & El-Rayes, 2006; Ioannou Photios & Yang, 2016; Nguyen et al., 2022; Tomczak & Jaśkowski, 2020; Tran et al., 2019; Ulusoy & Hazır, 2021; Yang & Chang, 2005). Comparison of different scheduling optimisation methods for repetitive tasks (Tomczak & Jaśkowski, 2022).
Resources		Construction crews execute the same or similar task each time in different locations, segments, structures in a project (Altuwaim & El-Rayes, 2018; Biruk & Rzepecki, 2019; El-Rayes, 2001; Hyari & El-Rayes, 2006; Ioannou Photios & Yang, 2016; Nguyen et al., 2022; Tran et al., 2018, 2019; Ulusoy & Hazır, 2021; Yang & Chang, 2005).
Categorisation	Typical (= repetitive linear)	(Baqerin et al., 2016; Murguia & Urbina, 2018; Tomczak & Jaśkowski, 2020, 2022; Vorster & Bafna, 1992): Project divided into units where in each unit there is repetition in the process (the same activities are executed in the same order) with the same result (product) (e.g. construction of sections of track with the same design).
	Non-typical (= repetitive nonlinear)	(Baqerin et al., 2016; Murguia & Urbina, 2018; Tomczak & Jaśkowski, 2020, 2022; Vorster & Bafna, 1992): Project divided into units where in each unit there is repetition in the process (the same activities are executed in the same order) with a result (product) that is different because of varied quantity used (e.g. building a school with different floor areas).
	Linear (horizontal)	Agrama, 2011; Hegazy et al., 2014; Tomczak & Jaśkowski, 2020, 2022): Project can be divided into (discrete) working units, where a working unit consists of construction processes and activities that are repeated in subsequent work units. Repetition follows from geometry (e.g., construction of a tunnel, pipeline, highway).
	Nonlinear vertical	(Agrama, 2011; Hegazy et al., 2014; Tomczak & Jaśkowski, 2020, 2022): Project can be divided into working units, where a working unit consists of construction processes and activities that are repeated in subsequent (vertical) units. The repetition results from the site layout (e.g. construction of high-rise building).
	Nonlinear scattered	(Hegazy et al., 2014; Tomczak & Jaśkowski, 2020, 2022): Project consisting of working units (constructions in different locations) where the construction processes and activities carried out in working unit 1 are then repeated in the other units (e.g. maintenance of several tunnels).
	Cyclical nature of works	(Tomczak & Jaśkowski, 2020; Tran et al., 2018): Similar to nonlinear vertical, nonlinear scattered.
	Geometric layout	(Tomczak & Jaśkowski, 2020; Tran et al., 2018): Similar to linear (horizontal) (Agrama, 2011).
	Discrete	(Ioannou Photios & Yang, 2016; Tomczak & Jaśkowski, 2022): Similar to nonlinear vertical and nonlinear scattered.
	Continuous	(Ioannou Photios & Yang, 2016; Tomczak & Jaśkowski, 2022): Similar to linear (horizontal).
Potential related to improvements through construction crew continuity, sequential activities -> the learning curve -> time and cost savings		Construction crew continuity (ideally) increases crew productivity due to optimal use of the learning curve effects (Altuwaim & El-Rayes, 2018; Ammar & Elbeltagi, 2001; Bakry et al., 2014; El-Rayes, 2001; Gottlieb & Haugbølle, 2010; Hegazy et al., 2014; Hyari & El-Rayes, 2006; Nguyen et al., 2022; Simonaitis et al., 2023; Tomczak & Jaśkowski, 2020, 2022; Tran et al., 2018). Repetition enables positive use of the learning curve (Arditi et al., 2001; Biruk & Rzepecki, 2019).
Potential related to improvements through knowledge gathering -> leading to more efficient and effective use of resources		(Economic Commission for Europe, 1965; Gottlieb & Haugbølle, 2010; Pearson & Wisner, 1993): Use the experience gained to improve the work process. Repetitive tasks are well suited to learning from past experience and implementing improvements for future identical or similar tasks (Molaei et al., 2023).

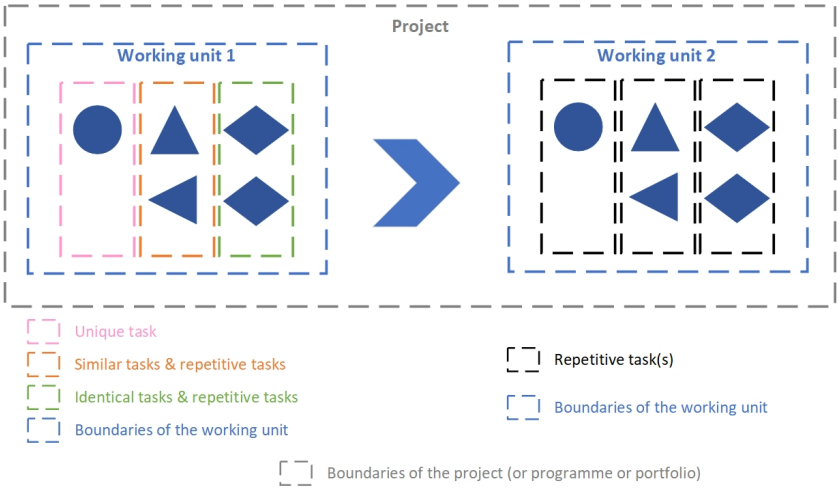

Figure 2.3**:** The principle of repetition emergence in a project, based on repetitive construction projects

Regarding repetitive construction projects, the literature also reflects on (specialised) construction crews[1] performing the same or similar activities in different locations, segments and/or structures (Altuwaim & El-Rayes, 2018; Biruk & Rzepecki, 2019; El-Rayes, 2001; Hyari & El-Rayes, 2006; Ioannou Photios & Yang, 2016; Nguyen et al., 2022; Tran et al., 2018, 2019; Ulusoy & Hazır, 2021; Yang & Chang, 2005) (see Table 2.1 and Appendix A.2). In the context of optimising a construction schedule, some authors categorise repetitive construction projects into classes such as (repetitive) (non)linear (scattered), discrete and continuous projects (see Table 2.1). Some of these classifications are related to the origin of repetition: repetition can result from the "geometry and location layouts or the multiplication of units" (Tran et al., 2019, p. 323). Examples include: asphalting a similar section of track (geometry), constructing a similar floor in a building (location layout), and carrying out similar (partial) constructions (multiplication of units). Each section of track, floor, or (partial) construction is considered a working unit (Ammar, 2020) and is executed consecutively, resulting in repetition. In addition, different classifications address how repetition is handled in projects. See Table 2.2 for the different types of classifications.

Table 2.2**:** Classification of repetitive construction projects based on the origin and handling of repetition

		Classifications	Comparable to
Origin of repetition	Repetition by geometry (Tran et al., 2018, 2019)	Linear (horizontal)	Geometric layout Continuous
	Repetition by location layout (Tran et al., 2018, 2019)	Nonlinear vertical	Cyclical nature of works Discrete
	Repetition by multiplication of working units (Tran et al., 2018, 2019)	Nonlinear scattered	
Addresses how repetition is handled	Project divided into units where in each unit there is repetition in process (the same activities are executed in the same order) with the same outcome (product) (Murguia & Urbina, 2018; Tomczak & Jaśkowski, 2020, 2022)	Repetitive linear	Typical
	Project divided into units where in each unit there is repetition in process (the same activities are executed in the same order) with an outcome (product) that differs because of quantity (Murguia & Urbina, 2018; Tomczak & Jaśkowski, 2020, 2022)	Repetitive nonlinear	Non-typical

It is important to note that using the term project can be limiting and lead to repetitive tasks being

[1] In the context of exploiting the potential of repetitive tasks, it is important that these construction crews are composed in a fixed way as much as possible so that they are able to learn and improve. A prerequisite is that construction crews consist of members who are able to execute their tasks ever better.

overlooked (see also Figure 2.3). Instead, it is preferred to use the classification that can be applied at the task level, which identifies repetition found in a process or an outcome (product) (Construction Task Force, 1998; Davies et al., 2009; Vrijhoef, 2011), rather than the classifications shown in Table 2.2.

2.1.5. Repetition in maintenance and operations

In addition to programmes and projects, repetition can also occur in maintenance and operations (Davies et al., 2009; X. Zhang et al., 2023) (see Figure 2.1). After the delivery of a newly built structure, the so-called operation phase begins, in which maintenance and operation are the main focus. If necessary, renovations are carried out to meet new requirements and desires, such as sustainability. According to Larsson and Larsson (2020), the infrastructure sector literature pays more attention to the new construction phase than the operation phase. During the operation phase, operation and (preventive, cyclical) maintenance tasks take place that are repeated at different intervals (Horner et al., 1997), such as painting window frames, checking lighting in residential buildings or maintenance tasks on roads (Godsell et al., 2018; Lai et al., 2006; Vestola et al., 2021). A distinction can be made between small routine activities that occur frequently (e.g. repairs and inspections) and (major) projects that occur at longer intervals (e.g. renovation) (Budai et al., 2006). Unlike a project, operations involve a continuous process, high volume (Davies et al., 2009), and routine tasks. These tasks are typically executed or outsourced by a permanent organisation, and the tasks executed in different locations are similar (Vestola et al., 2021).

2.1.6. Implication of identified knowledge gap in the literature

In the literature, the focus is mainly on repetitive tasks in projects, more specifically on repetitive tasks in projects involving the construction of similar tunnels, roads, high-rise buildings, canals, and houses (see Table 2.1). However, repetitive tasks within portfolios, including maintenance and operations and programmes, are much less studied (Blismas et al., 2004; Vrijhoef & Koskela, 2005). Within a portfolio, it is possible to distinguish between unique (one-off) and repetitive tasks (Davies & Brady, 2016; Engwall, 2003). It is then possible to strategically choose the ”right” (bundling of) projects (programmes) and activities, and thus allocate scarce resources (Godsell et al., 2018; Karim & Nekoufar, 2012). Below, this will be referred to when discussing how to exploit the potential of repetitive tasks. Strategic refers to the use of repetition and similarity within and across projects to achieve strategic goals (Vrijhoef, 2011). As noted by Godsell et al. (2018), this approach has received little attention in practice and literature.

If a public client wants to make full use of the potential of repetitive tasks, it is important to identify repetitive tasks prior to the order of the assignment. When designing an assignment, the public client can anticipate repetitive tasks in its portfolio (demand side), adapt the demand specification so that potential contractors can make use of repetition in their portfolio (supply side) (Vrijhoef & Koskela, 2005), or a combination of the two. If the public client chooses the second-last option, it can maximise the potential of repetitive tasks by standardising the demand specification or by bundling the same or similar tasks with other (public) clients (De Bouwcampus, n.d.).

2.1.7. Definition of repetitive tasks

Based on the characteristics of repetitive tasks and the definition of repetitive tasks according to Molaei et al. (2023, p. 12): ”tasks, activities, or operations that are performed frequently on objects or assets at a specific location or works that are carried out on objects with similar characteristics at various locations”, repetitive tasks are defined in this research as:

“Construction processes and activities that are executed more than once (repeatedly) on/for the same or different (parts of) structures at one or more locations without the result having to be the same.”

It should be noted that these are not only construction processes and activities that are repeated consecutively, but also those that are executed simultaneously, as improvements (potential) are also possible in that case. This definition enables the identification of repetitive tasks not only at the project level but also at the portfolio level for both (public) clients and contractors.

2.2. Potential of repetitive tasks

2.2.1. Improvements through the learning effect

Improvements through using fixed construction crews

The literature on repetitive tasks mainly focuses on optimising the scheduling of repetitive tasks in projects (see Table 2.1). Optimising the scheduling of repetitive tasks in projects is considered desirable due to the large number of repetitive projects in the construction industry and, therefore, the impact it can have on the more efficient use of resources (Ammar, 2020; Monghasemi & Abdallah, 2021; Yang & Chang, 2005). Optimisation can occur when a fixed construction crew executes the same or similar task on successive working units with no or as few interruptions as possible. The provision of large series of repetitive tasks is not in itself sufficient for the ”beneficial effects of repetition” to occur. According to the Economic Commission for Europe (1965), the ”beneficial effects of repetition” in repetitive tasks occur when there is continuity, meaning identical activities, identical crew involved and the least amount of breaks. In fact, continuity allows the use of the learning curve (Altuwaim & El-Rayes, 2018, 2021; Bakry et al., 2014; El-Rayes, 2001; Hyari & El-Rayes, 2006; Simonaitis et al., 2023) (see Table 2.1). The learning curve implies that the more often an activity is executed, the less time and effort it takes, because people learn from repetition (labour productivity improvement) (Arditi et al., 2001; Couto & Teixeira, 2005; Lam et al., 2001; Pellegrino et al., 2012; Srour et al., 2015). The learning curve was originally used in aircraft manufacturing (Couto & Teixeira, 2005) and then in the automotive industry and construction industry (Srour et al., 2015). Simonaitis et al. (2023) and Biruk and Rzepecki (2019) describe that as a construction crew repeats a task, their practical knowledge and experience increases, allowing them to execute the task more accurately and quickly with a lower cost of failure. The use of experience allows for more efficient work and avoids reinventing the wheel each time (Brady & Davies, 2004; Dave & Koskela, 2009; Hermans & Rots, 2019). As Gieskes and ten Broeke (2000) and Vestola et al. (2021) note, continuous improvement plays a role especially in repetitive tasks.

Improvements through knowledge gathering

In addition to ”learning by doing”, as previously described, knowledge can also be acquired through knowledge exchange, evaluations, or by using other sources and improving on this basis (S. Zhang et al., 2024). In addition, knowledge retention is crucial for improvement through learning (Davies & Hobday, 2005b), as is ensuring sufficient scale. The latter is reflected in the economies of learning described by Pearson and Wisner (1993). This refers to economies of scale that result from using (technical) experience to implement changes that lead to “more efficient and effective use of existing resources” (Pearson & Wisner, 1993, p.13). These improvements are related to ”exploitative learning” and enable the efficient use of scarce project resources (Eriksson & Leiringer, 2015; Eriksson et al., 2019; Liu et al., 2021) and more efficient and effective execution of repetitive tasks.

2.2.2. Improvements through standardisation

In the case of standardisation, it builds on previous experience and so-called successful practices. This allows repetitive tasks to be executed better. Standardisation is the adherence to a certain standard measure or model and can be laid down, for example, in standards. Standardisation can involve the design and execution of construction processes or activities or products (Karim & Nekoufar, 2012), for example a train wheel of a fixed size. Standardisation is concerned with: reducing variability, applying uniformity where desirable, resulting in predictability and productivity gains, and increasing repeatability (Vrijhoef, 2011). As indicated by Karim and Nekoufar (2012), it is important to first determine the extent of repetitive tasks from a portfolio perspective in order to determine where the application of standardisation is appropriate. As included in the definition of repetitive tasks, the application of standardisation and industrialisation does not necessarily result in identical end products (Construction Task Force, 1998), and a good balance should be sought to meet specific customer requirements and to learn and benefit from previous experience (Maylor et al., 2018). It should be avoided that specific requirements come at the expense of standardisation, as standardisation can be a way of exploiting the potential of repetitive tasks.

2.2.3. Improvements through industrialisation

In addition to standardisation, industrialisation is a way to increase productivity in the construction industry. Industrialisation is characterised by the scaling up of activities when the activity lends itself

to it. As defined by Konstantinou and Heesbeen (2022, p. 260), “industrialization in the context of building products refers to items produced in a repetitive process” and involves the production of large quantities (”economies of scale”) (Richard, 2005). An example is the mass production of the T Ford (see subsection 2.1.1). Industrialisation includes (1) prefabrication (production off site), (2) mechanisation (use of machines to (partially) replace human labour), (3) automation (replacement of human labour by machines or algorithms), (4) robotics (tasks previously executed by humans are executed by robots) and (5) reproduction (innovating and simplifying the ”old” process of arriving at a given product) (Konstantinou & Heesbeen, 2022; Richard, 2005). Industrialisation in construction can be applied to parts of a construction project. A balance must be found between specific customer requirements and industrialisation. As with the potential of repetitive tasks, the learning effect within industrialised construction through repeated execution of the same or similar processes plays a role (Kadefors et al., 2013; Richard, 2005). Continuity and sufficient volume are important for the successful application of industrialisation. Industrialisation can also use standardisation as a way of improving the process (see above) (Vrijhoef, 2011).

2.2.4. Definition of potential of repetitive tasks

Based on the literature, this research defines the potential of repetitive tasks as follows:

“Repetitive tasks are characterised by one or more repetitions of the same or similar tasks. The potential of repetitive tasks involves the possibility that these tasks – when repeated – will be executed better each time, and that the improvements will then be applied each time and contribute to more efficient and effective achievement of [the goal].”

To be able to apply the improvements each time, it is important to ensure continuity and knowledge retention (Davies & Hobday, 2005a) of both practical and theoretical knowledge. In addition, improvement can be achieved through learning by acquiring (practical and theoretical) knowledge and skills, standardisation, industrialisation and innovation. It is important to note that innovation can refer to a special repetitive task. In the definition, ”the goal” can vary. The goal can be purely economic (executing the same or similar tasks in less time and money), or it can be complemented or replaced by societal challenges such as sustainability. It is important to prioritise the goals.

In short, the potential of repetitive tasks includes improving processes and activities, for example through the learning effect (Molaei et al., 2023). In order to exploit the potential of repetitive tasks, it is important for the public client, if necessary together with the contractor, to explore which repetitive tasks occur in its or the contractor’s portfolio and possibly examine what can be improved. After a task has been executed, it is advisable to consider with the contractor, if appropriate, how the execution of the task can be improved next time (Molaei et al., 2023). The frequency and design of the evaluation will depend on the nature and scope of tasks and the people executing them. The importance of reflecting on lessons learned is also emphasised by Davies and Hobday (2005b). Reflection enables the transformation of acquired experience into ”explicit knowledge”.

Exploiting the potential of repetitive tasks ensures that forces are combined, the wheel is not reinvented, and the realisation of societal and construction challenges is brought one step closer each time. With more efficient (faster and with fewer resources) and more effective (targeted) execution of repetitive tasks as the means.

2.3. Collaboration

2.3.1. Client-(main) contractor relationship in projects

Client-(main) contractor relationship, considered as the main (interorganisational) relationship within projects (Cox et al., 2006), is categorised by Meng (2012) into: traditional adversarial, short-term collaborative and long-term collaborative. In an adversarial relationship, which is often seen as leading within the project culture in the competitive (Cox et al., 2006) construction industry, the parties involved prefer to pursue their own objectives in a project (Thompson & Sanders, 1998). These may include profit maximisation (contractor) or public value realisation (public client) (PMI, 2021). However, in recent years, more attention has been paid to collaborative relationships, which aim to replace adversarial relationships with relationships in which common goals are pursued (Meng, 2012; Nikulina et al., 2022; Suprapto et al., 2015). Common terms for collaborative relationships are alliances and partnering

(Bresnen & Marshall, 2000; Meng, 2012; Nikulina et al., 2022; Suprapto et al., 2015). The difference between short-term and long-term collaborations lies in the duration of the collaboration: one or more projects.

As described by Suprapto et al. (2015), project performance is influenced by the nature of the working relationship between public client and contractor. If a collaborative relationship can be jointly developed and there is a unification of mutual interests, knowledge exchange is facilitated and it becomes possible to combine the skills and qualities of both parties for the realisation of the assignment (Kadefors et al., 2013; Suprapto et al., 2015). The Dutch word 'samenwerken', when translated into English, results in two words: cooperation and collaboration. According to the literature review by Castañer and Oliveira (2020), cooperation and collaboration can be distinguished by the different objectives pursued. In the case of collaboration, in addition to the pursuit of "common goals", the private goals of the parties involved in the collaboration are also taken into account and possibly supported. In the current research the word "collaboration" is used, which is defined as "the behavioral interaction between owner and contractor working together for the purpose of achieving specific project and business objectives by effective utilization of each party's specific resources and capabilities based on shared values and norms" (Nikulina et al., 2022; Suprapto et al., 2015, p. 665). As the above definition also indicates, collaboration is not an end but a means to achieve common goals.

2.3.2. Interests

In the construction industry, both establishing and maintaining collaboration between individuals is seen as a dynamic and complex process (Koops, 2017; Nikulina et al., 2022). Private and public organisations operate in different environments, pursue different organisational goals and use different working methods (Koops, 2017; PMI, 2021). When choosing to collaborate in maintenance, operations, a project or a programme, it is important to respond to the different objectives of the parties and to look for added value for the parties (Liu et al., 2021). When a public client wishes to collaborate with a contractor, it is important to consider the type of organisation of both public client and contractor and whether and to what extent an assignment is appropriate. In other words, the extent to which the objectives associated with the assignment can simultaneously contribute to various organisational objectives (Thompson & Sanders, 1998). What follows is a discussion of the characteristics of both contractors and public clients, in order to provide an insight into the motivations of both organisations, which will be useful in exploring different ways of collaboration, and in particular the case studies in the empirical research in Part III.

Business interests - contractors

Different types of companies are involved within the construction industry, distinguishing between large companies and Small and Medium-sized Enterprises (SMEs). The heterogeneity within SMEs is high (Groot et al., 2022; Windapo et al., 2020): small SMEs tend to be more specialised than larger SMEs, which operate mainly in the same market segments as large construction firms. In addition, small construction companies are particularly involved in small-scale projects and maintenance tasks (Molaei et al., 2022). The size of a company affects both "organisational behaviour [and] organisational structure" (Edvardsson, 2006; Rutherford et al., 2001). The smaller the company, the more likely it is to have informal and flexible structures (Edvardsson, 2006; Martínez-Costa et al., 2018; Zahoor & Al-Tabbaa, 2020). The limited resources available to SMEs compared to large companies (Zahoor & Al-Tabbaa, 2020), make it difficult for SMEs to participate in complex and time-consuming tenders (Pianoo, n.d.-c). With regard to SMEs, contracting authorities should avoid unnecessary clustering of assignments in tenders and take account of the limited resources of SMEs in the requirements imposed on the bidder and in the bid. This also follows from the Procurement Act 2012 (see article 1.5) and the principle of proportionality (Ministry of Economic Affairs and Climate Policy, 2021; Pianoo, n.d.-a). Specifically in terms of requirements, Groot et al. (2022) note that less burdensome administrative and procedural requirements would improve accessibility for SMEs.

Achieving responsible returns for the execution of assignments plays a role for market parties in deciding whether or not to bid for a contract; business continuity is paramount. Furthermore, in today's knowledge economy, it is important for contractors to use knowledge well in order to gain competitive advantage (Dave & Koskela, 2009; Edmondson, 2019).

Social interest – public clients

Clients in the construction industry differ in terms of their dependence on the type of financing, the tasks executed (public or private) and the political influence on the organisation (Grandia et al., 2023). Some clients are predominantly public, some are predominantly private and some are mixed. In the construction industry, public (e.g. RWS, provinces, municipalities and water authorities) and semi-public (e.g. housing corporations) clients predominate in terms of procurement volume (Boyd & Chinyio, 2006; Grandia et al., 2023). The applicable regulations, interests and objectives differ from those of private parties (Grandia et al., 2023; Hartmann et al., 2008; Lindblad & Gustavsson, 2021). Public clients find themselves in a political playing field that determines the core values and policy goals pursued (Grandia et al., 2023; Koops, 2017). For policy implementation, public clients rely on works, services and supplies, for which they use the make-or-buy decision to choose whether to execute them themselves or to have them executed by market parties through tendering (Grandia et al., 2023; Nicholas & Steyn, 2017). Irrespective of the choice, the public client seeks to both create and secure public value and achieve policy objectives with these works, services and supplies (Grandia et al., 2023; Kuitert et al., 2019).

2.3.3. Designing a collaboration

If a public client decides to procure, it then decides whether and how to collaborate with one or more future contractors. If a public client chooses to collaborate, the public client records agreements on how to collaborate, for example in the procurement procedure and contracts (Eriksson et al., 2019; Suprapto et al., 2015). Examples of agreements include agreements on the division of tasks, responsibilities, risks and remuneration between the contracting parties (Het Opdrachtgeversforum in de bouw, 2022). By remuneration, fixed remuneration, variable remuneration or remuneration depending on the performance delivered can be considered (Eriksson et al., 2019; Grandia et al., 2023). Project delivery method (PDM) defined as: “a system for organizing and financing design, construction, operations and maintenance activities that facilitates the delivery of a good or service“ (Miller et al., 2000, p. 59), can be used to organise parties within a collaboration (Engebø et al., 2020; Zhong et al., 2021). PDMs can be distinguished in the following three areas: the degree of (1) bundling (assignment consisting of one or a combination of (similar) projects/activities, e.g. framework agreement or programme contract), (2) integration (is the market party only involved in execution or also in design, maintenance and/or operation) and (3) risk allocation (Het Opdrachtgeversforum in de bouw, 2022). Here, the first two options influence the duration of the assignment and possibly also the collaboration (Eriksson et al., 2019). The choice of PDM is influenced by the public client’s objective and the type of assignment, as well as the public client’s capabilities and the available market capacity (healthy competitive market) (Suprapto et al., 2015). On the basis of these decisions, the procurement procedure and the content of the contract are then determined.

Additional agreements that parties can make with each other include agreements about what is expected of each other. Parties can agree on relational norms: “expectations about behaviours shared by the parties […] or norms of social exchange” (Nikulina et al., 2022, p. 800). Trust, transparency (openness), commitment, win-win philosophy and shared vision and values are examples of relational norms found in the literature by Nikulina et al. (2022) and influence the relationship between parties (Grandia et al., 2023). Recorded agreements on rules, norms and processes prior to collaboration can guide the intended behaviour and collaborative activities within an assignment (Nikulina et al., 2022). Culture, resulting from established norms and/or behaviours of team members (PMI, 2021), can play a positive role in project learning and knowledge exchange (Liu et al., 2021).

In summary, collaboration between public client and contractor can be designed and used in a variety of ways to work together to find ways of executing a repetitive task better each time, for example through joint learning, standardisation and/or industrialisation (see definition of potential of repetitive tasks subsection 2.2.4).

2.4. Ways to bring about change in construction industry

Strategic change can be achieved through projects or programmes. Below is a reflection on whether and how the way of organising encourages the occurrence of repetitive tasks and the exploitation of the potential of repetitive tasks.

2.4.1. Project-based approach

The traditionally dominant project culture in the construction industry (Dave & Koskela, 2009; Liu et al., 2021; Meng, 2012; Vosman, 2020) hinders learning between projects and risks repeating mistakes (Adriaanse, 2014; Brady & Davies, 2004). As defined in subsection 1.2.2, projects are seen as unique (Vrijhoef & Koskela, 2005) because of the one-off, "never to be repeated exactly" tasks they consist of (Nicholas & Steyn, 2017, p. 3). In particular, the image of a one-off, unique, non-recurring, temporary project prevents systematic learning (Brady & Davies, 2004; Cooper et al., 2002; Flyvbjerg, 2021; PMI, 2021) and knowledge development, and transfer between and within organisations (Blayse & Manley, 2004). The constant competition in project procurement and the resulting changing composition of project teams hinders knowledge exchange, retention (Vosman, 2020) and learning (Koolwijk et al., 2018), and contributes to uncertainty about whether improvements will be applied to other projects (Gieskes & ten Broeke, 2000). Completion of projects is often accompanied by a loss of knowledge (Koolwijk et al., 2003; Liu et al., 2021), and meeting project deadlines often results in lessons learned being sidelined (Liu et al., 2021). The temporary nature of projects leads to disruption of "learning and feedback loops" (Eriksson et al., 2019; Liu et al., 2021) and the lack of continuity in the project approach makes it difficult to invest in improvements (Cox et al., 2006). Furthermore, Adriaanse (2014) notes that in practice, projects are often managed and viewed as stand-alone, rather than in relation to each other (Dubois & Gadde, 2001; Vrijhoef & Koskela, 2005). The discontinuous nature of projects and the failure to manage and optimise projects in a coherent way prevents the potential of repetitive tasks from being exploited.

The comments above on the project-based approach in the construction industry are similar to the comments on construction crews in section 2.2.1, which indicated that continuity is important as well as providing enough repetitive tasks.

2.4.2. Programmatic approach

In addition to the project approach, there has been an increasing focus on the programmatic approach in recent years. By strategically bundling, coordinating and managing related projects and activities, an attempt is made to create added value and achieve "overarching" goals (Frederiksen et al., 2021; Geraldi et al., 2022; Lycett et al., 2004; Nicholas & Steyn, 2017; Pellegrinelli, 1997; PMI, 2021; Rijke et al., 2014; Shehu & Akintoye, 2009). It should be noted that the term "multi-project" is often mistakenly associated with the programmatic approach (Nicholas & Steyn, 2017; Pellegrinelli, 1997). Multi-projects also manage different projects together on the basis of shared resources, but do not pursue overarching goals (Nicholas & Steyn, 2017; Prevaas, 2018). While projects are about achieving certain results and thus contributing to goals, programmes are about achieving goals (Nicholas & Steyn, 2017; Prevaas, 2018). Programmes often have a longer lead time than projects and are more subject to change and uncertainty (Martinsuo & Hoverfält, 2018; Nicholas & Steyn, 2017; PMI, 2017; Prevaas, 2018). The goals of a programme are clear, but the way in which they are to be achieved is not. The scope moves with the changing context and the outcomes of the projects and activities included in the programme, so that the benefits generated are maximised (PMI, 2017).

By bundling projects and increasing the scope of work, repetitive tasks are more likely to occur (Arnoldussen et al., 2017). Godsell et al. (2018) even argue for a new type of programme in which repetitive projects are bundled to provide continuity for contractors, learning opportunities and "economies of repetition" (Davies & Brady, 2000). As Vrijhoef and Koskela (2005) point out, the use of a "project-independent approach" can lead to greater predictability and application of improvements across projects. As a programme consists of a bundle of projects, experience gained in one project can be used in future projects included in the programme and provides opportunities for cross-project learning (Arnoldussen et al., 2017; Geraldi et al., 2022; Maylor et al., 2006). As also described by Hartmann and Dorée (2015), cross-project learning can be promoted by using strategic goals that provide connections between projects. The same can be found in programmes: using cross-project, overarching goals. The bundling of projects combined with long-term collaboration also promotes knowledge exchange between projects (Arnoldussen et al., 2017) and provides opportunities to share and apply experience and knowledge across projects (Bresnen & Marshall, 2000; Vrijhoef & Koskela, 2005).

In short, programmes which bundle interdependent projects, activities increase the likelihood of more repetitive tasks occurring and increase the potential of repetitive tasks. In particular, when programmes

are accompanied by continuity and a sufficient volume of tasks, knowledge exchange, knowledge retention and learning are promoted.

2.5. Conclusion

Through the literature review, insight was gained into (the potential of) repetitive tasks. The literature mainly focuses on one-off, unique projects and emphasises repetition in projects, often in combination with schedule optimisation. However, repetitive tasks involve processes and activities that are repeated, making it useful to look at repetition not at the project level, but at the portfolio level, so that more repetitive tasks can be discovered. By organising repetitive tasks well, public clients can exploit their potential together with contractors, if desired. However, examples of this are currently lacking in the literature. Yet, the literature describes that bundling enough tasks so that repetition can occur, continuity (identical or similar activities, identical people involved and few breaks), knowledge exchange and retention, and evaluation are important elements to exploit the potential of repetitive tasks.

In addition, the literature review shows that collaboration can be designed in different ways to promote knowledge acquisition and transfer, and to exploit the potential of repetitive tasks together. A programmatic approach, where coherent projects and activities are bundled together, also promotes the occurrence of repetitive tasks and appeals to the potential of repetitive tasks. Especially when programmes are accompanied by continuity and a sufficient volume of tasks. In contrast, a project-based approach, particularly when projects are viewed as unique and temporary and are not managed coherently (lack of continuity), hinders the exploitation of the potential of repetitive tasks.

The literature review revealed that repetitive tasks can occur at various levels in construction and can be addressed in different ways. Table 2.3 presents a theoretical framework that includes the following aspects: (1) level of occurrence, (2) asset life cycle phase, (3) deliverables, (4) located, (5) potential of repetitive tasks and (6) type of bundling repetitive tasks. In order to complement both the theoretical framework and the knowledge gap, Part III examines three cases in which both collaboration between public client and contractors, and repetitive tasks are part of the assignments.

Table 2.3**:** Theoretical framework regarding repetitive tasks based on the literature

Aspects	Subaspects	Mentioned in literature (as)
Repetitive tasks: *"Construction processes and activities that are executed more than once (repeatedly) on/for the same or different (parts of) structures at one or more locations without the result having to be the same."*		
1. Level of occurrence	In projects: the same or similar tasks (activities or processes) are executed more than once in a project	See Figure 2.3; working units in repetitive (construction) projects; (Davies et al., 2009; Lundin & Soderholm, 1995)
	At the project level: (part of result of) projects are identical (or similar)	(Huang & Sun, 2005; Lundin & Söderholm, 1995; Davies & Hobday, 2005a)
	At programme level: the same or similar tasks (activities or processes) are executed more than once in the programme	(Godsell et al., 2018)
	At portfolio level: portfolio contains repetitive tasks - consider activity level	(Brady & Davies, 2004; Davies & Brady, 2016; Engwall, 2003; Molaei et al., 2022; Godsell et al., 2018)
	Maintenance and operations	Routine tasks; (preventive, cyclical) maintenance
2. Asset life cycle phase	New construction	(literature related to) repetitive (construction) projects
	Maintenance (upkeep; preventive)	Maintenance and repair tasks (Construction Task Force, 1998); (preventive, cyclical) maintenance tasks
	Renovation (improvement)	Renovation project
3. Deliverables	Preparatory tasks ("services")	(Davies et al., 2009; Godsell et al., 2018)
	Execution tasks ("works")	(literature related to) repetitive (construction) projects; (Vrijhoef & Koskela, 2005)
4. Located	Process (repetition in the order of and type of activities part of the process)	(Construction Task Force, 1998; Davies et al., 2009; Vrijhoef, 2011)
	Product (repetition in the result)	(Construction Task Force, 1998; Davies et al., 2009; Vrijhoef, 2011)
Potential of repetitive tasks*: "Repetitive tasks are characterised by one or more repetitions of the same or similar tasks. The potential of repetitive tasks involves the possibility that these tasks – when repeated – will be executed better each time, and that the improvements will then be applied each time and contribute to more efficient and effective achievement of [the goal]."*		
5. Potential of repetitive tasks	Improvements	Learning curve; continuity (of crews); exploitative learning; standardisation; industrialisation; innovation
	Elements to consider for exploiting the potential	Identifying repetitive tasks, responding to volume requirements through bundling, continuity, ensuring knowledge exchange and retention, and evaluation
6. Type of bundling repetitive tasks	At activity level (portfolio perspective public client vs contractor)	Programmatic approach
	At project level (portfolio perspective public client vs contractor)	Nonlinear scattered; programmatic approach (Godsell et al. 2018); project-independent (Vrijhoef & Koskela, 2005)

Part III

Empirical research

-Practice makes perfect-

3

Case study set-up

Based on the research questions and research objective, a multiple case study was chosen. This makes it possible to understand the design of an assignment in which a public client collaborates with contractors and repetitive tasks occur, in different contexts (Stake, 2005). Likewise, the expected impact of a specific assignment design on exploiting the potential of repetitive tasks can be investigated. In the following, the case selection is discussed first (section 3.1), after which the three selected cases are presented (section 3.2). The data retrieval process used is then discussed, describing which data sources were used and how the data were subsequently analysed (section 3.3).

3.1. Case selection

As case studies often use a limited number of cases, it is important to select them strategically (Verschuren & Doorewaard, 2010). Due to the exploratory nature of the research, and in order to contribute to the main research question and the research objective, it was decided to select cases for which applies:

- Each case belongs to a **different sector** of the construction industry in the Netherlands: as described in Chapter 1, the construction industry as a whole is confronted with societal and construction challenges. By studying cases from different sectors, it is possible to see whether learning can be achieved between the different sectors so that the challenges can be tackled together.
- Each case involves **repetitive tasks**: it can be deduced from the research objective and research questions that (the potential of) repetitive tasks is one of the key concepts of this research. With this selection criterion it is possible to select cases in which the potential of repetitive tasks can be exploited.
- In each case, the public client sees added value in **collaborating** with contractors to achieve the objectives initially set by the public client: this is also one of the key concepts of this research. This criterion enables examining the elements in the design of an assignment in which a public client collaborates with contractors that influence the exploitation of the potential of repetitive tasks.
- Each case is in the **realisation phase**: makes it possible to study the design of the assignment and the collaboration. It also provides an opportunity to include the contractor's perspective, in addition to the public client's, on repetitive tasks and how best to exploit its potential.
- Each case is a programme, however each programme consists of activities belonging to a different phase of the **asset life cycle**: allows the similarities and differences of repetitive tasks in both new construction, maintenance and renovation to be considered. These three categories were also identified in the literature review (see Table 2.3).

The design of the assignment different in each case, which makes it possible to examine the impact of design on exploiting the potential of repetitive tasks.

3.2. Selected cases

Based on the above criteria, the following cases are selected: Wonen Limburg (WL) (residential construction; maintenance and renovation), Innovation Partnership (IPS) Schoolgebouwen (utility construction; new construction), and Values-Driven Maintenance Floodplains (in Dutch: Waardengedreven Onderhoud UiterWaarden) (WOUW) (infrastructure construction; maintenance). Table 3.1 shows how the selection criteria were met. A brief description of each case is given below, with particular attention paid to the reason of and objective pursued in each case. Several case documents were used for this

purpose, which are included in Appendix B.1 and referred to in the text by document codes. For the document codes, [**XY**] was used, where X represents the specific case (A: WL, B: IPS Schoolgebouwen, C: WOUW) and Y represents the number used for the specific document.

Table 3.1**:** Characteristics of selected cases

	Case A - WL	**Case B - IPS Schoolgebouwen**	**Case C - WOUW**
Public client	Housing corporation Wonen Limburg (WL)	Municipality of Amsterdam	Rijkswaterstaat (RWS)
Sector of the construction industry	Residential construction	Utility construction	Infrastructure construction
Budget realisation tasks	Total €103,5 million per year Work package 1: €43 million per year Work package 2: €37,5 million per year Work package 3: €23 million per year	Ca. €80 - 120 million for the realisation of nine school buildings	Total €58,4 million 1. Plot Maas: €21,6 million 2. Plot Rijntakken: €25,4 million 3. Plot IJssel: €11,4 million
Repetitive tasks	The same and similar maintenance and renovation tasks on (similar) houses and buildings are programmed and executed for several years.	Realisation of school buildings using building concepts, where the end result is different each time but consists of repeating elements as much as possible.	Annual preparation of a maintenance plan and execution of maintenance tasks in the same plot.
Reason for designing the assignment	Continue to improve services. With good services, WL can achieve the desired "welcome home" feeling for residents.	Disappointing tenders in 2018 and gap between available construction capacity and current construction challenge.	As administrator, RWS is responsible for the management and maintenance of the floodplains owned by the government and those owned by third parties.
Reason of collaboration	WL is committed to providing high quality, efficient and effective maintenance services and needs the help of market parties.	Collaboration is seen as essential to ensure that the necessary innovations are developed and applied.	The maintenance tasks themselves are relatively straightforward, but achieving a maintenance plan that is accepted by the various stakeholders and the uncertainty about the scope of the work make collaboration desirable.
Contract length	2023-2030 (2033) [7 years with extension option of up to 10 years]	2023-2033 [commercial phase 10 years]	2022-2026 (2029/2032) [4 years with extension option of up to 2 x 3 years]
Current stage of the case	Realisation maintenance year 2	Commercial phase year 1	Realisation maintenance year 3

3.2.1. Introduction Case A. Client: Housing corporation WL

Housing corporation WL, which owns 26.000 dwellings and 3.000 units of other real estate (e.g. commercial and social real estate), wanted to conclude new maintenance contracts with market parties for its maintenance challenge in order to improve its services as of 2023 [**A1; A2; A4**]. WL has therefore developed a maintenance programme in which it determines, together with contracted market parties, what is necessary to maintain WL's real estate [**A1; A2**]. Maintenance includes both the upkeep (keeping the real estate stock in good condition) and improvement (e.g. in terms of sustainability) of the buildings in WL's real estate portfolio [**A1; A2; A9**] (see Figure 3.1).

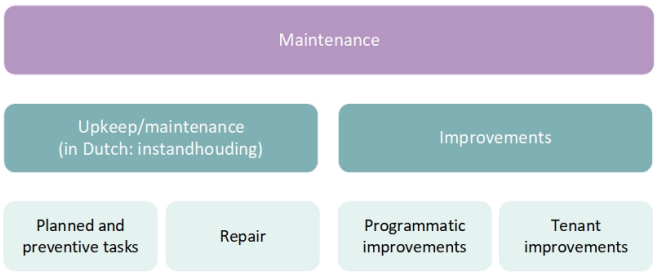

Figure 3.1**:** Tasks within the scope of the WL case [**A1, A2**]

In the Netherlands, housing corporations are considered semi-public organisations on the public-private continuum (Grandia et al., 2023)(see also section 2.3.2). Although this does not make a housing corporation subject to public procurement (van Zoest et al., 2020), WL decided to use a European procurement procedure. This is due to the size of the contract and the expectation that in the near future housing corporations will be seen as public organisations (Wonen Limburg, 2022). WL is therefore considered a public client in the further analysis.

3.2.2. Introduction Case B. Client: Municipality of Amsterdam

The housing challenge mentioned in Chapter 1 as one of the construction challenges, means for the municipality of Amsterdam that, in addition to 70,000 housing units, various social facilities, such as schools, have to be built. School boards are legally responsible for the maintenance, possible renovation and new construction of school buildings [**B1**]. However, this led to a situation where new school building projects were mainly marketed as individual projects at different times by different clients (school boards) [**B1**], resulting in fragmentation of the property portfolio and a lack of understanding of the overall assignment.

The report ”Spanning op de Bouwmarkt & Gemeentelijke bouwopgave maatschappelijk vastgoed” was written after the tender for the Cartesius Lyceum in 2018 failed to generate sufficient interest from market parties [**B1**]. Additionally, fifty primary schools and ten secondary schools had to be realised by 2040 [**B2**]. The report confirmed the suspicion that the available building capacity does not match the current construction challenge and the fulfilment of the ambitions of the municipality of Amsterdam [**B1**]. Furthermore, the report suggests that the municipality must take an active role in the development of social facilities, as the market may not respond quickly without its involvement [**B1**]. Using the European procurement procedure the innovation partnership for the construction of several primary schools (hereafter school buildings), enables long-term collaboration between the municipality, market parties and school boards aimed at innovation and seeks to bridge the gap between the construction challenge related to school buildings and construction capacity [**B2**].

3.2.3. Introduction Case C. Client: RWS

The name of RWS’s assignment, Values-Driven Maintenance Floodplains (in Dutch: Waardengedreven Onderhoud UiterWaarden) (WOUW), outlines the core of the assignment: to maintain 64.000 hectares of floodplains along the major rivers in the Netherlands according to five defined values [**C2**], so that safe and natural floodplains are achieved [**C4**]. Only 15% of the floodplains are owned by the government, the rest is owned by third parties. Ensuring water safety in the floodplains is a legal task of the administrator RWS under the Water Act, which applies to the entire 64.000 ha [**C1; C2; C3; C5**].

Floodplains fulfil not only a flood function, but also a natural, residential, working and recreational function (Rijkswaterstaat, 2022). The complexity of the assignment is attributed to the vastness of the area to be maintained, the large number of stakeholders (12.000 owners, 500 interest groups, 80 municipalities) and the dynamic nature [**C3**]. This requires maintenance that is carefully prepared and executed (Rijkswaterstaat, 2022). Due to the dynamic nature of the floodplains and the partly unknown area, the exact details of the floodplain contract are determined annually by RWS together with the contractors, including the price (two-phase approach (Rijkswaterstaat, 2023a)).

3.3. Data gathering and analysis

For the data analysis, both (publicly available) case documents (secondary data) and semi-structured interviews with the public client and contractor staff involved (primary data) were utilised (Saunders et al., 2009). By consulting different sources, it is possible to obtain the desired in-depth and contextual knowledge (Yin, 2018). The different sources used for data collection are discussed below.

3.3.1. Case documents

First, publicly available case documents, as well as documents obtained from the different public clients of the cases, were examined. See Appendix B.1 for an overview of the documents used per case and the document codes referred to in the document review in Chapter 4.

The initial use of the document analysis was to gather background knowledge on the different cases and in particular to understand the different assignment designs in view of repetitive tasks and the exploitation of their potential. In order to study the different cases, Table 3.2 is used specifically to explore the design of the assignment. The table includes (sub)elements that, according to the literature studied in Chapter 2, influence the design of the assignment and collaboration, as well as elements that refer specifically to the (proposed) aspects of repetitive tasks mentioned in Table 2.3. In addition, the goal and vision of the assignment and collaboration was considered as this research is part of the study conducted by Dr.ir. Maedeh Molaei and Prof.dr.ir. Marleen Hermans.

Table 3.2**:** Analysis framework for the assignments and associated collaborations in the case document analysis

Category	Element	Subelement
1. Design of an assignment	1.1 Reason for designing the assignment	
	1.2 Intended goal, vision, ambition of assignment	
	1.3 Design of collaboration	1.3.1 Reason of the collaboration
		1.3.2 Intended goal and vision of the collaboration
		1.3.3 PDM (bundling, integration and risk allocation)
		1.3.4 Relational aspect of collaboration (norms, values, behaviour, culture)
		1.3.5 Approach of repetitive tasks (based on theoretical framework)

After examining the documents, the design elements that could affect the exploitation of the potential of repetitive tasks were explained for each case. In addition, the theoretical framework concerning repetitive tasks (see Table 2.3) was tested and compared with the findings from the case documents. The resulting insights were then used to formulate the interview questions.

3.3.2. Semi-structured interviews

A minimum of six semi-structured interviews were conducted for each case, with three interviewees being employed by the public client and three by a contractor. In this way, an attempt is made to gain insight into the different perspectives, to learn what the public client and contractor believe is necessary to exploit the potential of repetitive tasks and to evaluate the document review findings.

Interview participants were chosen based on their organisation (public client or contractor), position, and level of involvement in the collaboration (design) (expert sampling). On the public client side, people in positions such as contract manager or project manager, who had contributed to the design of the assignment, or who were aware of the design principles, were therefore preferred. On the contractor side, preference was given to people in positions such as project manager or asset manager, who are involved as a contractual market party in the specific case. It should be noted that in the WL case there have been changes in the key people working for WL. As a result, it was not possible to interview three people working for the client WL who were involved in the design of the assignment.

In total, 18 interviews were conducted and the profiles of the participants and the corresponding codes used for the case analysis are presented in Table 3.3. For the codes, XY.Z was utilised, where X represents the role of the organisation in which the interviewee works (P: public client, c: SME contractor, C:

large contractor, S: school board), Y represents the case in which the interviewee was involved (WL, IPS Schoolgebouwen, WOUW) and Z represents the interviewee's identification code.

Table 3.3**:** Interviewee profile

Case	Role of the organisation	Role interviewee's within case	Involved in the assignment	Interviewee code	Date of interview
WL	Public client	Procurement and contract specialist	From tendering	PWL.1	04-12-2023
WL	Public client	Strategic contract advisor	From tendering	PWL.2	06-12-2023
WL	Contractor	Deputy director	From tendering	CWL.4	04-12-2023
WL	Contractor	Process manager	From tendering	cWL.5	08-12-2023
WL	Contractor	Account manager	From tendering	cWL.6	20-12-2023
IPS Schoolgebouwen	Public client	Contract manager	From tendering	PIPS.1	21-11-2023
IPS Schoolgebouwen	Public client	Education housing director	From designing the assignment	PIPS.2	24-11-2023
IPS Schoolgebouwen	Public client	Procurement specialist	From designing the assignment	PIPS.3	29-11-2023
IPS Schoolgebouwen	Contractor	Deputy director	From tendering	CIPS.4	23-11-2023
IPS Schoolgebouwen	Contractor	Director	From tendering	CIPS.5	01-12-2023
IPS Schoolgebouwen	Contractor	Tender manager	From tendering	cIPS.6	06-12-2023
IPS Schoolgebouwen	School board	Client	From R&D phase	SIPS.7	07-12-2023
WOUW	Public client	Project manager	From designing the assignment	PWOUW.1	13-11-2023
WOUW	Public client	Contract manager	From designing the assignment	PWOUW.2	29-11-2023
WOUW	Public client	Contract manager	From designing the assignment	PWOUW.3	01-12-2023
WOUW	Contractor	Project manager	During the realisation phase	CWOUW.4	20-11-2023
WOUW	Contractor	Project manager	During the realisation phase	CWOUW.5	28-11-2023
WOUW	Contractor	Project manager	From tendering	cWOUW.6	28-11-2023

Before the interviews were conducted, the interviewees were informed by email about the purpose of the research and the interview. Prior to each interview, the interviewees were given a consent form to sign, which outlined how the data obtained would be processed. The interviews were conducted either online or face-to-face, depending on the interviewee's preference. The semi-structured interviews were carried out using an interview protocol outlined in Appendix B.3, comprising of five sections: (1) introduction, (2) ambition and purpose, (3) design of the collaboration and potential of repetitive tasks, (4) result of the collaboration and (5) conclusion. The interview protocol did not only include questions about repetitive tasks and exploiting their potential, as this research is part of another study (see subsection 1.3.4). Prior to the interviews, a pilot interview was carried out with an employee of RWS who was involved in the WOUW case, to refine the interview questions. The purpose of this pilot interview was to assess the relevance of the questions. Based on the feedback received, some questions were adjusted and added.

3.3.3. Data analysis

Data analysis of the case documents and semi-structured interviews is an iterative process due to the exploratory nature of the research and the subject matter. The data set was carefully analysed several times and common patterns were sought (Guest et al., 2012). Atlas.ti software was used for the analysis of the semi-structured interviews. Once the interviews had been conducted, they were transcribed and coded using thematic analysis, so that (overarching) themes could be discovered in the transcriptions (Guest et al., 2012). To analyse the different transcriptions, the (sub)codes listed in Table 3.4 were used. The initial (sub)codes were based on the theoretical framework presented in Chapter 2 (deductive approach) and supplemented with (sub)codes based on the responses provided

during the interviews (inductive approach). Table 3.4 distinguishes between answers given by the public client or contractor and the case in which the interviewee was involved. The results of the analysis of the coded data are then presented for each case in Chapter 5 and compared in Chapter 6.

Table 3.4**:** Code scheme used for analysing semi-structured interviews.

	Public client (PC)		Contractor (C)	
Theme	**Code**	**Subcode**	**Code**	**Subcode**
Repetitive tasks	Definition of repetitive tasks - PC - [CASE]		Definition of repetitive tasks - C - [CASE]	
	Examples of repetitive tasks - PC - [CASE]	Preparatory tasks	Examples of repetitive tasks - C - [CASE]	Preparatory tasks
		Execution tasks		Execution tasks
	Reason for applied bundling - PC - [CASE]		Creating repetition in the contractor's portfolio - C - [CASE]	
Potential of repetitive tasks	Definition of the potential of repetitive tasks - PC - [CASE]		Definition of the potential of repetitive tasks - C - [CASE]	
	Comment repetitive tasks - PC - [CASE]		Comment repetitive tasks - C - [CASE]	
	Required to exploit the potential of repetitive tasks - PC - [CASE]		Required to exploit the potential of repetitive tasks - C - [CASE]	
	Design elements in collaboration - Promoting - PC - [CASE]		Design elements in collaboration - Promoting - C - [CASE]	
	Design elements in collaboration - Hindering - PC - [CASE]		Design elements in collaboration - Hindering - C - [CASE]	

In the following chapters, first the results of the document review of each case are presented (see Chapter 4), followed by the results of the semi-structured interviews (see Chapter 5). In Chapter 6, a cross case analysis is conducted in order to identify both the commonalities and the distinctions between the cases, and to gain valuable insights from the comparative analysis.

4

Document review

This chapter discusses the case study findings of the three selected cases, WL (section 4.1), IPS Schoolgebouwen (section 4.2) and WOUW (section 4.3), based on the analysis of (public) case documents. For each case, the subelements belonging to the design of collaboration element in Table 3.2 are discussed successively: (1) reason and intended goal of the collaboration, (2) formal design of the collaboration and (3) approach of repetitive tasks. Thereafter, it is examined which elements in the design of the collaboration can promote or hinder the exploitation of the potential of repetitive tasks. Since these design elements are not explicitly stated in the case documents, the researcher's interpretation is provided. The chapter concludes by reviewing the theoretical framework concerning repetitive tasks in section 2.5 against the findings of the document review (section 4.4). This chapter partly answers the second sub-question: *How does the (intended) design of an assignment in which a public client collaborates with contractors promote the exploitation of the potential of repetitive tasks in practice?*.

4.1. Case document analysis - WL

Below the design of the collaboration by the housing corporation WL for the WL case is discussed. The case documents used, are listed in Appendix B.1. Additional information on WL is provided in Appendix B.2.1.

4.1.1. Reason and intended goal of the collaboration

WL aims to enhance its service and believes that collaborating with the market to maintain and improve its real estate is more effective than asking the market what WL thinks it needs [**A2**]. Collaboration between WL and contractor (specifically: network partner), as well as between network partners themselves, is seen by WL as desirable and necessary in order to achieve "high quality, efficient and effective maintenance services" [**A1; A2**].

WL aims to achieve the following three objectives through collaboration [**A4**]:

1. Improved service delivery to both WL and its residents;
2. Optimisation of maintenance and associated costs;
3. Obtaining up-to-date and relevant asset data.

The term "network partner" is derived from WL's desired application of network collaboration. This refers to "a way of working with different parties based on trust and achieving our own and each other's goals" [**A1; A2**]. As shown in Figure 4.1, WL requires collaboration not only between WL and the network partner, but also between the network partners themselves. Due to the scope of this research, only the collaboration between WL and network partners is considered.

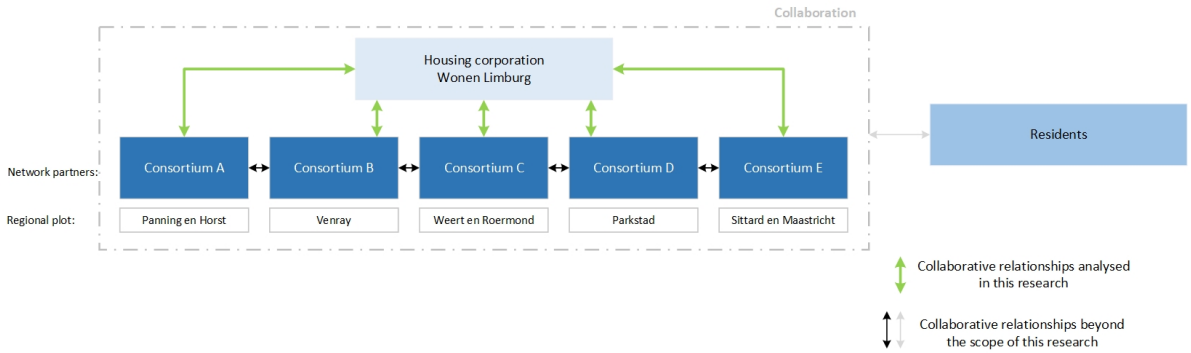

Figure 4.1: Visualisation of involved parties and collaboration relationships WL. Network partners of work package 2 are excluded

4.1.2. Formal design of the collaboration

WL has chosen to divide its maintenance challenge into three categories, each of which is assigned to a separate work package: (1) Exterior and general areas: planned maintenance, (2) Installations: planned and preventive maintenance and (3) In the resident's home: demand driven maintenance [**A1; A2; A4; A7**]. Subsequently, the tasks in each work package were divided into regional plots based on geographical location to ensure risk diversification [**A1; A2**]. This research only considers work packages 1 and 3, as for these work packages the same network partners are responsible for the preparation and execution of maintenance tasks in a regional plot. In addition, work package 2 includes installation tasks which are considered to be distinct from the civil tasks included in the scope of this research.

Work packages 1 and 3 have been divided into seven regional plots and contracted to five network partners: (1) Maastricht – Sittard, (2) Horst, (3) Panningen, (4) Roermond, (5) Parkstad, (6) Venray and (7) Weert (see Figure 4.1) [**A1; A2**]. For both work packages 1 and 3, the network partners are responsible for preparation of and implementing an increasingly optimised maintenance programme. To this end, WL concluded a performance-based maintenance contract with each network partner for a minimum of seven years, with an extension option of up to three years [**A1; A2; A4**].

WL has sought a good balance in the design of the collaboration in terms of prescribing and leaving room for the network partners. WL provides the network partners with quality frameworks, after which the network partners take the lead in planning and executing maintenance [**A8**].

WL expects that by bundling different maintenance activities (repair, planned preventive and improvement, see Figure 3.1) into one contract, there will be opportunities for network partners to cleverly combine the different tasks [**A4; A19**]. This is intended to contribute both to improved services for WL and its residents, and to the optimisation of maintenance.

4.1.3. Approach of repetitive tasks

Repetitive tasks

The WL assignment involves bundling maintenance and renovation tasks at activity level into a programme from the public client's portfolio perspective. From the various case documents, it can be identified that repetitive tasks occur in:

- Annual preparation of a baseline file (in Dutch: uitgangspuntendossier) by WL [**A11; A20**]
  (deliverable: preparatory tasks, repetition in process and product);
- Annual preparation of a Multi-Year Maintenance Plan (MYMP) and annual plan by the network partner [**A11; A13**]
  (deliverable: preparatory tasks, repetition in process and product);
- Annual approval and issue of an assignment by WL [**A8**]
  (deliverable: preparatory tasks, repetition in process and product);
- Annual preparation of an execution plan by the network partner [**A14**]

(deliverable: preparatory tasks, repetition in process and product);

- Execution of the same or similar tasks on the same or similar structures (houses), one or more occasions during the contract period by the network partner
(deliverable: execution tasks, repetition in process and product).

Potential of repetitive tasks

In **WL1** and **WL2**, WL has included that not only the preparation and execution of maintenance tasks by the network partner is part of the assignment, but also the continuous optimisation of the maintenance approach. WL values learning and improvement and expects the network partner to learn together with WL and to continuously (re)develop the maintenance approach [**A1; A2; A4**]. WL pursues the following during the assignment: “in everything we do, we look to see if it can be done better, smarter, more fun or faster” [**A8**]. In their annual plans, network partners have to demonstrate to WL that they are continuously improving the way they work, by ”increasing the number of assignments that are done well in one go, or resolving cases faster/smarter” [**A13; A15**]. In addition, an annual evaluation takes place at the end of the year. During the annual evaluation, optimisations (= improvements in the definition of potential of repetitive tasks subsection 2.2.4) for the coming year, which the network partner has included in his final report, are also discussed.

WL sees value in knowledge exchange and expects to achieve better results [**A8**]. WL expects its network partners to bring their ”experience, knowledge and skills” to the collaboration, to share them with WL and the other network partners on a non-binding basis, and to develop and use them to improve ”methods, techniques and (process) solutions” [**A6**].

Expected enablers in collaboration design

Design elements that are expected to promote the exploitation of the potential of repetitive tasks:

1. A fixed network partner is responsible for maintenance in a given area over a long period of time (at least seven years) [**A1; A2; A4**]. This allows the same or similar maintenance tasks to be executed several times on the same or different structures or sites, and knowledge to be built up and used. [**continuity, volume requirements & payback opportunity**]
2. The network partner is responsible for planning in addition to execution and can therefore create more opportunities to exploit the potential of repetitive tasks. WL provides hard frameworks with the baseline file, but tries to make the best use of both parties’ knowledge in the maintenance approach by using the annual plans prepared by the network partner [**A8**]. In addition, WL expects its network partners to share knowledge with each other [**A6**]. [**early involvement of contractor & knowledge exchange**]
3. With regard to repairs, the network partner had to specify a surrender value in the tender, which applies to all repairs in its plot for one year. As a result, repairs can be financially advantageous to the network partner [**A23**]. [**incentive to (continue to) improve**]
4. Carry out (monthly and annual) evaluations (through reports and discussions) with the network partner and WL, paying particular attention to the degree of application of optimisations. In addition, the annual evaluation will consider improvement opportunities for the coming year [**A13; A15; A16**]. [**knowledge retention & evaluation**]

Expected barrier in collaboration design

Design element that is expected to hinder the exploitation of the potential of repetitive tasks:

- Tasks included in work package 3 are demand-driven (depending on demand from residents) and for programmatic improvements included in work package 1, there is an uncertain scope in advance [**A2; A3; A22**]. [**continuity impediment**]

4.2. Case document analysis - IPS Schoolgebouwen

Below the design of the collaboration by the municipality of Amsterdam for the IPS Schoolgebouwen case is discussed. The case documents used, are listed in Appendix B.1. Additional information on IPS Schoolgebouwen is provided in Appendix B.2.2.

4.2.1. Reason and intended goal of the collaboration

There are two key goals within the collaboration. First, to achieve affordable, sustainable and high quality school buildings. Second, to initiate the transition to a supply-driven market approach. The latter involves a different way of asking the market to come up with different solutions (building concepts) for a specific problem (the realisation of school buildings) [**B1**]. The municipality of Amsterdam used the innovation partnership, because it enables innovation-oriented collaboration and provides sufficient scale and opportunities for the application of innovation (in this case building concepts) by market parties [**B1**]. The use of innovation is seen as essential in order to realise school buildings with a higher building quality at the same price compared to recently realised school buildings before IPS Schoolgebouwen [**B1; B2**].

4.2.2. Formal design of the collaboration

The innovation partnership consists of three phases: (1) procurement phase, (2) research and development (R&D) phase and (3) commercial phase [**B2; B3; B4; B5; B6**]. After completion of the procurement phase, the R&D phase started in November 2022 with three consortia (specifically: innovation partner). See Figure 4.2 for a visualisation of the parties involved in the assignment. Due to the scope of this research, only the collaboration between the municipality of Amsterdam and the consortia is considered.

During the R&D phase, the three consortia worked on their flexible building concept, which will be offered during the commercial phase to the various school boards that want to build a school building. The intellectual property rights for the innovative building concepts are owned by the consortia [**B3; B4; B5**]. After the successful completion of the R&D phase by the three consortia, the municipality concluded a framework agreement with these consortia for a period of up to ten years, which marked the start of the commercial phase [**B2; B4**]. With this framework agreement, the participating school boards[1] assign the design, realisation and, optionally, the maintenance of at least nine and up to thirty school buildings to the three consortia [**B2; B4; B5; B7**].

Each school building to be realised will be considered as a separate ”Further assignment” (in Dutch: Nadere opdracht), for which a further contract will be concluded, the terms of which will be based on the UAV-GC [**B2; B8**]. In order to determine which consortium will build which school using the building concept, mini-competitions will be held in the commercial phase [**B2**]. In this way, the municipality of Amsterdam wants to ensure sufficient competition during and after IPS Schoolgebouwen [**B2**] to encourage the consortia to continuously improve their building concept (Pianoo, n.d.-b; Schaatsbergen, 2021). This is also expected to contribute to the desired transition to ”supply-driven demand articulation” for future school buildings. The municipality would like school boards to apply a fixed price during the mini-competition for the selection of a building concept for their school building, so that quality can be steered [**B2**].

In the further analysis of the IPS Schoolgebouwen case, only the agreements applicable to the commercial phase are considered. This is because in this phase most of the repetitive tasks are exectued over a longer period of time.

[1] At the request of a school board, the municipality of Amsterdam can take on the role of commissioner (building owner) for the realisation of a school building [**B2**].

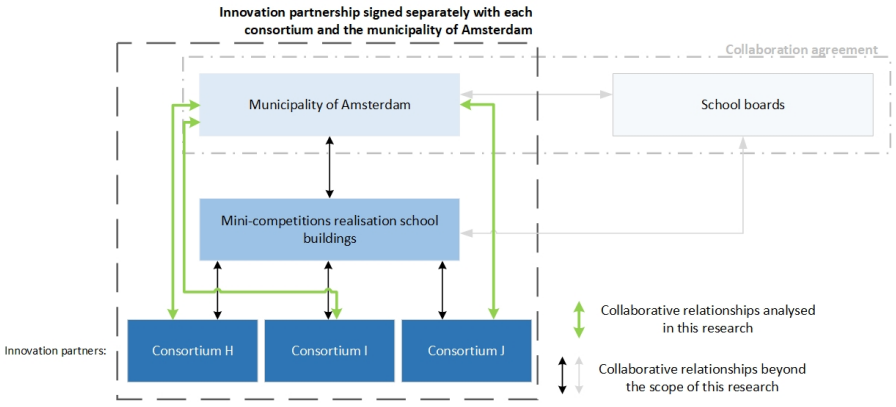

Figure 4.2: Visualisation of involved parties and collaboration relationships IPS Schoolgebouwen

4.2.3. Approach of repetitive tasks

Repetitive tasks

The IPS Schoolgebouwen assignment involves the clustering of new construction tasks at project level into a programme from the public client's portfolio perspective. This is due to the choice of clustering assignments (school buildings) [**B2**], which are treated as separate assignments (Further assignment) through the use of mini-competitions. In addition, the municipality of Amsterdam has designed the demand specification in such a way that the three consortia can (ideally) apply their building concept several times. This also allows for repetition in the contractor's portfolio. In this case, the contractor portfolio was specifically taken into account when bundling in order to make the desired contribution to a supply-driven market. This is expected to lead to an increase in repetition in the contractor's portfolio, not only within IPS Schoolgebouwen but also beyond.

From the various case documents, it can be identified that repetitive tasks occur in:

- Participation in several mini-competitions by the public client and consortia
  (deliverable: preparatory tasks, repetition in process and product);
- The design of (ideally) several school buildings, repeatedly using the building concept that has been (re)developed by a consortium in the R&D phase
  (deliverable: preparatory tasks, repetition in process and product);
- Application of the (re)developed building concept in the realisation of (ideally) several school buildings by a consortium
  (deliverable: execution tasks, repetition in process and product);
- Executing optional maintenance tasks over a number of years on one or more school buildings where the same building concept has been applied by a consortium
  (deliverable: execution tasks, repetition in process and product).

Potential of repetitive tasks

During the commercial phase, the building concepts (re)developed will be applied for the first time, and the municipality of Amsterdam expects that the consortia further develop and optimise the components that make up their flexible building concept (Smit, 2023). As Stedebouw & Architectuur (2023) also points out: "Each building means: more experience and a more efficient way of working". To ensure that all three consortia can apply their developed building concept at least once, it was decided during the R&D phase to award the first three school buildings "by means of an elimination race" (Smit, 2023).

Expected enablers in collaboration design

Design elements that are expected to promote the exploitation of the potential of repetitive tasks:

1. In addition to bundling a minimum of nine and a maximum of thirty school buildings, the bundling also took into account the uniformity of the school buildings included. This resulted in the inclusion of only new, stand-alone primary schools [**B2**]. Combined with the use of the location-independent

generic programme of requirements document, which was optimised by the municipality of Amsterdam together with the three consortia during the R&D phase, this means that the (re)developed building concepts can be used several times and allows the application of standardisation and industrialisation [**B2; B4**]. [**volume requirements & facilitating demand specification**]

2. Instead of tendering each school building separately and having it designed by architects and consultants and then built by a contractor, as in the original situation, the three consortia (ideally) design and build several school buildings with the same building concept [**B2; B4; B5; B7**]. [**early involvement of contractor & volume requirements**]
3. There is a long-term, cross-project collaboration between the municipality of Amsterdam and the three consortia, starting in the R&D phase to develop and test the building concepts. In the commercial phase, a framework agreement is concluded for a period of 10 years [**B2; B4**]. [**continuity & knowledge exchange**]
4. The intellectual property rights for the innovative building concepts are owned by the consortia [**B3; B4; B5**]. This makes it attractive for market parties to continually improve their building concepts. [**payback opportunity**]
5. Evaluations will be carried out at the end of each mini-competition in order to develop the mini-competition process [**B8**]. Evaluations will also be carried out on the result delivered (including quality, price, time) and other performance of the contractor in the execution of a further assignment [**B5**]. Both the municipality of Amsterdam and the contractor will appoint a single permanent contact person for the evaluations. [**knowledge exchange & evaluation**]

Expected barriers in collaboration design

Design elements that are expected to hinder the exploitation of the potential of repetitive tasks:

1. The framework agreement gives the municipality of Amsterdam and the school boards the right to award the realisation of school buildings to the contracted consortia. However, the use of a framework agreement with mini-competitions does not guarantee the quantity of school buildings to be constructed per consortium. Furthermore, the market consultation revealed that ”the lack of a revenue guarantee combined with mini-competitions for the further assignments [provides] too little guarantee to cover the investments made in the tender and research and development phases” [**B2**]. [**continuity & volume requirements impediment**]
2. Competition between the three consortia is central in the commercial phase [**B2**] and can hinder knowledge sharing between parties. [**knowledge exchange impediment**]
3. For each school building, in addition to a generic programme of requirements, there is a specific programme of requirements depending on the specific requirements of a school board (location, educational vision, fulfilment of sustainability objectives) [**B2**]. The award criteria for each mini-competition are also adapted accordingly [**B2**]. The changing clients and their requirements and/or wishes may result in the tasks being executed varying from one school building to another. [**continuity & volume requirements impediment**]

4.3. Case document analysis - WOUW

Below the design of the collaboration by RWS for the WOUW case is discussed. The case documents used, are listed in Appendix B.1. Additional information on WOUW is provided in Appendix B.2.3.

4.3.1. Reason and intended goal of the collaboration

The RWS transition programme ”Towards a vital infrastructure sector” is looking at new forms of tendering and execution (Rijkswaterstaat, n.d.). In line with this, WOUW has adopted a two-phase process and long-term maintenance contracts in which collaboration between client and contractor is central (Rijkswaterstaat, 2022) [**C7**]. In addition, the lack of a multi-year maintenance plan and the dynamic nature of the maintenance contract created a high degree of uncertainty (Rijkswaterstaat, 2023b). Therefore, a combination of expertise from both RWS and the market was desirable (Rijkswaterstaat, 2023b).

Optimal collaboration is seen as a means of achieving the desired maximum customer value [**C4**]. In this assignment, the customer consists of: (1) residents in the Netherlands who depend on the floodplains

for their safety, (2) Dutch people who recreate on the land in the floodplains owned by RWS, (3) Dutch people who benefit from the natural values and (4) RWS itself as ”asset owner of the sites and objects”. In WOUW, Team Uiterwaarden (TU) was chosen to represent this customer as the administrator of RWS [**C4; C6**].

4.3.2. Formal design of the collaboration

RWS has decided to divide the maintenance of the 64.000 ha of floodplains into three plots, regions: Maas, Rhine branches (in Dutch: Rijntakken) and IJssel. Three plots were chosen, because splitting into more plots would lead to higher transaction costs for market parties and many interfaces, resulting in an unmanageable risk profile [**C1**]. The many interfaces result from the connection between the different (maintenance) tasks. In addition, the choice of three plots was based on the river system, so that there was also a good fit within RWS [**C1**]. In principle, the same type of tasks should be executed for all three plots [**C2**], regardless of whether the plot is owned by RWS or a third party [**C1; C3**]:

- Environmental and asset management;
- Vegetation maintenance (mowing, pruning, cutting, clipping);
- Civil engineering maintenance.

The tasks are roughly divided as follows: one third environmental management, one third asset management and one third maintenance [**C4**]. In this case, not only the execution of maintenance is important, but also the process that ultimately leads to maintenance, preparatory tasks [**C4**]. For these preparatory tasks, it was decided to use a single integrated project management (IPM) team per contracted contractor (or in others words per plot) (Rijkswaterstaat, 2023b, 2023c). The rationale behind this, is that each IPM role is in principle performed by either the public client or the contractor (Rijkswaterstaat, 2023c). In WOUW, it was decided that the project manager, technical manager and project control manager would be filled by the contractor and the contract manager by the public client (Rijkswaterstaat, 2023c). The role of environmental manager is filled by both the public client and the contractor, and the role of asset manager is filled by the administrator (TU) (see Figure 4.3) (Rijkswaterstaat, 2023c). The public client and contractor jointly provide the design for floodplain maintenance [**C4**], so that the knowledge of both can be used and complemented.

See Figure 4.3 for a visualisation of the parties involved in the assignment. From RWS, TU has assigned part of the maintenance of the floodplains to Team WOUW, which is part of Programmes, Projects and Maintenance (PPO) [**C4**]. The part of Team WOUW that works across plots is the programme team WOUW [**C4**]. Asset managers from TU participate in the various plot teams to incorporate customer values in the preparation and execution of maintenance [**C4**]. Due to the scope of this research, only the collaboration between Team WOUW and the contractors (specifically: assignment partners) is considered.

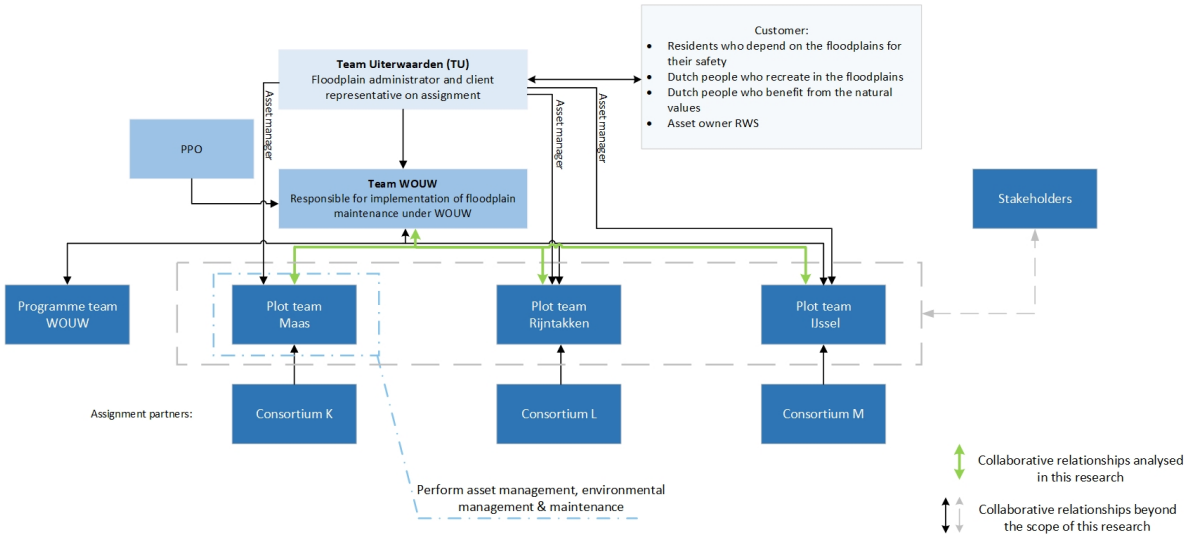

Figure 4.3**:** Visualisation of involved parties and collaboration relationships WOUW

For the maintenance of the floodplains, a so-called Values-Driven Maintenance Contract Floodplains (in Dutch: Waardengedreven Onderhoudscontract Uiterwaarden) (WOCU) is concluded with the contractors involved for each plot for a period of four years with two extension options of three years [**C1; C4**]. RWS chose this long term, because it provides:

- the possibility for the contractor to use the accumulated knowledge about the area and the stakeholders for a longer period of time;
- better use of the expected learning effect, resulting in more efficient and effective work;
- stimulating innovation because of the payback opportunity [**C1**].

4.3.3. Approach of repetitive tasks

Repetitive tasks

The WOUW assignment involves bundling maintenance tasks at activity level into a programme from the public client's portfolio perspective. From the various case documents, it can be identified that repetitive tasks occur in:

- Annual preparation of an annual plan of maintenance tasks to be executed by each plot team in the coming year [**C2**]
  (deliverable: preparatory tasks, repetition in process and product);
- Executing the same or similar tasks on the same or similar structures (civil engineering maintenance) or land (vegetation maintenance) by the contractors [**C1**]
  (deliverable: execution tasks, repetition in process and product).

Potential of repetitive tasks

Learning, one of the values within WOUW, is used to achieve the goal of "safe and natural floodplains for all" "better, faster [, smarter] and more efficiently" [**C4**]. RWS is committed to improving and optimising the processes each year [**C4**]. RWS expects that the long-term nature of the contract will ensure increasingly efficient and effective maintenance through the opportunity to learn and build knowledge [**C1; C2**]. In addition, having three plots, each with a different contractor, provides an opportunity for cross-pollination of knowledge and is expected to lead to improved maintenance [**C1**].

However, as noted by RWS, the right conditions must be in place to make learning possible. Two elements are mentioned: the ability to reflect and a learning space where making mistakes is part of the process [**C4**]. It is also noted that attention should be paid to the exchange of knowledge after the contract has been awarded and, in particular, how competitively sensitive information is handled so that learning is not hindered [**C4**].

Expected enablers in collaboration design

Design elements that are expected to promote the exploitation of the potential of repetitive tasks:

1. A fixed plot team is responsible for maintenance in a given plot over a long period of time (at least four years) [**C1; C4**]. This allows the same or similar maintenance tasks to be executed several times on the same or different structures or sites, and knowledge to be built up and used. [**continuity, volume requirements & payback opportunity**]
2. For each plot, the public client and contractor work together in a single IPM team and the contractors are involved at an early stage (Rijkswaterstaat, 2023b, 2023c). The public client and contractor execute the preparatory tasks together and the results are then incorporated into an annual plan [**C1; C4**]. This allows knowledge retention, the use of both parties' knowledge, and exploration of how to exploit the potential of repetitive tasks. [**early involvement of contractor, knowledge exchange & knowledge retention**]
3. The division of floodplain maintenance into three plots allows for knowledge exchange between the plot teams and is expected to improve floodplain maintenance [**C1**]. [**knowledge exchange**]

Expected barrier in collaboration design

Design element that is expected to hinder the exploitation of the potential of repetitive tasks:

- Contract contains two extension options instead of a ten-year contract [**C1**]. [**continuity impediment**]

4.4. Conclusion

The document review in this chapter shows that different ways of collaboration with contractors are sought in order to make the best use of the knowledge and expertise of both public client and contractors for the assignment at hand. In the cases WL, IPS Schoolgebouwen and WOUW, a programmatic approach was used to realise the different assignments. The choice was made to bundle projects, activities and manage them in a cohesive manner in the expectation that this would better contribute to the achievement of the formulated goals[2]. It is noticeable that in WL, IPS Schoolgebouwen and WOUW, there are uncertainties about scope, budget and/or time. These aspects are also mentioned in the literature as one of the characteristics of a programme (PMI, 2017). Despite many similarities with the programmatic approach, IPS Schoolgebouwen is very similar to a project-based approach through the use of mini-competitions and different clients for each school building to be realised.

In addition, several design elements were identified in each case that are likely to promote the exploitation of the potential of repetitive tasks. For example, all cases involve the bundling of activities (WL and WOUW) or projects (IPS Schoolgebouwen) and long-term collaboration between public client and contractors, not only for the execution tasks but also for the preparatory tasks. Whereas the WL and WOUW cases involve the bundling of maintenance and/or renovation tasks that are contracted per area to a specific contractor, the IPS Schoolgebouwen case involves the bundling of new construction tasks that are divided between the contractors during the term of the contract through mini-competitions. Furthermore, in the WL and WOUW cases, it was decided to eliminate competition between the contractors in order to promote knowledge exchange. In the IPS Schoolgebouwen case, on the other hand, a conscious decision was made to promote competition, with the idea that this would allow contractors to continuously improve their building concepts.

Based on the document review, Table 4.1 indicates how the elements of the theoretical framework presented in Chapter 2 are reflected in each case. Through the use of semi-structured interviews, the results of which are presented in Chapter 5, it is examined which elements in the different cases, according to the public clients and contractors, offer the opportunity to exploit the potential of repetitive tasks or, on the contrary, hinder it.

[2] Goal in case WL: "Effectively and efficiently achieve and maintain the desired condition of WL's real estate with regard to residents and users, which includes minimising inconvenience to residents and users." [**A4**]
Goal in case IPS Schoolgebouwen: "Towards a supply-driven market approach in which sustainability, flexibility and quality are pursued in the realisation of social facilities within the municipality of Amsterdam. The supply-driven approach facilitates product development and thus innovation and standardisation in the construction market." [**B2**]
Goal in case WOUW: "Safe and natural floodplains for all" "better, faster [, smarter] and more efficiently." [**C4**]

Table 4.1: Filled-in theoretical framework for the three cases studied based on document review

		Mentioned in		
Aspects	**Subaspects**	**WL**	**IPS Schoolgebouwen**	**WOUW**
Repetitive tasks: *"Construction processes and activities that are executed more than once (repeatedly) on/for the same or different (parts of) structures at one or more locations without the result having to be the same."*				
1. Level of occurrence	In projects: the same or similar tasks (activities or processes) are executed more than once in a project		x	
	At the project level: (part of result of) projects are identical (or similar)		x	
	At programme level: the same or similar tasks (activities or processes) are executed more than once in the programme	x	x	x
	At portfolio level: portfolio contains repetitive tasks - consider activity level	x	x	x
	Maintenance and operations	x	Only if maintenance is part of the further assignment	x
2. Asset life cycle phase	New construction		x	
	Maintenance (upkeep; preventive)	x		x
	Renovation (improvement)	x		
3. Deliverables	Preparatory tasks ("services")	x	x	x
	Execution tasks ("works")	x	x	x
4. Located	Process (repetition in the order of and type of activities part of the process)	x	x	x
	Product (repetition in the result)	x	x	x
Potential of repetitive tasks*: "Repetitive tasks are characterised by one or more repetitions of the same or similar tasks. The potential of repetitive tasks involves the possibility that these tasks – when repeated – will be executed better each time, and that the improvements will then be applied each time and contribute to more efficient and effective achievement of [the goal]."*				
5. Potential of repetitive tasks	Improvements	Test with the interviews	Test with the interviews	Test with the interviews
	Elements to consider for exploiting the potential	Test with the interviews	Test with the interviews	Test with the interviews
6. Type of bundling repetitive tasks	At activity level (portfolio perspective public client vs contractor)	x Public client perspective		x Public client perspective
	At project level (portfolio perspective public client vs contractor)		x Public client perspective (clustering of assignments (school buildings)) & Contractor perspective	

5

Semi-structured interviews

This chapter discusses the case study results of the three selected cases, respectively WL (section 5.1), IPS Schoolgebouwen (section 5.2) and WOUW (section 5.3), based on the semi-structured interviews conducted. First, for each case, the formulated definition of repetitive tasks and their potential according to the interviewed public clients and contractors are discussed. Next, the mentioned design elements required to exploit the potential are discussed, followed by a description of the specific design elements mentioned during the interviews as ”promoting” or ”hindering” for exploiting the potential of repetitive tasks. Again, both the public client and contractor perspectives are presented. Where insightful, findings are illustrated with verbatim quotes from the interview transcripts. Finally, the results are reflected upon and the second sub-question is answered: *How does the (intended) design of an assignment in which a public client collaborates with contractors promote the exploitation of the potential of repetitive tasks in practice?* (section 5.4).

5.1. Results Public client - Contractor - WL

5.1.1. Definition repetitive tasks

The interviewees from both public client and contractor organisations indicated that repetitive tasks involve ”recurring” tasks. CWL.4 and cWL.6 add that the process for these tasks is often the same, but the product (the result) may be different. Repetition in execution tasks is divided into:

1. Repetition related to the maintenance cycle of an asset (planned and preventive tasks).
2. Repetition related to the same or similar tasks to be executed in different buildings or complexes (e.g. (void) repairs, improvements).

The definition of repetitive tasks given by PWL.1, PWL.2, cWL.5 and cWL.6 is based on repetition found in execution tasks. In contrast, the examples given by interviewees show that repetition is found in both preparatory and execution tasks (see Appendix C.1.1). Examples cited by public clients and contractors include scheduling repetitive tasks (preparatory tasks) and executing (void) repairs (execution tasks).

PWL.1 indicates that a characteristic of repetitive tasks within real estate is that they are predictable, scheduleable and manageable, as the large number of properties makes it possible to estimate both planned preventive tasks and repairs. According to CWL.4, the term assignments is used instead of projects due to the large numbers in maintenance compared to new construction.

5.1.2. Definition potential of repetitive tasks

The public clients and contractors interviewed did not give a univocal answer to the question of how to define the potential of repetitive tasks. The responses received are explained below.

Repetitive tasks provide the opportunity to learn, build on past experience and improve [PWL.1, PWL.2, cWL.6]. Or as PWL.1 states: *Opportunity to learn, to ”go beyond the material” and then use this to determine ”where [contractors] can still extract what gains”.* PWL.2 also refers to the use of standardisation to achieve benefits *”in terms of money, time and risk information”*.

The large numbers within real estate have the advantage of making repetitive tasks predictable and therefore manageable [PWL.1, CWL.4, cWL.6]. *”You know exactly what to do”*, which allows good scheduling of repetitive tasks, as well as optimisation of materials procurement and better information for residents [CWL.4, cWL.6]. This allows more efficient and cheaper work [CWL.4]. Good scheduling means that the same people execute the same tasks with as few interruptions as possible [CWL.4, cWL.6]. This allows repetitive tasks to become routine and knowledge to be captured [cWL.6].

Comment
A comment is made by PWL.1 and PWL.2 that if an error is made in a repetitive task, then that error will be repeated. This comment is supplemented by PWL.2 with limited freedom and *"unitary work"*.

5.1.3. Required to exploit potential

The elements design which, according to the public clients and contractors interviewed, are necessary to exploit the potential of repetitive tasks are listed in Appendix C.1.2. A variety of answers were given. The most important elements are explained below.

Collaboration between public client and contractor is seen as necessary for knowledge exchange and identification of opportunities to exploit the potential of repetitive tasks, so that the approach matches the public client's requirements [PWL.1, CWL.4] and the public client's and contractor's capabilities [PWL.2]. As PWL.2 points out, *"[the public client's] basic processes"* may be related to (the potential of) repetitive tasks. According to the contractors interviewed, this is complemented by knowledge exchange between contractors, as this provides the opportunity to learn from each other and work more efficiently [CWL.4, cWL.6]. cWL.5 indicates that collaboration and exchange of knowledge and experience at the tactical level between client and contractor, and between contractors is particularly useful, as it is at this level that the *"improvement agenda is set"* and uniformity in the tasks to be executed can be achieved.

In addition, cWL.6 indicates that real estate data is needed to enable the contractor to make suggestions for improvement. PWL.1 indicates that maintenance data tracking is necessary to make repetitive tasks predictable.

5.1.4. Promoting design elements

The specific elements of this assignment which, according to the public clients and contractors interviewed, promote the exploitation of the potential of repetitive tasks are listed in Appendix C.1.3. A variety of answers were given. The main elements mentioned, are explained below.

Within the contract there are social housing units which are all very similar [PWL.1]. This, combined with the fact that each network partner has a large number of properties to maintain, results in repetitive tasks occurring more frequently and becoming more predictable and manageable [PWL.1]. In addition, the combination of unplanned and planned maintenance (integral maintenance) offers room for improvement [PWL.2, CWL.4]. *"Being smart about it, making those decisions well. Yes, that is really where the profit is."* [CWL.4] Because the contractor is now responsible for both planning and directing and executing maintenance, the contractor can manage these smart choices [CWL.4]. As cWL.6 points out, the contractor is now given space by WL *"to make suggestions if we think a repetitive approach is better"*. cWL.5 notes that because the contractor is responsible for preparation of the MYMP, the contractor can gain insight into recurring expenditure and tasks and has the opportunity to create a continuous flow of tasks (ensuring continuity).

In addition, the long-term contract with the same public client and the same houses provides continuity and therefore the opportunity for the contractor to know better what is expected of him and to respond to it, enabling him to work more efficiently [CWL.4]. Furthermore, the long-term contract allows the contractor to be involved in several maintenance cycles, which provides learning and payback opportunities for the contractor [cWL.5, cWL.6].

Finally, according to PWL.1, the surrender value for repair maintenance gives the contractor an incentive to keep improving maintenance. cWL.5 and cWL.6 agree that the surrender value makes it in the contractor's interest to organise maintenance tasks more intelligently.

5.1.5. Hindering design elements

Specific elements in this assignment which, according to the public clients and contractors interviewed, may hinder the exploitation of the potential of repetitive tasks are listed in Appendix C.1.4. The main elements mentioned, are discussed below.

The barriers mentioned by the interviewed contractors are related to the ambiguity of the assignment.

- Lack of clarity in demarcation of who is responsible for what tasks results in the contractor not

knowing exactly what tasks need to be executed [CWL.4].

- Lack of clarity about the strategy of the real estate complexes at the front end makes the precise maintenance tasks unknown and therefore difficult for a contractor to work efficiently [cWL.5].
- Unclear or unavailable (real estate) data makes it difficult for a contractor to *"do much work"* (in Dutch: meters maken) [cWL.6].

PWL.1 indicates that, apart from the repair maintenance surrender value, there are no Key Performance Indicators (KPIs) *"at portfolio level"*, which means that there is no bonus scheme for contractors to work more efficiently and intelligently in areas other than repairs.

5.1.6. Summary of the results - WL

Table 5.1 shows the main findings from the WL interviews described above.

Table 5.1**:** Summary main findings WL interviews

Aspects	Statements	Interviewees
Definition repetitive tasks	Recurring tasks	PWL.1, PWL.2 CWL.4, cWL.5, cWL.6
	Wording definition based on repetition in execution tasks	PWL.1, PWL.2, cWL.5, cWL.6
	Examples related to preparatory tasks and execution tasks	PWL.1, CWL.4, cWL.5, cWL.6
	Repetition in execution tasks due to the maintenance cycle of an asset and executing a task in different locations	PWL.1, PWL.2 CWL.4, cWL.5, cWL.6
Definition potential of repetitive tasks	Learning, building on past experiences and improving	PWL.1, PWL.2, cWL.6
	Predictability -> enabling scheduling, procurement and informing residents	PWL.1, CWL.4, cWL.6 CWL.4, cWL.6
	Comment: repetition of mistakes and limiting choice	PWL.1, PWL.2
Required to exploit the potential	Collaboration between client and contractor to share knowledge and inventory (the potential of) repetitive tasks	PWL.1, PWL.2, CWL.4, cWL.5
	Knowledge exchange between contractors	CWL.4, cWL.5, cWL.6
Promoting design elements	Integral maintenance	PWL.1, CWL.4
	Surrender value repair maintenance	PWL.1, cWL.5, cWL.6
	Large volume of uniform real estate	PWL.1
	Involvement of contractor at tactical level in maintenance approach	CWL.4, cWL.5, cWL.6
	Long-term contract	CWL.4, cWL.5, cWL.6
Hindering design elements	Lack of KPIs at portfolio level	PWL.1
	Lack of clarity in demarcation, strategy of real estate complexes and (real estate) data	CWL.4, cWL.5, cWL.6

5.2. Results Public client - Contractor - IPS Schoolgebouwen

5.2.1. Definition repetitive tasks

Public clients and contractors interviewed indicated that repetitive tasks involve ”recurring” tasks, both in:

- preparatory tasks, as the same process is carried out for each school building in order to match the contractor’s offer with the school board’s requirements [PIPS.1, PIPS.2, PIPS.3, SIPS.7, cIPS.6];
- as execution tasks because several school buildings are being built [CIPS.4, CIPS.5].

When giving a definition of repetitive tasks, CIPS.4 and CIPS.5 thought of repetition reflected in the execution. Furthermore, most of the interviewees [PIPS.1, PIPS.2, SIPS.7, CIPS.4, CIPS.5] indicated that repetition occurs in the realisation between school buildings and not in the realisation of one school building as indicated by PIPS.3 and cIPS.6. When providing examples, all interviewees acknowledge repetition in preparatory and execution tasks, with the exception of CIPS.5 (see Appendix C.2.1). The interviewed public clients and contractors mentioned the mini-competition process and the repeated application of building elements using a building concept as examples of preparatory and execution tasks, respectively.

5.2.2. Definition potential of repetitive tasks

According to the interviewed public clients and contractors, repetition can be an opportunity to learn and improve building concepts [PIPS.1, PIPS.2, SIPS.7] and/or mini-competitions [PIPS.1, PIPS.2], provided that the repetitive tasks are executed by the same skilled person(s) [cIPS.6]. Repetition allows for learning and re-use of experience [CIPS.4, SIPS.7]. *"Because you know how the system works"*, you can save time [PIPS.3, CIPS.5, cIPS.6] and *"work more efficiently"* [PIPS.2]. *"Offering more quality for less money"* is made possible as a result, according to cIPS.6. Predictability in repetitive tasks also offers the opportunity to better schedule and organise procurement from suppliers [PIPS.1, CIPS.4] and to reduce failure costs [PIPS.2].

Repetitive tasks can also take advantage of standardisation and industrialisation [PIPS.2, CIPS.4, SIPS.7], thereby reducing costs [PIPS.3]. *"In less time and with less labour, realise buildings [...], because we do not have to reinvent the wheel each time"* [CIPS.4]. The cost reduction can then be used to improve quality [PIPS.3, CIPS.4].

In addition, it is noted that fewer craftsmen are needed for repetitive tasks [CIPS.4]. Finally, the use of the same building elements in each school building, allows the creation of donor buildings or the interchangeability of elements between school buildings [CIPS.4, CIPS.5].

5.2.3. Required to exploit potential

The design elements which, according to the public clients and contractors interviewed, are necessary to exploit the potential of repetitive tasks are listed in Appendix C.2.2. A variety of answers were given. The most important elements are explained below.

First of all, the formulation of the demand specification should take into account the fact that a contractor may apply his building concept (several times) [PIPS.1, PIPS.3] as well as use repetitive tasks [PIPS.2]. The same principle applies to suppliers [cIPS6]. As stated by CIPS.5: using the same set of requirements each time, in line with the building concept, *"prevents each school from becoming its own project again"*.

> *"As a client, [you must be] very aware that the way you ask questions can be restrictive in how a contractor can better design the repetitive tasks." [PIPS.2]*

Interviewed public clients complement this with the use of evaluation and knowledge exchange between public client and contractor, so that both can exploit the potential of repetitive tasks and create learning opportunities [PIPS.1, SIPS.7]. cIPS.6 suggests that knowledge exchange between public client and contractor is important in identifying where the potential of repetitive tasks lies and how both parties can enable it to be exploited.

Finally, involving the contractor early on, in both design and execution, provides more opportunities for the use of repetitive tasks [CIPS.4].

5.2.4. Promoting design elements

The specific elements of this assignment which, according to the public clients and contractors interviewed, promote the exploitation of the potential of repetitive tasks are listed in Appendix C.2.3. The responses from the contractors interviewed are limited compared to those from the public clients interviewed. The main elements mentioned, are explained below.

Bundling similar school buildings in the framework agreement [PIPS.1, PIPS.2, PIPS.3] results in repetition and scale [PIPS.2], and allows contractors to invest and innovate because of the payback opportunity (revenue guarantee [SIPS.7]) [PIPS.1]. CIPS.4 notes that the realisation of several school buildings with the same building concept, enables learning and quality improvement of school buildings. Additionally, participating in different mini-competitions is seen as a learning opportunity [cIPS.6].

Furthermore, the use of a generic programme of requirements with functional specifications applicable to each school building to be realised and developed jointly with the contractors, allows the different building concepts to be applied, ideally several times during the commercial phase [PIPS.2, CIPS.5] and provides predictability [CIPS.4].

Likewise, early involvement of the contractor, already in the design phase, offers several advantages.

Not only does the contractor get the opportunity to apply his building concept to different school buildings [PIPS.2, CIPS.4, CIPS.5], but he can also use industrialisation instead of customisation [PIPS.3]. It is important for the public client to formulate their demand differently, as indicated by PIPS.3.

The above elements are complemented by the interviewed public clients with the evaluation that takes place after each mini-competition [PIPS.1, PIPS.2, PIPS.3]. This provides an opportunity for both public client and contractors to learn from each other and improve both the mini-competitions and the building concepts. The mini-competition, which only assesses quality [PIPS.1, PIPS.3], is seen as a means for contractors to continuously improve their building concepts [PIPS.2, PIPS.3] and innovate [PIPS.1].

Finally, long-term collaboration with the same parties can improve mini-competitions and building concepts with each iteration, as suggested by PIPS.2 and SIPS.7.

5.2.5. Hindering design elements

Specific elements in this assignment which, according to the public clients and contractors interviewed, may hinder the exploitation of the potential of repetitive tasks are listed in Appendix C.2.4. The main elements mentioned, are discussed below.

Firstly, the number of school buildings included in the framework agreement is considered to be too small to scale up, industrialise [CIPS.5] and improve for contractors [PIPS.2, PIPS.3].

Secondly, mini-competitions create mutual competition between contractors, hindering knowledge exchange between consortia [PIPS.1, PIPS.2] and impeding learning [CIPS.5, cIPS.6]. In addition, mini-competitions lead to uncertainty (in terms of turnover), making it difficult to reach favourable agreements with the contractor's supply chain [PIPS.1, cIPS.6] and to invest in industrialisation [PIPS.7].

Thirdly, each school building has a different client [PIPS.1], resulting in less predictability [PIPS.2, PIPS.3, CIPS.4, cIPS.6]. According to PIPS.3, school boards can be "*fickle*" and may deviate from their previously stated programme of requirements when making their choice. After the initial mini-competition, it was decided to replace the school board's specific programme of requirements for the upcoming mini-competitions with a specific programme of wishes [PIPS.2]. PIPS.1, PIPS.2 and CIPS.5 pointed out that this would make it easier to use the same building concept several times.

"The more things you fix at the front end, the less effective these elaborate building concepts become." [PIPS.1]

5.2.6. Summary of the results - IPS Schoolgebouwen

Table 5.2 shows the main findings from the IPS Schoolgebouwen interviews described above.

Table 5.2**:** Summary main findings IPS Schoolgebouwen interviews

Aspects	Statements	Interviewees
Definition repetitive tasks	Recurring tasks	PIPS.1, PIPS.2, PIPS.3, SIPS.7, CIPS.4, CIPS.5, cIPS.6
	Wording definition based on repetition in execution tasks	CIPS.4, CIPS.5
	Examples related to preparatory tasks and execution tasks	PIPS.1, PIPS.2, PIPS.3, SIPS.7, CIPS.4, CIPS.5, cIPS.6
	Repetitive tasks only if several the same or similar school buildings are realised	PIPS.1, PIPS.2, SIPS.7, CIPS.4, CIPS.5
	Repetitive tasks during the realisation of one school building	PIPS.3, cIPS.6
Definition potential of repetitive tasks	Learning and improving; building on past experiences	PIPS.1, PIPS.2, SIPS.7, CIPS.4, cIPS.6
	Predictability -> more efficient procurement and reduction of failure costs	PIPS.1, PIPS.2, CIPS.4
	Standardisation and industrialisation	PIPS.2, PIPS.3, CIPS.4, SIPS.7
	Fewer craftsmen needed	CIPS.4
	Creation of donor buildings	CIPS.4, CIPS.5
Required to exploit the potential	Adjust the wording of the demand specification	PIPS.1, PIPS.2, PIPS.3, CIPS.5, cIPS.6
	Knowledge exchange between public client and contractor to inventory (the potential of) repetitive tasks	PIPS.1, SIPS.7, cIPS.6
	Evaluation enabling learning	PIPS.1, SIPS.7
	Early involvement of contractor	CIPS.4
Promoting design elements	Bundling of several similar school buildings	PIPS.1, PIPS.2, PIPS.3, SIPS.7, CIPS.4
	Application of generic programme of requirements with functional specifications	PIPS.2, CIPS.5
	Early involvement of contractor	PIPS.2, PIPS.3, CIPS.4, CIPS.5
	Mini-competition with assessment on quality	PIPS.1, PIPS.2, PIPS.3
	Evaluation after each mini-competition	PIPS.1, PIPS.2, PIPS.3
	Long-term collaboration with the same parties	PIPS.2, SIPS.7
Hindering design elements	Number of school buildings bundled is too low	PIPS.2, PIPS.3, CIPS.5
	Application of mini-competitions result in mutual competition	PIPS.1, PIPS.2, CIPS.5, cIPS.6
	Application of mini-competitions result in uncertainty	PIPS.1, SIPS.7, cIPS.6
	Changing client (school board) per school building	PIPS.1, PIPS.2, PIPS.3, CIPS.4, cIPS.6

Based on the interviews, it remains uncertain whether the intended benefits of mini-competitions (contractors continuously improve their building concepts), outweigh the perceived disadvantages (reduced knowledge exchange and continuity for contractors). The interviewed public clients noted that because of the stated goal of ”transition to a supply-driven market”, the mini-competition is poured into an independent European tender, which can then be used by any municipality or school board in the Netherlands. This independent tender is in line with the building concepts developed by the consortia involved in IPS Schoolgebouwen and gives them an advantage in the event of a tender by another municipality or school board. This gives the contractors the opportunity to create repetition in their portfolio and increase scale.

The message attempted to be conveyed to the reader in Chapter 2, that the limitation to projects is a barrier to exploiting the potential of repetitive tasks, is echoed in the quote from PIPS.2.

”You could really move more towards the industry where you start to think about inventory management, procurement and in a different way than individually per project. The scale of repetitive tasks is such that you can start to think separately from individual projects.” [PIPS.2]

5.3. Results Public client - Contractor - WOUW

5.3.1. Definition repetitive tasks

According to interviews with public clients and contractors, repetitive tasks involve ”recurring” tasks, both preparatory and execution (see Appendix C.3.1). Some examples given by the public clients and contractors interviewed were the preparation of an annual plan (preparatory tasks) and the maintenance of channels (execution tasks). Repetition in execution tasks is divided into two categories:

1. Repetition occurs when a task is executed in an identical or similar way in a subsequent period (e.g. year) (cyclical maintenance [PWOUW.2, CWOUW.5, cWOUW.6]).
2. Repetition occurs when the same or similar task is executed at different locations.

PWOUW.2 and cWOUW.6 only describe the first possibility of repetition in execution tasks. In addition, when defining repetitive tasks by PWOUW.1, PWOUW.2 and cWOUW.5, repetition is considered to be the repetition found in execution tasks.

5.3.2. Definition potential of repetitive tasks

Firstly, it is noted that repetition provides an opportunity to build up knowledge that increases the predictability of the repeated task: you know better what, when and where to do something. This is supported by PWOUW.1 and cWOUW.5, who suggest that increased efficiency can lead to handling a greater scope of work. Furthermore, predictability enables the public client and contractor to efficiently organise and schedule repetitive tasks [PWOUW.3] and to better inform stakeholders about the tasks [PWOUW.2].

Additionally, repetition can facilitate innovation by allowing for the application of new ideas repeatedly, thus providing payback opportunity [PWOUW.2, PWOUW.3, CWOUW.4, cWOUW.6].

Comment
PWOUW.2, CWOUW.4 and CWOUW.5 point out that repetition of tasks can lead to less critical thinking and boredom in people. CWOUW.4 adds that repetitive tasks also often involve the use of assumptions.

"I have found repetitive tasks to be a bigger risk than a project, because if you do something 100 times and you keep doing it, you do not talk to each other about it. You start to assume that you are thinking what the other person is thinking. And things go on autopilot, so it becomes routine, and I think that is a very big risk." [CWOUW.4]

5.3.3. Required to exploit potential

The design elements which, according to the public clients and contractors interviewed, are necessary to exploit the potential of repetitive tasks are listed in Appendix C.3.2. The most important elements are explained below.

All three contractors interviewed, and PWOUW.2, pointed to the need for knowledge retention to exploit the potential of repetitive tasks.

"It is indeed the case that the first few years are the most difficult in terms of getting the scope, what exactly am I supposed to do? Additionally, identifying the landowner and the type of grassland can also pose difficulties. [...] Of course, you find that out mainly in the first few years and then you can record it. Once this information is obtained, subsequent years should be more straightforward." [CWOUW.5]

CWOUW.4 complements this by having the same person executing the same task, so that a trend can be identified.

The interviewed public clients also indicated that a sufficiently large volume of tasks should be available, so that several repetitions are possible and it is possible and interesting to work more efficiently and to apply innovations [PWOUW.1, PWOUW.2, PWOUW.3]. They also emphasized the importance of regular reflection and the documentation of lessons learned [PWOUW.1, PWOUW.2].

Finally, the exchange of knowledge between the public client and contractor is mentioned as a crucial element. This allows for a joint examination of how to exploit the potential of repetitive tasks and, if necessary, how processes can be organised differently to make this possible [PWOUW.1, PWOUW.2, CWOUW.4]. According to PWOUW.3, bringing in a contractor at a tactical level and involving them in decisions that were previously made solely by the public client can facilitate this process.

"No single party possesses the knowledge required to fully comprehend and operate effectively within such a system, let alone learn from it." [PWOUW.1]

5.3.4. Promoting design elements

The specific elements of this assignment which, according to the public clients and contractors interviewed, promote the exploitation of the potential of repetitive tasks are listed in Appendix C.3.3. The main elements mentioned, are explained below.

The interviewed public clients and contractors unanimously agree on the added value of having one IPM team per plot. This allows for the exchange of knowledge and collaborative exploration of how to exploit the potential of repetitive tasks and what it takes to do so. In addition, cross-plot knowledge exchange is facilitated by the consultation structures - knowledge-sharing sessions, working with all plot teams in one location once a fortnight with associated coffee mornings, project managers' meetings

once a week, discipline meetings - and is seen as valuable for learning and improving from each other. It is also preferred that the knowledge-sharing sessions reflect on mistakes made [CWOUW.4].

"Because when we just started, [plot X] had done something in a GIS layer. And apparently we got that wrong too and then [X] a project manager told us to stop time, because if you go ahead with these layers with this information. So they had mown all kinds of things that were not theirs. [...] But if you do not share that, then we have done it all wrong." [CWOUW.4]

PWOUW.3, CWOUW.4 and CWOUW.6 indicate that knowledge exchange between the different plot teams is facilitated by the absence of competition between them. These cross-plot consultations also provide the opportunity for joint implementation of standards [PWOUW.3].

Furthermore, it is suggested that limiting the number of parties responsible for long-term maintenance in specific areas can lead to repetition, experience accumulation and the use of this experience for improvement [PWOUW.1, PWOUW.2, PWOUW.3, cWOUW.6]. Additionally, PWOUW.3 highlights that bundling uniform floodplain maintenance tasks into a single assignment increases the degree of repetition.

"The moment I put a different party in there every time, I always lose a piece of knowledge." [PWOUW.2]

Finally, the establishment and utilisation of an asset management system is considered beneficial for capturing repetitive tasks in maintenance and securing the knowledge gained [PWOUW.2, cWOUW.6].

5.3.5. Hindering design elements

Specific elements in this assignment which, according to the public clients and contractors interviewed, may hinder the exploitation of the potential of repetitive tasks are listed in Appendix C.3.4. The main elements mentioned, are discussed below.

The interviewed contractors mainly identified role ambiguity of the public client and customer as a hindrance [PWOUW.2, CWOUW.4, CWOUW.5, cWOUW.6]. This leads to different expectations from the contractor regarding maintenance and ambiguity about the tasks to be executed.

PWOUW.1 and PWOUW.3 both suggest that the extension option of the contract should not impede contractors from making investments. Open discussions with contractors are being held to remove any possible obstacles.

Additionally, it has been noted that the contract lacks a financial incentive that would make it interesting to work more efficiently [PWOUW.1, PWOUW.3]. CWOUW.5 notes that if the contractor does not price out the risks, *"the incentive with the contractor, with people outside doing the work, the incentive to work hard and make money, to really get the maximum out of it, is less"*. PWOUW.1 and CWOUW.5 suggest that intrinsic value plays a role in executing tasks smarter, in addition to financial incentives.

Finally, PWOUW.1 mentions the autonomy of plot teams as a risk for mutual learning between the plot teams.

5.3.6. Summary of the results - WOUW

Table 5.3 shows the main findings from the WOUW interviews described above.

Table 5.3**:** Summary main findings WOUW interviews

Aspects	Statements	Interviewees
Definition repetitive tasks	Recurring tasks	PWOUW.1, PWOUW.2, PWOUW.3, CWOUW.4, CWOUW.5, cWOUW.6
	Wording definition based on repetition in execution tasks	PWOUW.1, PWOUW.2, CWOUW.5
	Examples related to preparatory tasks and execution tasks	PWOUW.1, PWOUW.2, PWOUW.3, CWOUW.4, CWOUW.5, cWOUW.6
	Repetition in execution tasks due to the maintenance cycle	PWOUW.1, PWOUW.2, PWOUW.3, CWOUW.4, CWOUW.5, cWOUW.6
	Repetition in execution tasks due to executing a task in different locations	PWOUW.1, PWOUW.3, CWOUW.4, CWOUW.5
Definition potential of repetitive tasks	Build knowledge (provides predictability) and then use it every time	PWOUW.1, PWOUW.2, PWOUW.3, CWOUW.4, CWOUW.5, cWOUW.6
	Innovation because of payback opportunity	PWOUW.2, PWOUW.3, CWOUW.4, cWOUW.6
	Predictability -> enabling better organisation and planning of repetitive tasks and informing stakeholders	PWOUW.2, PWOUW.3
	Comment: less critical thinking and boredom	PWOUW.2, CWOUW.4, CWOUW.5
Required to exploit the potential	Knowledge retention	PWOUW.2, CWOUW.4, CWOUW.5, cWOUW.6
	Sufficient volume of tasks	PWOUW.1, PWOUW.2, PWOUW.3
	Reflecting and securing learning points	PWOUW.1, PWOUW.2
	Knowledge exchange between public client and contractor to inventory (the potential of) repetitive tasks	PWOUW.1, PWOUW.2, CWOUW.4
Fostering design elements	One IPM team per plot promotes knowledge sharing and identifying together how to exploit the potential of repetitive tasks	PWOUW.1, PWOUW.2, PWOUW.3, CWOUW.4, CWOUW.5, cWOUW.6
	Involvement of contractor at tactical level	PWOUW.3
	Cross-plot knowledge sharing through consultation structures including discussion of mistakes	PWOUW.1, PWOUW.2, PWOUW.3, CWOUW.5, cWOUW.6 CWOUW.4
	Long-term responsibility of the same parties only for floodplain maintenance in the allocated plot	PWOUW.1, PWOUW.2, PWOUW.3, cWOUW.6
	Establishment and utilisation of an asset management system	PWOUW.2, cWOUW.6
Hindering design elements	Role ambiguity public client and customer	PWOUW.2, CWOUW.4, CWOUW.5, cWOUW.6
	Extension option of the contract	PWOUW.1, PWOUW.3, CWOUW.5
	Lack of financial incentive	PWOUW.1, PWOUW.3
	Autonomy of plot teams	PWOUW.1

5.4. Conclusion

The insights gained regarding repetitive tasks and the design elements that promote or hinder the exploitation of the potential of repetitive tasks, according to the public clients and contractors interviewed, are discussed below for each case.

WL

As illustrated by the examples given by the interviewed public clients and contractors, repetitive tasks occur in both preparatory tasks (e.g. scheduling tasks) and execution tasks (e.g. executing (void) repairs). In the case of repetition in execution tasks, a distinction is made between repetition related to the maintenance cycle of an asset and repetition related to the same or similar task to be executed in different buildings or complexes. It is also indicated that there is a large number and uniformity of properties within real estate, resulting in a high level of repetition and predictability of repetitive tasks.

According to the public clients and contractors interviewed, the combination of unplanned and planned maintenance, as well as the application of the repair maintenance surrender value, offers scope for improvement. In addition, according to the contractors interviewed, allowing contractors to think about maintenance at a tactical level makes it possible to identify repetitive tasks and subsequently focus on exploiting the associated potential. It is also mentioned that the long-term contract with the same public client provides continuity and the opportunity for the contractor to get to know better what is expected of him, to respond to it and also to benefit from the improvements made (payback opportunity). In terms of hindering the exploitation of the potential of repetitive tasks, the contractors interviewed indicate that the lack of clarity in the demarcation of who is responsible for what tasks, real estate strategy and (real estate) data makes it difficult to identify in advance the exact maintenance tasks to be executed.

IPS Schoolgebouwen

Repetitive tasks within IPS Schoolgebouwen are mainly related to mini-competitions (preparatory tasks) and recurring building elements between school buildings (execution tasks). Repetitive tasks during the realisation of one school building are only mentioned by PIPS.3 and cIPS.6.

The public clients and contractors interviewed indicated that it is helpful to adapt the demand specification to allow a contractor to apply its building concept repeatedly. This, combined with the use of a generic programme of requirements tailored to the building concepts and applied during each mini-competition, provides an opportunity to exploit the potential of repetitive tasks, according to the public clients and contractors interviewed. Bundling similar school buildings and involving the contractor at an early stage also offers opportunities. The effectiveness of mini-competitions is a matter of disagreement. On the one hand, the public clients interviewed see mini-competitions as necessary for contractors to continuously improve, but on the other hand, they note that they prevent sufficient scale and learning between contractors. The contractors interviewed indicated that mini-competitions in particular hinder continuity and learning opportunities. Finally, the change of client (school board) for each school building is seen as an obstacle to exploiting the potential of repetitive tasks, because of the unpredictability involved.

WOUW

As illustrated by the examples given by the interviewed public clients and contractors, repetitive tasks occur in both preparatory tasks (e.g. preparation of an annual plan) and execution tasks (e.g. maintenance of channels). In the case of repetition in execution tasks, a distinction is made between repetition due to maintenance cycles and repetition due to the large plot in which the same or similar tasks are executed in different locations.

The interviewed public clients and cWOUW.6 indicated that assigning a fixed party to maintain floodplains in a specific area for several years allows for repetition, gaining experience and building on it. This is expected to lead to improvements, more efficient and effective work, and innovation due to the payback opportunity. In addition, in order to exploit the potential of repetition, the public clients and contractors interviewed see added value in using one IPM team per plot. This enables knowledge exchange and a joint exploration of how to exploit the potential of repetitive tasks and what is needed to do so. As PWOUW.3 pointed out, this is feasible because the contractors are involved in floodplain maintenance at a tactical level. Similarly, sharing knowledge across plots through consultation structures is considered valuable for mutual learning and improvement due to the similarities in the tasks to be executed across the three plots. However, the freedom given to all plot teams may hinder uniformity between them, thereby exploiting the potential of repetitive tasks. Lastly, there is a lack of financial incentive to work more efficiently and the ambiguity of roles between public client and customer makes early identification of tasks to be executed difficult.

The following chapter builds on the insights gained from the different assignment designs of the three cases and specifically looks at the similarities and differences in order to learn from the different cases.

6

Cross case analysis

This chapter combines the information obtained from the document review (Chapter 4) and the semi-structured interviews (Chapter 5) of the three cases studies in order to identify the similarities and differences in the design and elaboration of the different assignments involving collaboration. The focus is on the design elements in the different assignments that affect the exploitation of the potential of repetitive tasks. First, the definitions of repetitive tasks and their potential obtained in the interviews are compared (section 6.1). Then, the (intended) design of the assignment and its elaboration in each case are compared (section 6.2). It is examined what determines whether or not the potential of repetitive tasks can be exploited, from both the public client's and the contractor's point of view. Where insightful, findings are illustrated with verbatim quotes from the interview transcripts. Finally, the results are reflected upon and the third sub-question is answered: *What lessons can be learned from the different assignment designs analysed in practice?* (section 6.3).

6.1. Comparison definition (potential of) repetitive tasks

6.1.1. Definition repetitive tasks

Interviewees in all three case studies refer to repetitive tasks as recurring tasks, both in preparation and in execution. It is notable that, in both WL and WOUW, a distinction is made between repetition related to the maintenance cycle of an asset or plot and repetition related to the execution of the same or similar tasks at different locations. For IPS Schoolgebouwen, the majority of interviewees indicated that repetition occurs when at least two school buildings have been realised. Finally, the interviews at WL show that repetition in real estate maintenance is something of a common theme, with the main reason given being the large number of similar housing complexes.

6.1.2. Definition potential of repetitive tasks

Interviewees from all three cases indicate that repeating a task provides an opportunity to learn and build on acquired knowledge and experience. With each repetition they know better what to do and the predictability of the task increases. This knowledge and experience can then be used to identify where improvement is possible, and repetition provides the opportunity to apply that improvement each time. According to the interviewees, improvements can lead to time and cost savings, among other things (see Table 6.1).

Table 6.1**:** Possible results of improving repetitive tasks

	Mentioned in		
Possible result of improving repetitive tasks	**WL**	**IPS Schoolgebouwen**	**WOUW**
Time reduction	-	PIPS.3, CIPS.4, CIPS.5, cIPS.6, SIPS.7	PWOUW.2
Cost reduction	CWL.4	SIPS.7	cWOUW.6
Quality increase	cWL.5	PIPS.1, PIPS.2, cIPS.6, SIPS.7	-
Working more efficiently	cWL.6	PIPS.2	PWOUW.1, CWOUW.5, cWOUW.6
Better (price) estimations	PWL.2	-	PWOUW.2
Beter procurement of materials	CWL.4, cWL.6	PIPS.1, PIPS.2, CIPS.4	-
Better informing residents, stakeholders	CWL.4, cWL.5, cWL.6	-	PWOUW.2
Failure cost reduction	-	PIPS.2	-

It is noted that in order to learn and build on previous experience, it is important that the repetitive task

is executed by the same person(s) [cIPS.6, CWOUW.4] and that long-term collaboration is helpful in this respect [PIPS.2, SIPS.7, PWOUW.1, PWOUW.2, PWOUW.3, cWOUW.6]. In addition, standardisation [PWL.2, cWOUW.6] and industrialisation [PIPS.2, PIPS.3, CIPS.4, SIPS.7] are mentioned as possible ways of improvement leading to cost reduction, time reduction and/or quality increase. Finally, innovation is mentioned, because repetition provides opportunities for repeated application and thus payback [PWOUW.2, PWOUW.3, CWOUW.4, cWOUW.6].

Factors that make it difficult to exploit the potential (comment)
Less critical thinking (making assumptions), boredom [PWOUW.2, CWOUW.4, CWOUW.5], limited choice when using standardisation [PWL.2] and repetition of errors [PWL.1, PWL.2] are mentioned as comments.

6.2. Comparison (intended) design assignments in view of potential of repetitive tasks

6.2.1. Bundling and distribution of (repetitive) tasks

In all three cases, uniformity of tasks was taken into account when bundling tasks. For WL, this involved the maintenance and renovation of uniform properties, for IPS Schoolgebouwen the construction of new IKC (Integral child centre) school buildings and for WOUW the maintenance of floodplains. However, different tactics were used to divide the tasks between different contractors in the three cases. In both WL and WOUW, the tasks were divided between contractors by geographical area after the contract was awarded, and the contractors are responsible for maintenance and/or improvements in the awarded area for a number of years. This allows contractors to be responsible for multiple maintenance cycles for the same assets and/or plots. For IPS Schoolgebouwen, the distribution of school buildings between contractors after award is not known. This distribution is done through mini-competitions during the commercial phase. The long-term contract covering several school buildings means that contractors have the opportunity to design and build several school buildings.

In each case, circumstances influence the choice of bundling and distribution of tasks. For WL, the volume of tasks was considered and distribution was based on the capacity of the regional parties; application of the so-called 30% rule [PWL.1][1]. For IPS Schoolgebouwen, the number of school buildings depends on residential development and the interest of school boards to have their school buildings included in the IPS Schoolgebouwen framework agreement. It is stated in advance that the contract will include a minimum of nine and up to thirty school buildings, and the exact number will become clearer during the commercial phase. It is also noted that the use of mini-competitions for the distribution of school buildings is necessary to allow school boards to choose between building concepts [PIPS.1]. In WOUW, the initial contract duration is ”only” four years due to the available budget [PWOUW.2]. To avoid this being a potential barrier for contractors to invest in improvements, it was decided to make this negotiable with the contractors [PWOUW.1, PWOUW.3].

Influence on exploiting the potential of repetitive tasks - interviews
Public client perspective: The public clients interviewed for WL, IPS Schoolgebouwen and WOUW noted that the bundling of uniform tasks and the offering of a large volume of tasks to contractors provides opportunities for repetition and the exploitation of associated potential. For WL and WOUW, the choice was also made to award each area to the same contractor for several years. According to the WOUW public clients interviewed, this has the advantage that the public client and the contractors have the opportunity to get to know the area and get better and better at executing the tasks. In addition, contractors can estimate the number of repetitions in advance, which makes innovation and investment interesting (payback opportunity) [PWOUW.2, PWOUW.3].

Similarly, IPS Schoolgebouwen includes similar school buildings and public clients interviewed recognised the limited and uncertain volume of tasks within IPS Schoolgebouwen through the use of mini-competitions [PIPS.1, PIPS.2, PIPS.3, SIPS.7]. In contrast, the volume of bundled school buildings and the resulting scale is seen as something that provides contractors with sufficient opportunities for investment, improvement and innovation (payback opportunity) [PIPS.1, SIPS.7]. Long-term collaboration with the same contractors is seen as helping to improve mini-competitions and building concepts

[1] *”A party may not depend on [WL] for more than 30 per cent of its turnover.”* [PWL.1]

[PIPS.2, SIPS.7].

Contractor perspective: Exploiting the potential of repetitive tasks requires sufficient repetitive tasks as well as continuity in the tasks to prevent the contractor from *"stalling"* [CWL.4]. The long-term contract with the same public client, provides the opportunity for continuity, *"you know what to do"* [CWL.4].

> *"You just deal with each other for seven years and you can improve things every year. [...] It is completely different with a project. Every time it is a different client, a different collaboration, a different house, a different problem." [CWL.4]*

In addition, long-term responsibility for the maintenance of assets and/or green spaces in an area provides an opportunity to reapply and improve on experience gained [CWL.4] through involvement in multiple maintenance cycles [cWL.5, cWL.6, cWOUW.6]. Learning can occur after just one repetition, but to ensure that an improvement can be reapplied and recouped, it is advantageous to have multiple repetitions within the same assignment [cWL.6].

The interviewed IPS Schoolgebouwen contractors indicate that the number of school buildings included is too small to *"run production"* [CIPS.5]. In addition, the mini-competition hinders the ability to scale up [CIPS.5] and efficient procurement due to the uncertain sales guarantee [cIPS.6].

6.2.2. Partially unknown scope at the time of award

In all three cases, a "growing" contract was chosen; a contract that will be refined in parts during implementation in collaboration with the contractors. At the time of award, WL did not know (1) the details of the improvement programmes to be agreed with the network partners [**A3; A22**] and (2) the current condition of some of its listed properties [**A4; A25**]. In addition, there may be interim acquisitions and disposals of real estate [**A1**] and it is noted that the long duration of the contract may lead to changes in the demand specification [**A24**]. For IPS Schoolgebouwen, the exact number of school buildings to be realised after the award is still unknown and depends on the interest of the school boards. For WOUW, the condition of the floodplains, including "objects present therein", was partly unknown at the time of procurement [**C1; C3; C4; C8**]. This, combined with the dynamic nature of the site, makes scope determination difficult [**C8**]. Due to the expected changes in scope, a so-called review clause was included in the WOCU (contract) [**C3; C8**], which takes into account the expected changes per plot (e.g. addition of new areas) [**C3**].

Influence on exploiting the potential of repetitive tasks - interviews
Public client perspective: The IPS Schoolgebouwen public clients interviewed noted that mini-competitions lead to less predictability in terms of volume of tasks [PIPS.1, SIPS.7]. This limits the visibility of the return on investment.

Contractor perspective: The contractors interviewed noted that the ambiguity in WL stems from the demarcation and strategy of the real estate complexes, in IPS Schoolgebouwen from the mini-competition, and in WOUW from the ambiguity of the role of the public client versus the customer. The lack of clarity makes it difficult to map the tasks at an early stage and, consequently, to identify repetitions and respond to their potential.

> *"If you do not have a clear idea of what you want to do, you can not start making improvements." [CWL.4]*

6.2.3. Early involvement (at tactical level) of contractor - integration

In all three case studies, the contractor is responsible not only for the execution of the tasks, but also for their preparation. This is also reflected in the examples cited of repetitive tasks by both the public client and the contractor (see Appendix C). As articulated by PWL.1, PWL.2, cWL.5 and PWOUW.3, the contractor is involved at tactical level and not just at operational level as was previously the norm. The choice has been made to ask for the challenge rather than the solution, in order to take advantage of the contractor's knowledge, expertise and capacity.

In WL it is about planning, directing and executing; in other words, organising, scheduling and executing maintenance tasks, and having them continuously optimised and evaluated by the contractor. In addition, WL has chosen to combine unplanned maintenance with planned maintenance (integral maintenance). IPS Schoolgebouwen involves both the design and adaptation of a building concept to

the specific needs of a school board, and the realisation and optional maintenance of the school building by the winning contractor in the mini-competition. WOUW involves the public client and contractor working together to identify the maintenance tasks to be executed and the contractor executing them.

Influence on exploiting the potential of repetitive tasks - interviews
Public client perspective: In all cases the public clients interviewed indicated that early involvement of a contractor provides more opportunities for the contractor to exploit the potential of repetitive tasks. In WL it is also noted that integral maintenance provides more opportunities for contractors to optimise maintenance. In IPS Schoolgebouwen, involving the contractor in the design, gives the contractor the opportunity to use its building concept for several school buildings [PIPS.2, PIPS.3]. In WOUW, early involvement of the contractor makes it easier for the contractor to identify and possibly add repetitive tasks and then exploit their potential [PWOUW.3].

Contractor perspective: In WL and IPS Schoolgebouwen, contractors interviewed mentioned the benefits of early involvement. In WL, the preparation of a MYMP provides an opportunity to map repetitive tasks and create a continuous flow of tasks [cWL.5]. In addition, involving the contractor early in the programme enables the application of a repetitive approach [cWL.6], and the involvement in planning and directing over several years provides the opportunity to create intelligent combinations with unplanned maintenance and planned maintenance [CWL.4]. In IPS Schoolgebouwen it is noted that the involvement of the contractor in the design provides an opportunity to make greater use of repetition [CIPS.4] and repeated application of his building concept [CIPS.5].

6.2.4. Facilitating demand specification

In all three cases, the formulation of the demand specification attempted to leave room for contractor input. On the one hand, the contractors are more or less given a framework to work within, and on the other hand, an attempt is made to give the contractors room to determine the best approach. In WL, WL provides contractors with an annual baseline file together with quality cards. In IPS Schoolgebouwen, the municipality of Amsterdam uses a generic programme of requirements for each school building, based on the various building concepts developed, combined with a specific programme of requirements (adapted to: wishes) that the building concepts must meet. In WOUW, RWS provides contractors in advance with a generic conservation plan, a vegetation management guideline [**C3; C6**] and an environmental plan, but states that this information can be adapted over time [**C3**].

Influence on exploiting the potential of repetitive tasks - interviews
Public client perspective: During the interviews, it became clear that in IPS Schoolgebouwen, the formulation of demand specification plays an important role in ensuring that the building concepts developed can be used again and again [PIPS.1, PIPS.2, PIPS.3]. For example, consideration is given to what the school board should require or want so that contractors can (ideally) apply their building design to several school buildings and take advantage of repetition [PIPS.1, PIPS.2]. In addition, a generic programme of functional requirements has been used, applicable to each school building to be constructed and based on the building concepts developed by the contractors. This allows contractors to apply their building concept multiple times [PIPS.2]. In WOUW, only legal requirements are given to the plot teams [PWOUW.2]. It is the responsibility of the plot teams to specify the other processes, and this provides an opportunity to determine the best approach together. PWOUW.1 indicates that this has been chosen with the idea that it will increase equality in the collaboration between the client and the contractor.

Contractor perspective: Contractors interviewed mentioned that the use of a generic programme of requirements for each school building allows for repeated application of a building concept [CIPS.5] and predictability [CIPS.4]. It is also noted that in order to take advantage of repetitive tasks and, in particular, the repeated application of a building concept, it is important not to nail everything down and to leave room for contractor input [CIPS.4, CIPS.5, cIPS.6]. In WOUW, it is noted that the requirements in the WOCU (contract) were minimal, allowing for *"leveraging of each other's knowledge and strengths"* [CWOUW.4].

6.2.5. Consideration of a third party

In all three cases, the execution of the tasks is complicated by the close involvement of a third party who is not the client of the programme or the contractor. In WL this involves the residents, in IPS

Schoolgebouwen it involves the school boards and in WOUW it involves various groups of residents in the Netherlands and RWS as the owner of the land and objects. In WL, a KPI related to customer satisfaction was chosen: a score of at least 8 for all components of the KWH (Quality of Housing Services for the Rental Sector) measurement and WL's target of a 9+ [**A11**]. In IPS Schoolgebouwen, the school boards propose school buildings that they would like to see realised using one of the building concepts of the participating consortia involved in IPS Schoolgebouwen. In WOUW, the customer is represented by TU. TU is responsible for determining the annual plan prepared by each plot team [**C3**].

Influence on exploiting the potential of repetitive tasks - interviews
Public client perspective: According to the IPS Schoolgebouwen public clients interviewed, a different school board for each school building to be realised, results in a specific programme of requirements (adapted to: wishes see Appendix C.2.4) that is different each time. This reduces the predictability of the degree of repetition [PIPS.1, PIPS.2, PIPS.3]. In WOUW, the customer plays an important role in the maintenance selection process. Each plot team considers what maximises customer value and defines it in an annual plan [PWOUW.3]. In IPS Schoolgebouwen and WOUW there is still a lack of clarity about the exact interpretation of the third party role within the programme. This also leads to a lack of clarity for contractors as to what tasks should be executed and how [PWOUW.2].

Contractor perspective: IPS Schoolgebouwen contractors interviewed indicated that changing school boards results in less predictability [cIPS.6] and less opportunity to learn from repetition as a school board [CIPS.4]. The WOUW contractors interviewed noted that the ambiguity of the roles of public client and customer sometimes makes it unclear what tasks need to be executed (see also subsection 6.2.2).

6.2.6. Knowledge exchange

In all three cases, the (intended) design of the collaboration treated knowledge exchange differently. In WL, network collaboration is central, and the tender documents indicate that knowledge exchange between public client and contractor, as well as between the contractors themselves, is important (see section 4.1.3). In IPS Schoolgebouwen there was intensive collaboration and knowledge exchange between the school boards, the municipality of Amsterdam and the three contractors during the R&D phase (see section 4.2.3). In WOUW, it was decided to use one IPM team per plot in order to facilitate collaboration, including knowledge exchange between public client and contractor. In addition, the tender documents indicate that knowledge exchange between plot teams was desirable (see section 4.3.3). The interviews clarified the exact interpretation of knowledge exchange per case and the (expected) effect of knowledge exchange on exploiting the potential of repetitive tasks.

Influence on exploiting the potential of repetitive tasks - interviews

Knowledge exchange Public client - Contractor

Public client perspective: Several public clients interviewed involved in WL, IPS Schoolgebouwen, WOUW indicated that knowledge exchange and joint identification of opportunities to exploit the potential of repetitive tasks, is useful. In this way, the approach to repetitive tasks can be linked to the public client's demand specification and tailored to the capabilities of both the public client and the contractor. Within WOUW, the use of a single IPM team is noted as a means of promoting knowledge exchange and learning [PWOUW.1, PWOUW.3]. It is also mentioned that knowledge sharing should include discussion of mistakes made in order to promote the learning process [PWOUW.2].

Contractor perspective: According to interviewed contractors from WL, exchanging knowledge between the public client and contractor is necessary in order to make the right decisions about maintenance tasks, for example upgrading to an A or A++ energy label [CWL.4]. Additionally, knowledge exchange provides an opportunity to identify necessary adjustments in processes to exploit the potential of repetitive tasks, such as the application of uniformity [cWL.5]. Interviewed contractors from IPS Schoolgebouwen suggest that knowledge exchange between the public client and contractor is useful to determine necessary changes on both the public client's and contractor's side to exploit the potential of repetitive tasks [cIPS.6]. In WOUW, a single IPM team is used to exchange knowledge and discuss what is possible and necessary to exploit the potential [CWOUW.4, cWOUW.6].

Knowledge exchange Contractor - Contractor

Public client perspective: The IPS Schoolgebouwen public clients interviewed noted that the mini-competition hinders knowledge exchange and learning between the three contractors [PIPS.1, PIPS.2].

In contrast, in WOUW, cross-plot consultations are viewed as a means of promoting knowledge exchange and learning between plot teams [PWOUW.1, PWOUW.2, PPWOUW.3]. In WOUW, a deliberate decision was made to eliminate competition between contractors to facilitate knowledge exchange between plot teams [PWOUW.3]. It should be noted that when plot teams operate autonomously, it can lead to a decrease in uniformity between them and hinder their ability to learn from each other (between plot teams) [PWOUW.1].

Contractor perspective: Contractors interviewed from WL noted that knowledge exchange (at the tactical level [cWL.5]) provides opportunities to learn from each other and work more efficiently [CWL.4, cWL.5, cWL.6]. Meanwhile, contractors from IPS Schoolgebouwen noted that mini-competitions hinder knowledge exchange and learning from other consortia [CIPS.5, cIPS.6]. In WOUW, cross-plot consultations are considered a way to share knowledge and learn across plot teams. Sharing mistakes is considered useful [CWOUW.4]. Dividing tasks between contractors after contract award is seen as facilitating knowledge exchange between plot teams [CWOUW.4].

6.2.7. Knowledge retention

Influence on exploiting the potential of repetitive tasks - interviews
Interestingly, WOUW interviewees in particular commented on the importance of knowledge retention in exploiting the potential of repetitive tasks.

Public client perspective: PWL.1 notes that knowledge retention of real estate data, for instance the number of failures, is important to make repetitive tasks predictable and manageable. In WOUW, it is indicated that knowledge retention is important to make use of the learning capability [PWOUW.2, PWOUW.3]. For instance, all three plot teams are currently setting up an asset management system. This approach enables transparent documentation of repetitive tasks [PWOUW.2]. Although the decision was made to start with a blank sheet, it is expected that it would have been useful to have an outline in advance for securing the lessons learnt in processes and protocols [PWOUW.3].

Contractor perspective: In the interviews of WL, only cWL.6 mentioned the necessity of knowledge retention for exploiting the potential of repetitive tasks. cWL.6 indicates that the interval between executing repetitive tasks should preferably not be too long (continuity) so that knowledge is not lost. In addition, the application of routine to repetitive tasks promotes the retention of knowledge [cWL.6]. In WOUW, it is indicated that knowledge retention is important to make use of the learning capability [CWOUW.5, cWOUW.6]. For instance, all three plot teams are currently setting up an asset management system. This approach enables transparent documentation of repetitive tasks and safeguarding of all lessons learned [CWOUW.4, cWOUW.6].

6.2.8. Evaluation

Only in WOUW's tender documents is attention paid to reflection. Reflection is considered part of the learning process [**C4**] and was also included as a selection criterion during the tender process, specifically "reflection on one's own organization" [**C1**].

Influence on exploiting the potential of repetitive tasks - interviews
Public client perspective: WL's interviewed public clients noted that regular reflection is useful for promoting learning [PWL.2]. According to public clients interviewed from IPS Schoolgebouwen, evaluation after each mini-competition allows for mutual learning between the public client and contractors, leading to improvements in both the building concepts [PIPS.2] and the mini-competition process [PIPS.1]. Evaluation also provides an opportunity for continued improvement of repetitive tasks by both the contractor and the public client [PIPS.1, SIPS.7]. Public clients interviewed from WOUW indicated that regular reflection is important for learning [PWOUW.1]. In addition to an intentions manager, individuals in each plot team consciously reflect on lessons learned.

6.2.9. Incentive to (continue to) improve

In all three cases, various incentives have been added to encourage contractors to continually improve. In WL, these incentives include financial incentives such as the repair maintenance surrender value and quoted unit prices, as well as a KPI on resident satisfaction. IPS Schoolgebouwen uses mini-competitions where only quality is assessed. However, WOUW does not have a financial incentive *"to work more efficiently"* [PWOUW.3].

Influence on exploiting the potential of repetitive tasks - interviews
Public client perspective: WL's interviewed public client expects that the repair maintenance surrender value can incentivise contractors to better plan and direct maintenance tasks [PWL.1]. According to interviewed public clients of IPS Schoolgebouwen, mini-competitions serve as a means for contractors to continuously improve their building concept. It is also added that selecting on quality during mini-competitions, enables steering for improvement [PIPS.3]. In WOUW it is noted that there is no financial incentive for contractors to complete the work faster [PWOUW.1, PWOUW.3].

In addition, according to the interviewees in the three cases there is a lack of KPIs [PWL.2, PIPS.1] on the basis of which a bonus system could be based to steer towards increasingly efficient and intelligent working [PWL.1, PWOUW.3]. In WL, the addition of KPIs was not possible due to *"time pressure during the tender"* [PWL.1]. Similarly, in IPS Schoolgebouwen, establishing KPIs was not possible as the building concepts were not known in advance [PIPS.1]. In WOUW, the scope was uncertain [PWOUW.3]. However, in IPS Schoolgebouwen and WOUW, there are plans to develop the KPIs jointly with the contractors [PIPS.1, PWOUW.3].

Contractor perspective: According to interviewed WL contractors, there are several incentives that could motivate them to continue improving. Firstly, the unit prices stated during tendering make it attractive to work more efficient [CWL.4]. Additionally, the application of the repair maintenance surrender value makes smarter organisation of maintenance tasks attractive [cWL.5, cWL.6]. It is also suggested that continuous learning and improvement is interesting, because the knowledge gained in the WL case can be applied to follow-up assignments [cWL.5]. Increasing yield improvements and customer value are also mentioned as incentives for continuous improvement [cWL.6]. Finally, it is noted that KPIs can be used for continuous learning and improvement and it is preferable to fines [cWL.5].

In IPS Schoolgebouwen, continuous improvement is central for making and keeping the building concept attractive to school boards [CIPS.4]. Similarly, "work" and cost efficiency serve as incentives for ongoing improvement [cIPS.6].

In WOUW, it is noted that the lack of risk pricing by contractors may reduce the incentive to work more efficiently [CWOUW.5].

6.2.10. Smart scheduling

During the interviews, WL contractors noted that smart scheduling in the execution of tasks is necessary for learning and improvement. Smart scheduling means having the same skilled people (continuously) executing the same or similar task [CWL.4, cWL.6] or, as articulated by CWL.4, *"working in trains"*. Smart scheduling, however, was not mentioned during the interviews in the IPS Schoolgebouwen and WOUW cases.

6.2.11. New future way of collaboration

Based on the interviews from all three cases, it appears that the assignment designs involving collaboration of the three cases are innovative and future-oriented. It is expected that the knowledge gained can be reapplied later in the (design of) follow-up assignments.

"Something that has not yet been marketed in this way in the Netherlands." [PWL.1]

"On many fronts we have agreed that we are going on a journey of discovery together." [PIPS.3]

"The form of collaboration is completely new for everyone involved and that makes it a big challenge." [CWOUW.5]

The new way of collaboration aims to create added value compared to the traditional situation. For example, integral maintenance is being used for the first time in WL, with the expectation that this will enable "smart combinations" of tasks and better service. Contractors interviewed indicated that they expect integral maintenance to be requested by other clients in the future and see WL as a learning opportunity. It is also noted that continuous learning and improvement is of interest, as the knowledge gained in WL can be used in subsequent assignments [cWL.5]. IPS Schoolgebouwen wants to be a spin-off for the rest of the Netherlands. The independent tender distilled from IPS Schoolgebouwen offers contractors the opportunity to use their building concept outside of IPS Schoolgebouwen. Several

of the contractors interviewed indicated that their building concept was/is being used in other assignments before or during IPS Schoolgebouwen [CIPS.5, cIPS.6]. For WOUW, a new type of contract was used because of the uncertain scope [PWOUW.2] and to test the added value of having one IPM team per plot team. Asset maintenance is new for some contractors, but it is expected that the knowledge gained in WOUW can be used in follow-up contracts [CWOUW.5, cWOUW.6].

The interviewed contractors expect to be able to execute the same or similar tasks in future assignments. This increases repetition in the contractor's portfolio. The new way of collaboration also means that public clients are looking at how best to organise their internal organisation.

"What change in collaboration are you going to organise and what does that mean for the organisation and are we ready for that?" [PWL.2]

6.2.12. Noting repetition in public client's portfolio

The focus of the interviews is on the repetitive tasks executed by the contractors and how the public client can ensure that the potential of these tasks can be exploited. However, the repetitive tasks of the public client resulting from the (new) design of the assignment involving collaboration remain in the background for the public client. PIPS.1 is the only one to comment on this during the interview:

"You also exploit the potential by [optimising] the repetitive tasks on your own [client's] side." [PIPS.1]

"With each mini-competition we [the municipality of Amsterdam] learn again which evaluation criteria are relevant, what our form requirements should look like, what the evaluation committee should look like, [what] knowledge the client needs to bring in order to be able to make a good evaluation of the bids." [PIPS.1]

However, the issue of uniformity between the maintenance approaches of different contractors is indirectly addressed by WL and WOUW. *"WL would like to see market parties working together to achieve uniformity in maintenance (e.g. type of central heating boilers, heat pumps) in addition to basic quality"* [PWL.1]. Within WOUW, the autonomy given to the three plot teams is seen as potentially hindering uniformity between plot teams [PWOUW.1] and thus exploiting the potential of repetitive tasks.

6.3. Conclusion

Based on the document review and semi-structured interviews, it is clear that each case had its own focus in designing the assignment involving collaboration and that certain choices in the design were influenced by circumstances. For instance, IPS Schoolgebouwen used mini-competitions to provide school boards with options, while WOUW had an initial contract duration of four years due to budget constraints. Circumstances not only influence the design of the assignment, but also how and to what extent the potential of repetitive tasks can be exploited. The latter is reflected in the design elements that, according to the interviewees in the different cases, influence whether or not the potential of repetitive tasks can be exploited (see Table 6.2).

The findings from the three case studies reveal that various design elements in an assignment involving collaboration promote the exploitation of the potential of repetitive tasks. These elements include:

1. Sufficient volume of tasks and, for maintenance tasks, offering multiple maintenance cycles to a contractor to increase the likelihood of repetition (1.1).
2. Predictability scope to enable early identification of repetitive tasks. This also gives contractors the opportunity to apply smart scheduling (working in trains) (2.1).
3. Early involvement of the contractor and asking for the challenge rather than the solution, so that the contractor's knowledge, expertise and capacity can be used.
4. Facilitating demand specification to increase the chance of repetition and provide space to exploit the potential of repetitive tasks.
5. Knowledge retention, so that the knowledge and experience gained can be built upon and the ability to learn can be utilised. Continuity of people involved on both the public client and contractor side is important here (5.1).

6. Knowledge exchange, both between public client and contractor and between contractors, to identify (the potential of) repetitive tasks and to exploit the potential as well as to promote learning.
7. Evaluation of the repetitive tasks executed to promote learning.
8. Uniformity in the tasks to be executed to increase the chance of repetition and enable learning from each other, both public client and contractors.
9. Incentives to (continue to) improve execution of repetitive tasks, including financial incentives and incentives linked to KPIs.

The above elements are listed in Table 6.2, indicating in which case (WL, IPS Schoolgebouwen, WOUW) and from which perspective the design elements were mentioned (public client, contractor).

A comparison of the three cases reveals that tasks related to maintenance, as in the WL and WOUW cases, lead to a different definition of repetitive tasks and interpretation of design element 1 in Table 6.2 than in the case of new construction or renovation, as in the WL and IPS Schoolgebouwen cases. For maintenance tasks, it is important to take into account maintenance cycles when creating repetition. In the next chapter, the findings from the case studies, including the design elements, are combined with the findings from the literature review (see Chapter 2) to create a framework.

Table 6.2**:** Design elements identified in the interviews that promote exploiting the potential of repetitive tasks

	Mentioned by					
Design elements promoting exploitation of the potential of repetitive tasks	**WL**		**IPS Schoolgebouwen**		**WOUW**	
	Public client	Contractor	Public client	Contractor	Public client	Contractor
1. Sufficient volume of tasks	x		x		x	x
1.1 Multiple maintenance cycles (maintenance tasks; offer more repetitions)		x			x	x
2. Predictability scope (continuity)		x	x	x	x	x
2.1 Smart scheduling		x		x		x
3. Early involvement contractor – integration		x	x	x	x	
4. Facilitating demand specification			x	x	x	x
5. Knowledge retention		x			x	x
5.1 Continuity of parties involved			x	x	x	x
6. Knowledge exchange						
6.1 Knowledge exchange Public client - Contractor	x	x	x	x	x	x
6.2 Knowledge exchange Contractor - Contractor		x	x	x	x	x
7. Evaluation	x		x		x	
8. Uniformity maintenance approach					x	
9. Incentive to (continue to) improve	x	x	x	x	x	x

Part IV

Framework development & evaluation

-Experience is the father of wisdom and memory the mother-

7

Framework development & expert evaluation

In this chapter, the results of the empirical research are combined with the literature review to develop the ”Innovative approach to repetitive tasks” framework. First, the developed initial framework is presented (section 7.1), then the feedback and insights from the expert evaluations are explained (section 7.2). Subsequently, the modified final version of the framework is explained (section 7.3). This allows answering the fourth sub-question: *What elements of an assignment design should public clients consider in order to exploit the potential of repetitive tasks in collaboration with contractors?* (section 7.4).

7.1. Development initial framework

The aim of the framework is to provide clarity on what repetitive tasks are, what their potential is and what design elements need to be considered in order for a public client together with contractors to exploit the potential of repetitive tasks. With the purpose of the framework in mind, the findings from the literature review (Part II) were combined with those from the empirical research (Part III). Table 7.1 lists the design elements found and indicates whether they are based on the literature review and/or the empirical research (case study WL, IPS Schoolgebouwen, WOUW and perspective public client, contractor).

Table 7.1: Found design elements that promote exploiting the potential of repetitive tasks

Promoting design elements to exploit the potential of repetitive tasks	Found in									
	Literature review – Chapter 2	WL			IPS Schoolgebouwen			WOUW		
		Document review	Interviews		Document review	Interviews		Document review	Interviews	
			Public client	Contractor		Public client	Contractor		Public client	Contractor
1. Sufficient volume of tasks	x[1]	x	x		x	x		x	x	x
1.1 Multiple maintenance cycles (maintenance tasks; offer more repetitions)		x		x				x	x	x
2. Predictability scope (continuity)	x	x		x	x	x	x	x	x	x
2.1 Smart scheduling	x (construction crew)			x			x			x
3. Early involvement contractor – integration	x[2]	x		x	x	x	x	x	x	
4. Facilitating demand specification					x	x	x		x	x
5. Knowledge retention	x	x		x				x	x	x
5.1 Continuity of parties involved		x			x	x	x	x	x	x
6. Knowledge exchange	x									
6.1 Knowledge exchange Public client - Contractor		x	x	x	x	x	x	x	x	x
6.2 Knowledge exchange Contractor - Contractor		x		x	x	x	x	x	x	x
7. Evaluation	x	x	x		x	x			x	
8. Uniformity (maintenance approach)									x	
9. Incentive to (continue to) improve		x	x	x	x	x	x		x	x

[1] This design element is also supported by the research of Eriksson and Szentes (2017), which shows that ”large projects [and/or] long-term contracts”, in addition to the possibility of repetition, also provide

room for payback opportunity for innovation.
(2) This design element is also confirmed by the research of Larsson et al. (2014), which shows that the early involvement of a contractor (both in design and execution) provides more opportunities for a contractor to apply and use repetition and exploit its expertise.

All the knowledge combined resulted in the initial framework called ”Innovative approach to repetitive tasks”, which can be found in Appendix D.1. This framework starts with the definition of repetitive tasks and the associated potential, as formulated in Chapter 2. These definitions are accompanied by examples derived from the cases studied. Then, for each of the eight design elements identified (see Table 7.2), advice is given to public clients considering exploiting the potential of repetitive tasks. The first four design elements are relevant at the time of defining an assignment and the next four design elements are relevant after awarding an assignment. The specific interpretation of the advices may vary from one assignment to another, depending on circumstances such as laws and regulations, the public client’s portfolio, stakeholders, availability of data, the public client’s competence and the duration of the assignment. Contractors are advised to consider the following design elements: smart scheduling, continuity of parties involved, evaluation and uniformity.

Table 7.2**:** Design elements from the framework provided in Appendix D.1

At the time of defining an assignment	After awarding an assignment
1. Sufficient volume (sale guarantee)	1. Knowledge retention 1.1 Continuity of parties involved
2. Predictability scope 2.1 Smart scheduling	2. Knowledge exchange 2.1 Public client – Contractor 2.2 Contractor – Contractor
3. Early involvement contractor	3. Evaluation
4. Facilitating demand specification	4. Uniformity

7.2. Framework evaluation

7.2.1. Set-up expert evaluations

In order to evaluate the initial framework ”Innovative approach to repetitive tasks”, several expert evaluations were used, including a focus group, based on the availability of the experts. The following criteria were used to select the experts:

1. Variation in the construction sectors in which people work (residential, utility and infrastructure construction);
2. Variation in employer (public client, contractor, consultancy, university);
3. Preferably familiar with a programmatic approach.

From this, six people agreed to participate in the expert evaluations, see Table 7.3 for an overview. The expert evaluations used a semi-structured interview, the interview protocol of which is included in Appendix D.2. Each expert evaluation lasted between 1 and 1.25 hours and was used to refine the initial framework.

Table 7.3**:** Expert evaluation profile

Expert code	Sector	Organisation	Experience in current position	Total work experience	Expert session	Date of evaluation
E1	Infrastructure construction	Public client	± 7 years	± 28 years	1	02-02-2024
E2	Infrastructure construction	Large contractor	± 5 years	± 28 years	2	05-02-2024
E3	Infrastructure construction	Large contractor	± 8 years	± 13 years	3	07-02-2024
E4	Residential and utility construction	Consultancy	± 6 years	± 17 years	3	07-02-2024
E5	Residential, utility and infrastructure construction	University	± 6 years	± 33 years	3	07-02-2024
E6	Residential construction	SME contractor	± 23 years	± 23 years	4	08-02-2024

7.2.2. Results expert evaluations

In the following, the feedback received during the expert evaluations on different parts of the initial framework are discussed: (1) definition repetitive tasks, (2) definition potential of repetitive tasks and (3) design elements and advices. The applicability of the framework according to the experts and the suggestions for future research are then discussed.

(1) Feedback definition repetitive tasks

- E2, E4 and E6 note that repetition is mainly in processes, which, according to E2, makes process innovation easier than product innovation in the case of repetitive tasks. The definition is appreciated as it refers to repetition not only in the product but also in the process.
- E5 raises the critical question of what exactly is meant by preparatory tasks. Are they just administrative tasks such as scheduling, prioritising, budgeting?
- E2 notes that the described tip about investigating repetitive tasks beyond the programme or project level is recognisable. As E4 also points out, repetitive tasks result from the objectives an organisation pursues with its portfolio. E5 notes that it may be useful to include in the definition that repetitive tasks should be considered at the portfolio level.

(2) Feedback definition potential of repetitive tasks

- E3 notes that it is as much about efficient and effective execution of tasks as it is about efficient and effective scheduling of tasks.
- E6 notes that although standardisation is applied, customisation should be possible.
- E6 points out that in order to learn from mistakes, there must be room to make mistakes in the collaboration with the client. *”If you are not allowed to make mistakes, you will not report them and you will not learn from them.”*

(3) Feedback design elements and advices

At the time of defining an assignment

1. Sufficient volume

- Payback is important for both contractor and client [E1]. As a client, sufficient volume provides the opportunity to *”do more with less or the same people”*.
- To schedule intelligently as a contractor, it is important to know in advance what tasks need to be executed [E2].
- The volume of tasks arises from the strategic level, where it is considered at the portfolio level which tasks are repetitive [E4].
- Due to the scarcity of people and resources, the bundling of tasks and the use of repetitive tasks is almost a necessity for clients [E4].
- ”Sufficient volume” is a sub-element of ”Predictability scope” [E5].

2. Predictability scope

- E1 indicated that the client should not prescribe everything, as this would allow less use of the contractor's expertise. A distinction is made between technical and functional specifications.
- The replacement and renovation challenge, especially renovation, is often unpredictable [E2]. The following advice is offered to clients: *"Embrace uncertainty. [...] As far as I am concerned, the scope does not have to be predictable at all, as long as you are predictable in resolving the uncertainties".*
- When things are uncertain or it is not clear what needs to be done, a client can set up a process to make better use of market knowledge [E4]. An example given is a client who wants to commit to sustainability but does not know how. As a client, it is useful to be clear about the task and to know where there might still be uncertainty.

2.1 Smart scheduling

- It is essential for the success of a programme that a certain amount of flow is created between activities [E2]. *"It must therefore be possible for a contractor to set up its processes in such a way as to create this flow. So if you have a lot of preconditions that determine whether an activity can start or not, that train will be frustrated. So you actually want trains of activities (sequence of activities)."* It is useful for a contractor to know in advance what he is going to do, so that a flow can be created. According to E2, it is helpful for a contractor to be responsible for several objects or a specific plot after being awarded an assignment, rather than being responsible for one object at first and a second object after good performance.
- Smart scheduling is a focus both at the time an assignment is defined and after it is awarded [E5].
- Smart scheduling applies not only to the execution phase (operational level), but also to the development of plans (tactical level) [E6].

3. Early involvement contractor

- Procurement law may limit the early involvement of a contractor [E1]. It is suggested that market consultations are used to obtain input from potential contractors on the design of an assignment.
- Involving contractors at tactical level and looking at tasks in an integrated way (e.g. both upkeep and sustainability) is very useful [E4]. As E4 formulates: *"Place responsibility with those who can carry it best".* In addition, the scarcity of human resources makes it interesting to involve contractors at tactical level.
- Early contractor involvement is desirable so that a contractor can schedule well [E6]. This can, for example, prevent the contractor from finding out during the execution phase that *"flora and fauna are not well regulated or that there is insufficient budget"*.

4. Facilitating demand specification
Functional demand specification allows the contractor to develop different scenarios [E6].

After awarding an assignment
1. Knowledge retention
E1 points out that knowledge retention and evaluation are important in order to have an output that can be used as input for a subsequent contract. It is noted that it is difficult to avoid knowledge being lost at the end of a contract. In addition, knowledge exchange, knowledge retention and evaluation are seen as a shared responsibility between the client and the contractor.

2.2 Knowledge exchange Contractor - Contractor
According to E2, knowledge exchange adds value to a programme, but can sometimes be complicated for contractors. It is helpful if the client facilitates knowledge exchange, for example by setting an objective that can only be achieved if contractors exchange knowledge with each other.

3. Evaluation

- E1 notes that evaluation is important to avoid repeating a mistake.
- E6 notes that evaluation is important and not just about evaluating the tasks executed, but also about evaluating the collaboration.

4. Uniformity

- If there is a ranking in the elements, E1 recommends moving the ”Uniformity” element from position 4 to a higher position. Uniformity and the tasks to be executed within it are in fact the basis, according to E1.
- E5 notes that thinking about uniformity is relevant both at the time of defining an assignment and after awarding an assignment.

Suggested additions

- Definition of the term ”assignment”
  E6 notes that the use of the term assignment can be misleading as it is sometimes not known at the time of award what the exact tasks will be.
- Design element ”Financial incentive (bonus)”
  E2 indicates that it is advisable to use incentives to encourage a contractor to continuously improve. *”For example, you can reward a party for achieving a certain level of efficiency.”* This can be linked to project portfolio management (flow) and can provide insight into the potential for improvement. Without a financial incentive, there is no need for a contractor to improve from a financial perspective [E3].
- Strategic - tactical - operational level
  E4 and E5 propose specifying the level (strategic, tactical or operational) at which repetitive tasks occur, identifying the involved actors, and determining the necessary knowledge for each level.
- Internal commissioning
  - E1 agrees that a client often finds it difficult to identify repetitive tasks in its own portfolio.
  - E4 and E6 note that a client should also look at its own processes to enable a contractor to work efficiently; internal commissioning [E5]. Or, as E3 points out, a client should facilitate the occurrence and use of repetitive tasks for a contractor. The contractor is then responsible for the rest of the chain.

Applicability of framework

During the expert evaluations, there was a lot of recognition of both the definitions, and the design elements and advices included in the framework. As E2 pointed out, the framework is applicable in various construction sectors such as infrastructure and residential construction: *”it really does not matter whether an object is a bridge or a house”*. E6 notes that the design elements and advices *”forces a client to think at the front end, the moment he starts to select parties, to think also about what it asks of him”*.

Suggestions for future research

- Investigate how knowledge gained in an assignment is secured and transferred towards the end of the contract. Or as E1 puts it: *”How do you maintain the incentive for the contractor, who no longer has an assignment, to secure and transfer the knowledge?”*. In addition, it is also interesting to see how a new team can build on previously acquired knowledge and use it to improve [E1].
- Researching assignments with repetitive tasks designed by clients such as the Rijksvastgoedbedrijf, ProRail and water boards, can be interesting *”because the money flows from the government are different”* from Rijkswaterstaat [E1].
- Research project portfolio management, and in particular the flow method, in order to substantiate the theoretically achievable efficiencies of repetitive tasks and to quantify the potential of repetitive tasks [E2]. This knowledge can then be used to formulate a bonus scheme to incentivise continuous improvement as a contractor.
- Investigate the impact of repetitive tasks and the level (tactical and/or operational) at which a contractor is involved in an assignment on the level of transaction costs [E5].
- Investigate the applicability of the design elements and advices when there are several (public) clients bundling their demand [E5].

7.3. Final framework

Two versions of the final framework were created. Version 1 (see Figure 7.2) was developed with the aim of contributing to the academic literature and answering sub-question 4. Version 2 (see Appendix D.3), on the other hand, was designed to allow practical application by public clients who are considering exploiting the potential of repetitive tasks, without having to read the research report. The main difference between the two versions of the framework is the addition of a definition of repetitive tasks and their potential, accompanied by examples derived from the cases studied in version 2.

7.3.1. Addition strategic-tactical-operational level

As shown in the ”policy cycle” in Figure 7.1, a public client first formulates its ambitions and objectives for its portfolio at a strategic level. Based on this, it then considers, at the portfolio level, which activities, projects and/or programmes to undertake. At this level, it is advisable to identify repetitive tasks and bundle them strategically. Additionally, setting ”the goal” of improving repetitive tasks is recommended (see also subsection 2.1.6). Then, at a tactical level, consideration is given to how best to translate the ambitions and objectives into execution programmes, with a focus on asset management. This information is then used to create execution plans, which are used at the operational level during the execution of activities or projects. The results of the execution are then used as evaluation points to improve the execution programme and possibly revise the public client’s ambitions and objectives.

Repetitive tasks can be found at all three organisational levels. Preparatory tasks are present both at the tactical level (e.g. preparing an annual plan and MYMP) and at the operational level (e.g. scheduling and administration of tasks). Execution tasks can only be found at the operational level. When a public client decides to outsource certain tasks to contractors, the level at which a contractor is involved should be considered. In the cases studied, contractors are involved at both tactical level and operational level in order to make better use of the knowledge, expertise and capacity of the market. With a view to exploiting the potential of repetitive tasks, it is noted that the involvement of a contractor at both tactical level and operational level offers advantages (see design element 2 in Figure 7.2). If this option is chosen, it is recommended to apply the relevant design elements ”at the time of defining & after awarding an assignment” and ”after awarding an assignment” at both tactical level and operational level (see Figure 7.2). For design elements 1 and 3, it is recommended to implement them at the strategic level, as this is where the challenge is formulated and the portfolio is allocated, which can influence the occurrence of repetitive tasks. Additionally, it is recommended to apply design element 2 at the tactical level, where the execution programme is preferably tendered to the market. Consequently, design elements 1 and 3 are also relevant at the tactical level. Furthermore, it is recommended to take into account design element 1 at the operational level. This is due to the advice to involve a contractor at both tactical and operational level during the execution of the assignment. The letters after each design element indicate at which organisational level(s) application of the design element and associated advice is recommended.

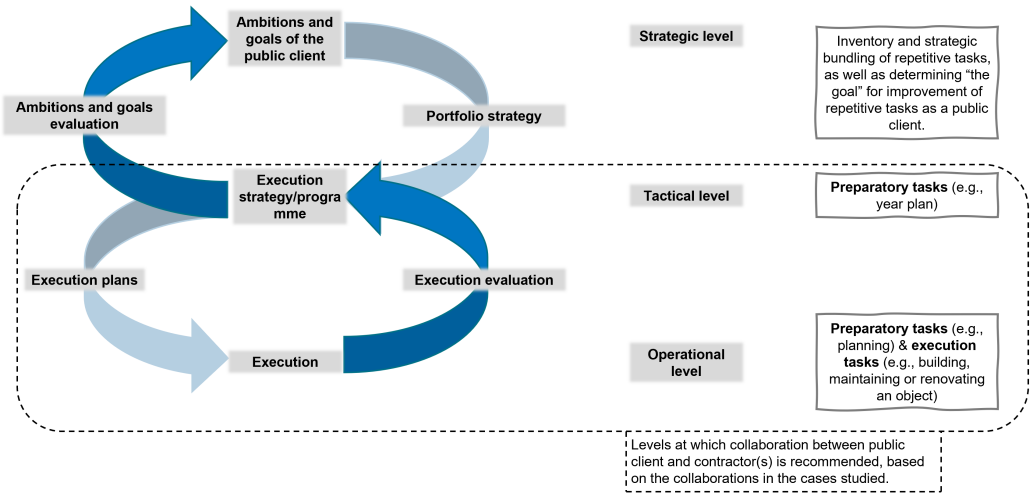

Figure 7.1**:** Policy cycle related to repetitive tasks and advised levels of collaboration adapted from Hermans et al. (2022), Sayers et al. (2021), and Van Os (2022)

7.3.2. Addition design element financial incentive (bonus)

In the interviews of the cases studied, customer satisfaction and attractiveness, intrinsic motivation, follow-up assignments with the same or similar tasks, and yield improvements were mentioned as incentives for a contractor to keep improving. The latter can be addressed by public clients through the use of a bonus scheme, possibly linked to established KPIs. When setting KPIs, a public client must first consider where improvement is possible, i.e. where the potential of repetitive tasks lies. They should also consider the goal of the improvement. Is it to achieve the same result with less money, to deliver higher quality and/or to contribute to social goals such as sustainability (see also subsection 2.2.4)? The advantage of using KPIs is that goals can be made concrete (SMART: specific, measurable, achievable, relevant, time-bound) and it becomes clear to all parties what needs to be steered towards. This encourages the quantification of the potential of repetitive tasks.

7.3.3. Explanation final framework

If a public client is considering exploiting the potential of repetitive tasks, the following is recommended. Firstly, at the portfolio level, a public client should inventory repetitive tasks and determine ”the goal” of improving repetitive tasks. It is then recommended to consider the design elements and associated advices included in the ”Innovative approach to repetitive tasks” framework (see Figure 7.2). The interpretation of the advices may vary from one assignment to another, depending on circumstances such as laws and regulations, a public client’s portfolio, stakeholders, availability of data, competence of the public client and duration of an assignment. The term assignment is derived from the procurement law and refers to the execution of tasks at tactical level and/or operational level. The design elements and associated advices are divided into the following phases: (1) at the time of defining an assignment, (2) at the time of defining & after awarding an assignment, (3) after awarding an assignment. The design elements are numbered, but the numbering is not intended as a ranking. The letters after each design element indicate at which organisational level(s) application of the design element and associated advice is recommended (see also subsection 7.3.1). S denotes strategic level, T denotes tactical level and O denotes operational level. Below is a description of the advices associated with the design elements included in the framework.

At the time of defining an assignment

1. Predictability scope [S, T, O]: Promote continuity and provide clarity about the tasks to be executed and the associated timeframe, thereby enabling early identification of repetitive tasks and their potential for both public client and contractor; promote predictability about what needs to be done. Increasing

clarity regarding the number of times a task will be repeated and the timeframe in which it will be repeated, for example, allows the contractor to use ”smart scheduling” (4) and determine whether innovation can be recouped. Provide clarity on which parts of the assignment are (still) uncertain and how this will be dealt with (processes), so that the contractor can respond accordingly.

1.1 Sufficient volume of the same or similar tasks (sale guarantee): Promote sufficient volume to increase the likelihood of repetition and provide room for improvement (through learning (gaining experience and building on it, developing and using routine), standardisation, industrialisation and innovation). The more often a task is repeated, the greater the payback opportunity for both public client and contractor, and the incentive to keep improving and innovating. For example, bundle maintenance cycles in the case of maintenance tasks.

2. Early involvement of contractor [T]: Involve the contractor at tactical level rather than only at operational level (preparation and execution) after awarding the assignment, so that the contractor can use and add repetition to the assignment (exploitation of market knowledge, both design and execution knowledge). Question (in Dutch: uitvragen van) the challenge rather than the solution.
In the cases studied, where a programmatic approach was applied, the market parties are called network partners (case WL), innovation partners (case IPS Schoolgebouwen), assignment partners (WOUW). As Hermans et al. (2022) suggest, a programmatic approach changes the relationship between the public client and the contractor, from a transactional model based interaction to a long-term partnership.

3. Facilitating demand specification [S, T]: Formulate the demand specification in such a way as to increase the likelihood of repetition and to provide room for improvement for both public client and contractor. As the public client, clarify in advance what is standard and where there is design freedom. Determine whether aligning with demand specifications of other assignments from your own organisation (internal) or other public clients (external), in which the same or similar tasks are executed, is feasible.
Hermans et al. (2018) emphasised the importance of comprehensively understanding an organisation’s portfolio to accurately define the demand specification to the market.

At the time of defining & after awarding an assignment
4. Smart scheduling [T, O]: Promote that the same (specialised) people (construction crew) (stable teams) execute the same or similar tasks sequentially (”in trains”) for efficiency. Possibly develop and use routine (learning by routine).

5. Uniformity [T, O]: Promote uniformity in the tasks to be executed within an assignment where multiple contractors are involved and contractors are executing the same or similar tasks. This will increase the chance of repetition and its potential (e.g. learning from each other) for both public client and contractors. Consider this when defining an assignment and, if necessary, work it out with the contractors after the assignment has been awarded.

6. Financial incentive (bonus) [T, O]: Promote contractors to (continue to) improve repetitive tasks by applying a financial incentive, for example in the form of a bonus.

After awarding an assignment
7. Knowledge retention [T, O]: Promote building on acquired knowledge*** and experience and avoid losing knowledge (reinventing the wheel).
***This concerns practical and theoretical knowledge that can be used to execute a task better next time.

7.1 Continuity of parties involved: Promote that people involved in the assignment (both public client and contractor) change as little as possible, so that knowledge*** and experience gained can be reused and there is certainty between the parties about what is expected of each other.
***This concerns practical and theoretical knowledge that can be used to execute a task better next time.

8. Knowledge exchange** [T, O]: Exchange knowledge on repetitive tasks and their potential, and identify whether processes within the organisation hinder the exploitation of the potential of repetitive tasks and adjust them where possible.
**Be aware that competition in the assignment can hinder knowledge exchange.

8.1 Public client - Contractor: Exchange knowledge about repetitive tasks and their potential, and identify whether processes within the public client's and/or contractor's organisation are hindering the use of the potential of repetitive tasks, and adjust them where possible.

8.2 Contractor - Contractor: Promote learning by exchanging knowledge*** and inspiring each other, even when executing repetitive tasks "simultaneously". For example, encourage discussion of mistakes made.
***This concerns practical and theoretical knowledge that can be used to execute a task better next time.

9. Evaluation [T, O]: Avoid repeating mistakes and less critical thinking through evaluation. During the evaluation, consider questions such as: what repetitive tasks have we executed, what can be improved, what is needed to improve, and is the standard used still appropriate? Frequency and design of the evaluation will depend on the nature and scope of the tasks (annual plan versus replacing a window) and the people executing the tasks. Use routine to exploit the potential of repetitive tasks.

Advices on exploiting the potential of repetitive tasks

If a public client is considering exploiting the potential of repetitive tasks, the following is recommended. Firstly, at a portfolio level, a public client should inventory repetitive tasks and determine "the goal" of improving repetitive tasks. It is then recommended to consider the design elements and advices listed below. The interpretation of the advices may vary from one assignment to another, depending on circumstances such as laws and regulations, a public client's portfolio, stakeholders, availability of data, competence of the public client and duration of an assignment. The term assignment is derived from the procurement law and refers to the execution of tasks at tactical level and/or operational level. The design elements and associated advices are divided into the following phases: (1) at the time of defining an assignment, (2) at the time of defining & after awarding an assignment, (3) after awarding an assignment. The design elements are numbered, but the numbering is not intended as a ranking. The design element and associated advice labelled with the letter S is recommended at strategic level, with the letter T at tactical level and with the letter O at operational level. The successful implementation of the advices below for public clients also depends on the cooperation of the contractor(s), especially in 2. Early involvement contractor, 4. Smart scheduling, 5. Uniformity, 7. Knowledge retention, 8. Knowledge exchange and 9. Evaluation.

	Design element	Advice
At the time of defining an assignment	**1. Predictability scope [S, T, O]**	promote continuity and provide clarity about the tasks to be executed and the associated timeframe, thereby enabling early identification of repetitive tasks and their potential for both public client and contractor; promote predictability about what needs to be done. Increasing clarity regarding the number of times a task will be repeated and the timeframe in which it will be repeated, for example, allows the contractor to use "smart scheduling" (4) and determine whether innovation can be recouped. Provide clarity on which parts of the assignment are (still) uncertain and how this will be dealt with (processes), so that the contractor can respond accordingly.
	1.1 Sufficient volume* (sale guarantee)	promote sufficient volume to increase the likelihood of repetition and provide room for improvement (through learning (gaining experience and building on it, developing and using routine), standardisation, industrialisation and innovation). The more often a task is repeated, the greater the payback opportunity for both public client and contractor, and the incentive to keep improving and innovating. For example, bundle maintenance cycles in the case of maintenance tasks.
	2. Early involvement contractor [T]**	involve the contractor at tactical level rather than only at operational level (preparation and execution) after awarding the assignment, so that the contractor can use and add repetition to the assignment (exploitation of market knowledge, both design and execution knowledge). Question the challenge rather than the solution.
	3. Facilitating demand specification [S, T]	formulate the demand specification in such a way as to increase the likelihood of repetition and to provide room for improvement for both public client and contractor. As the public client, clarify in advance what is standard and where there is design freedom. Determine whether aligning with demand specifications of other assignments from your own organisation (internal) or other public clients (external), in which the same or similar tasks are executed, is feasible.
At the time of defining & after awarding an assignment	**4. Smart scheduling [T, O]**	promote that the same (specialised) people (construction crew) (stable teams) execute the same or similar tasks sequentially ("in trains") for efficiency. Possibly develop and use routine (learning by routine).
	5. Uniformity [T, O]	promote uniformity in the tasks to be executed within an assignment where multiple contractors are involved and contractors are executing the same or similar tasks. This will increase the chance of repetition and its potential (e.g. learning from each other) for both public client and contractors. Consider this when defining an assignment and, if necessary, work it out with the contractors after the assignment has been awarded.
	6. Financial incentive (bonus) [T, O]	promote contractors to (continue to) improve repetitive tasks by applying a financial incentive, for example in the form of a bonus.
After awarding an assignment	**7. Knowledge retention [T, O]**	promote building an acquired knowledge**** and experience and avoid losing knowledge (reinventing the wheel).
	7.1 Continuity of parties involved	promote that people involved in the assignment (both public client and contractor) change as little as possible, so that knowledge**** and experience gained can be reused and there is certainty between the parties about what is expected of each other.
	8. Knowledge exchange* [T, O]**	exchange knowledge on repetitive tasks and their potential, and identify whether processes within the organisation hinder the exploitation of the potential of repetitive tasks and adjust them if possible.
	8.1 Knowledge exchange Public client – Contractor**	exchange knowledge about repetitive tasks and their potential, and identify whether processes within the public client's and/or contractor's organisation are hindering the use of the potential of repetitive tasks, and adjust them where possible.
	8.2 Knowledge exchange Contractor – Contractor**	promote learning by exchanging knowledge**** and inspiring each other, even when executing repetitive tasks "simultaneously". For example, encourage discussion of mistakes made.
	9. Evaluation [T, O]	avoid repeating mistakes and less critical thinking through evaluation. During the evaluation, consider questions such as: what repetitive tasks have we executed, what can be improved, what is needed to improve, and is the standard used still appropriate? Frequency and design of the evaluation will depend on the nature and scope of the tasks (annual plan versus replacing a window) and the people executing the tasks. Use routine to exploit the potential of repetitive tasks.

*Of the same or similar tasks.
**In the cases studied, where a programmatic approach was applied, the market parties are called network partners (case WL), innovation partners (case IPS Schoolgebouwen), assignment partners (case WOUW).
***Be aware that competition in the assignment can hinder knowledge exchange.
****This concerns practical and theoretical knowledge that can be used to execute a task better next time.

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Figure 7.2**:** Final "Innovative approach to repetitive tasks" framework

7.3.4. Addressing comments

Finally, it is noted that various design elements can also address the comments found earlier (repetition of mistakes, less critical thinking (making assumptions), boredom and limitation of choice/flexibility (see subsection 6.1.2)).

- Avoid repetition of mistakes, less critical thinking and boredom through knowledge retention, knowledge exchange and evaluation within an assignment (see design element 7, 8 and 9) and across assignments. This will ensure a focus on continuously improving repetitive tasks.
- Avoid limitation of freedom of choice/flexibility by being critical of the use of routines, standardisation and industrialisation, and by continually checking that specific client wishes and requirements are being met.

7.4. Conclusion

This chapter describes the ”Innovative approach to repetitive tasks” framework that has emerged from the findings of the literature review (Part II) and the empirical research (Part III). The final ”Innovative approach to repetitive tasks” framework includes design elements with associated advices for exploiting the potential of repetitive tasks. The application of the framework is recommended for public clients who are considering exploiting the potential of repetitive tasks in collaboration with contractors. The expert evaluations conducted, have sharpened the design of the framework as well as the wording to promote the applicability of the framework.

For public clients, it is recommended to first make an inventory of repetitive tasks at strategic level (portfolio level) and determine the goal of improving repetitive tasks. Subsequently, the design elements and associated advices included in the ”Innovative approach to repetitive tasks” framework (Figure 7.2) should be considered, both in the pre-collaboration phase and during the collaboration. The successful implementation of the advices below for public clients also depends on the cooperation of the contractor(s), especially in 2. Early involvement contractor, 4. Smart scheduling, 5. Uniformity, 7. Knowledge retention, 8. Knowledge exchange and 9. Evaluation. In this way, forces can be combined and ways of exploiting the potential of repetitive tasks can be jointly explored. For practical application of the framework, it is recommended to use the version included in Appendix D.3. This version also contains the definition of repetitive tasks and corresponding potential, as well as examples derived from the cases studied.

Finally, by applying the identified design elements 7. Knowledge retention, 8. Knowledge exchange, and 9. Evaluation both within and across assignments, and maintaining a critical attitude towards the use of routines, standardisation, and industrialisation, it is possible to address the previously identified comments (see subsection 6.1.2).

Part V

Conclusion

-Never too old to learn-

8

Discussion

This chapter discusses the main research findings and their relation to the available literature (section 8.1 and section 8.2). It then examines the scientific and practical relevance of the research (section 8.3), the validity of the research design (section 8.4) and the limitations of the research (section 8.5).

8.1. Extended definition repetitive tasks

Although the definition of repetitive tasks in Chapter 2 is based on the literature, the definition is extended beyond what is commonly found in the available literature. The aim of this expanded definition is to capture a wider range of repetitive tasks. The extension is explained below.

Repetition in preparatory and execution tasks

The literature reviewed in Chapter 2 is mainly concerned with repetition in relation to execution tasks. Only Godsell et al. (2018) and Davies et al. (2009) describe repetition in design and/or execution plans. During the interviews, preparatory tasks such as preparing an annual plan, procuring materials and administration are also mentioned (see Appendix C). As noted during the focus group, these preparatory tasks can occur at tactical level and operational level. The proposed expanded definition allows for identification of repetition in both preparatory and execution tasks.

Repetition in new construction, maintenance and renovation

The literature reviewed in Chapter 2 focuses on repetitive tasks in the case of new construction. However, it is important to also consider repetitive tasks in the maintenance and operation phase, especially as many buildings and structures are currently ageing and in need of maintenance, renovation and/or replacement (Lind & Muyingo, 2012; Van den Boomen et al., 2019). The three cases were therefore chosen so that it was possible to examine repetition in new construction, maintenance and renovation. Interestingly, in the WL case concerning the maintenance of housing, reference is made to ”large numbers” and a distinction is made between ”more repetitive” and ”less repetitive”. Similarly, Vestola et al. (2021), whose research is on road maintenance, also make a distinction between more and less repetitive.

Repetitive tasks and not repetitive projects

Furthermore, according to the extended definition, repetitive tasks can also be identified in a project with a unique result. By focusing not on the repetition of projects, but mainly on the repetitive tasks within and even outside of projects, it is possible to identify repetitive tasks for example on a portfolio level, and to create space for a strategic choice of the ”right” (bundling of) projects and/or activities, also called programmes, and to exploit the potential. This recommendation goes beyond the recommendation of Godsell et al. (2018) to categorise projects in the portfolio as repetitive or unique. Viewing and managing activities, projects together rather than object by object (Adriaanse, 2014; Engwall, 2003), promotes exploiting the potential of repetitive tasks.

Repetition in process and product

The expanded definition enables the identification of repetition in product and process, in line with the Construction Task Force (1998) and Davies et al. (2009). During the expert evaluations, it was pointed out that repetition is primarily found in processes and that there is particular potential in process innovation.

Repetition in tasks executed consecutively or simultaneously

Although the term ”repetition” implies a time component, it is noted, in addition to the literature, that repetitive tasks occur not only when they are executed consecutively, but also when they are executed

simultaneously. For instance, one of the three contractors detected an error in a GIS layer (see subsection 5.3.4). As all three contractors were executing the same or similar task and the error was shared, it was possible to correct the repetitive task at all three contractors at the same time.

Repetition in tasks of (public) client and contractor

The expanded definition enables both the (public) client and contractor to identify repetitive tasks. Both can respond to repetition in their portfolios by bundling repetitive tasks into a programme by a (public) client or by applying building concepts for example, as in the IPS Schoolgebouwen case, by a contractor. This is referred to by Vrijhoef and Koskela (2005) as a ”project-independent approach”.

Benefits can be obtained when a market party executes the same or similar tasks for several clients. As a market party, it is worth considering whether repetition is possible within an assignment and whether a particular process and/or activity can be executed the same or similarly for different (public) clients and/or assignments. For instance, according to the research by Molaei et al. (2023), contractors execute the same or similar tasks for different clients. According to the contractors interviewed in this research, improving repetitive tasks is of interest to them as they expect to execute the same or similar tasks in follow-up assignments.

8.2. Extended definition potential of repetitive tasks

The extended definition of the potential of repetitive tasks focuses on the ability to execute repetitive tasks better each time. Improvement can be achieved through learning (learning effect, e.g. through routine), standardisation, industrialisation, and innovation. The addition of innovation to the definition is based on the conducted semi-structured interviews, which revealed that innovation is seen as a special repetitive task. Special because it is a market-ready task and, by definition, aimed at improvement. During the expert evaluations it was pointed out that process innovation is particularly relevant for repetitive tasks, as processes are especially repetitive.

In addition to the literature, the interviews revealed comments that hinder the exploitation of the potential: repetition of mistakes, less critical thinking, boredom and limited choice/flexibility (see subsection 6.1.2). An example of the first comment is the HSL in the Netherlands. The same design has been applied to ten viaducts, and the same construction error has been identified (Smal & Verlaan, 2024). The advantage is that if the same error is repeated, a (standard) solution can be sought that can be applied to all viaducts (Tissink, 2024). When utilising routine, standardisation, and industrialisation processes, it is crucial to verify that the client’s specific wishes and requirements are still being met, and to regularly evaluate whether the routine (Denicol & Davies, 2022), standards, and industrialisation processes are still up to date.

8.3. Relevance of the research

8.3.1. Scientific relevance

In the current literature, repetitive tasks are associated with project management. However, this research proposes and substantiates an extended definition of repetitive tasks so that repetitive tasks can be considered outside of projects. Therefore, the literature should also consider repetitive tasks outside of projects, for example, repetitive tasks in programmes. The insufficiency is also substantiated by the examined cases where a programmatic approach was used. This research has started to complement programme literature with the found design elements and advices that can be used by public clients to steer exploitation of the potential of repetitive tasks (Denicol et al., 2023).

8.3.2. Practical relevance

Current societal and construction challenges require solutions, and public clients play an important role due to their social responsibility (Hermans et al., 2016). In the context of the construction challenge, for example, the ageing of existing structures plays a role. This is where repetitive tasks can provide a solution. With the extended definition of repetitive tasks and their potential, as well as the proposed design elements and associated advices, the exploitation of the potential of repetitive tasks can be promoted. The research shows that improving repetitive tasks can lead to time savings, cost savings, improved quality, improved (price) estimates, improved procurement of materials and better information for stakeholders. In summary, by exploiting the potential, repetitive tasks are expected to be executed

more efficiently and effectively and contribute to societal and construction challenges, despite limited time and scarcity of people and resources.

8.4. Validity of the research

The following subsections consider the reliability, construct validity, internal validity and external validity of the research design used.

8.4.1. Reliability

Reliability means that repetition of the research will yield the same result (Creswell & Creswell, 2018; Yin, 2018). Therefore, in Chapter 3 the case selection criteria, the way in which the interviews were conducted and the cases analysed are explained. In addition, in Chapter 3 the codes applied to the transcripts are presented and in Chapter 7 the way in which the expert evaluations were conducted is described. The use of semi-structured interviews and the interviewer bias reduce reliability (Saunders et al., 2009). Reliability is enhanced by the fact that all interviews were conducted together with Dr.ir. Maedeh Molaei, and the results of the interviews verified with Dr.ir. Maedeh Molaei. Additionally, the interviewees were provided with the interview results and asked if any modifications were necessary before incorporating the results into the research.

8.4.2. Validity

Validity is concerned with whether the research methods used have measured what is being studied, in other words the accuracy of the results obtained.

Construct validity is concerned with whether this research and the research methods used have actually investigated the collaboration elements that influence the exploitation of the potential of repetitive tasks. In Part II, definitions of (the potential of) repetitive tasks were established on the basis of the scientific literature and a theoretical framework concerning repetitive tasks was developed. Subsequently, in Part III, three cases were studied on the basis of case documents and semi-structured interviews. To select the three cases, different selection criteria were used, partly based on the insights gained in Part II, so that the case analysis could serve as input for answering the main research question. The insights gained from the interviews were then combined with the theoretical results in the ”Innovative approach to repetitive tasks” framework. Finally, in Part IV, the applicability of the framework was tested through expert evaluations with six experts. On this basis, the results are expected to be reasonably reliable, but due to the limited and missing literature and the analysis of only three cases, this is not certain.

To increase internal validity, the interview questions used were based on insights gained from the scientific literature, a pilot interview was conducted to ensure that the correct terminology was used to elicit the intended data, and the results were verified by several expert evaluations. As 14 out of 18 interviews and 3 out of 4 expert evaluations were conducted online, they could be scheduled with greater flexibility. However, this approach made it more challenging to interpret body language and evaluate the work environment. Additionally, it was observed that during in-person interviews, interviewees took more time to answer questions.

External validity refers to the generalisability of the results of this research to a wider context. The use of three case studies allows the findings from the different cases to be compared and therefore offers more opportunities for generalisation than studying a single case (Saunders et al., 2009). However, the choice of three case studies, all of which used a programmatic approach and are seen as new ways of collaboration, may limit external validation (at present). An attempt was made to ensure the generalisability of the results by using expert evaluations with experts who were not involved in the three cases and who work in different construction sectors.

8.5. Research limitations

The applied research scope as well as the used research methods have limitations:

- With the selected cases, only the collaboration between public client and contractors in the Dutch situation could be studied. As a result, the framework is not expected to be directly applicable

to other organisations, such as private, semi-public and foreign organisations, without expert evaluation.

- This research only considered the collaboration between public client and contractors. However, the three cases involved a wider group of actors such as customers (residents in the case of WL, school boards in the case of IPS Schoolgebouwen and residents of the Netherlands and TU in the case of WOUW), suppliers and subcontractors (further supply chain).
- In this research, only people in managerial positions who are involved in the collaboration at the tactical level were interviewed. However, some of the repetitive tasks and the exploitation of the associated potential belong to the operational level. As people involved at the operational level were not interviewed, advices may be missing in the framework and/or require adaptation(s).
- All three cases were at an early stage, so not all tasks had been repeated, and it was still unclear, for example, to what extent the financial incentive affected the exploitation of the potential of repetitive tasks. In addition, in WL in particular, there had been several changes in the client's staff, making it impossible to interview three people who had been involved both in the design of the assignment and after the contract had been awarded.
- Unfortunately, due to the availability of experts, it was not possible to organise one focus group to evaluate the initial framework.

9

Conclusion and Recommendations

The research objective was to increase the understanding and knowledge of the design elements aimed at exploiting the potential of repetitive tasks in assignments where public clients and contractors collaborate. This chapter focuses on answering the main research question of this research. It first answers the four sub-questions (section 9.1), then the main research question (section 9.2). Finally, it provides recommendations for public clients and (potential) contractors, and suggestions for future research (section 9.3).

9.1. Answers to the sub-questions

Sub-question 1: How can a project-based approach and a programmatic approach help unlock the potential of repetitive tasks?
The literature review in Chapter 2 focused on answering sub-question 1. The insights gained from the literature resulted in the definition of repetitive tasks in this chapter as *"Construction processes and activities that are executed more than once (repeatedly) on/for the same or different (parts of) structures at one or more locations without the result having to be the same."* It is emphasised that, in contrast to the current focus in the literature on repetition in projects, repetitive tasks involve the repetition of tasks that are not only part of a project but also part of a programme, operations or portfolio. It is noted here that although a project is completed with a unique result, repetitive tasks may occur because the same or similar tasks are repeated in the project itself or in another project. The repetition of repetitive tasks makes it possible to do them better each subsequent time and to apply improvements each time. The literature review reveals four elements that are important for this: (1) sufficient volume of tasks, (2) continuity in both activities and people involved, (3) knowledge exchange and retention, and (4) evaluation.

A project-based approach, especially where projects are seen as isolated ("islands"), reduces the likelihood that repetitive tasks will be identified and exploited, and comes at the expense of knowledge building and continuity of work and people. A programmatic approach reduces this risk and in fact promotes knowledge accumulation and continuity.

Sub-question 2: How does the (intended) design of an assignment in which a public client collaborates with contractors promote the exploitation of the potential of repetitive tasks in practice?
In Chapter 4 and 5, three cases (WL, IPS Schoolgebouwen, WOUW), in which a programmatic approach was applied, were examined and sub-question 2 was answered using case documents and 18 semi-structured interviews. The theoretical framework presented in Chapter 2 (see Table 2.3 and Table 4.1), which summarises the insights gained regarding (the potential of) repetitive tasks, served as the starting point for the case study. For each case, the main promoting and hindering design elements for exploiting the potential of repetitive tasks in the different assignment designs are described below.

In WL, a collaboration has been established with contractors to maintain and improve properties that the public client has divided into plots and awarded to different contractors for seven years. In this case, exploiting the potential of repetitive tasks is possible because:

- planned and unplanned maintenance and improvements have been bundled;
- a large volume of uniform real estate has been bundled;
- each plot has been awarded to one contractor for seven years;
- contractor is involved at tactical level (e.g. preparation of annual plans and MYMP) and operational level (e.g. painting).

The contractors interviewed indicated that demarcation of who is responsible for what tasks, real estate strategy and (real estate) data are not completely clear to them, which prevents them from early identification of maintenance tasks and thus from exploiting the potential of repetitive tasks.

In IPS Schoolgebouwen, a ten-year collaboration has been established with contractors to design and realise a minimum of nine and a maximum of thirty school buildings, with the distribution of school buildings being done through mini-competitions. In this case, exploiting the potential of repetitive tasks is possible because:

- several uniform school buildings are bundled into one framework agreement;
- long-term involvement of contractors in both design and realisation;
- a generic programme of requirements is used for each school building.

Since each time a different school board initiates the mini-competition, there is uncertainty among contractors about the tasks to be executed, they cannot scale up, and it is difficult to exploit the potential of repetitive tasks.

In WOUW, a collaboration has been established with contractors to maintain floodplains that the public client has divided into plots and awarded to different contractors for at least four years. In this case, exploiting the potential of repetitive tasks is possible because:

- only floodplain maintenance was bundled;
- each plot was awarded to one contractor for at least four years;
- contractor is involved at tactical level (e.g. preparation of annual plans) and operational level (e.g. mowing);
- one IPM team per plot to promote knowledge exchange between public client and contractor;
- knowledge exchange between contractors.

However, the lack of a financial incentive and a lack of clarity about the division of roles between public client and customer are identified by interviewees as possible barriers to exploiting the potential of repetitive tasks.

Sub-question 3: What lessons can be learned from the different assignment designs analysed in practice?
In Chapter 6, a cross case analysis revealed that the assignment design involving collaboration varies from case to case, influenced by circumstances such as laws and regulations, availability of data, and third parties, including residents, school boards and an asset manager. This affects the potential of repetitive tasks. Furthermore, in the three cases, interviewees refer to a new way of collaboration and the expectation that the knowledge gained will be used in (setting up) follow-up assignments. Finally, during the interviews the public clients paid most attention to the repetitive tasks executed by contractors, and the internal commissioning was underexposed.

According to the cross case analysis, the following design elements are promoting the exploitation of the potential of repetitive tasks: (1) sufficient volume of tasks, (2) predictability scope (continuity), (3) early involvement of contractor, (4) facilitating demand specification, (5) knowledge retention, (6) knowledge exchange between public client and contractor and between contractors, (7) evaluation, (8) uniformity and (9) incentive to (continue to) improve (see Table 6.2). In addition, bundling maintenance cycles promotes repetition according to the WL and WOUW cases (1.1), predictability promotes smart scheduling (2.1) and continuity of people involved (5.1) promotes knowledge retention.

Sub-question 4: What elements of an assignment design should public clients consider in order to exploit the potential of repetitive tasks in collaboration with contractors?
The ”Innovative approach to repetitive tasks” framework in Chapter 7, which was reviewed during expert evaluations, provides advices for public clients for each of the design elements found in the cross case analysis (see Figure 7.2). The design elements and associated advices are divided into the following phases: (1) at the time of defining an assignment, (2) at the time of defining & after awarding an assignment, (3) after awarding an assignment. The term assignment is derived from the procurement law and refers to the execution of tasks at tactical level and/or operational level.

9.2. Answer to the main research question

Main research question: How can a public client design an assignment that involves collaboration with contractors to exploit the potential of repetitive tasks?

If a public client is considering exploiting the potential of repetitive tasks, the following is recommended. Prior to the collaboration with contractors, it is important for a public client to make an inventory of repetitive tasks - both preparatory and execution tasks - at portfolio level and to determine ”the goal” of improving repetitive tasks. Subsequently, a public client can design an assignment that involves collaboration with contractors in such a way that the exploitation of the potential of repetitive tasks is facilitated. In doing so, it is recommended to consider the design elements and associated advices included in the framework (see Figure 7.2), both in the pre-collaboration phase and during the collaboration. In addition, the letters after each design element indicate at which organisational level(s) application of the design element and associated advice is recommended. S denotes strategic level, T denotes tactical level and O denotes operational level. It is recommended to involve contractors at both tactical and operational level after an assignment has been awarded in order to make better use of their knowledge, expertise and capacity. Therefore, implementation of the design elements ”at the time of defining & after awarding an assignment” and ”after awarding an assignment” is recommended at both tactical and operational level. The successful implementation of the advices for public clients also depends on the cooperation of the contractor(s), especially in 2. Early involvement contractor, 4. Smart scheduling, 5. Uniformity, 7. Knowledge retention, 8. Knowledge exchange and 9. Evaluation. For practical application of the framework, it is recommended to use the version included in Appendix D.3. This version also contains the definition of repetitive tasks and corresponding potential, as well as examples derived from the cases studied.

Through an ”innovative approach to repetitive tasks”, consisting of a cross-project inventory of repetitive tasks and the application of the proposed design elements and advices, the forces of the public client and the contractors are combined and the potential of repetitive tasks is unlocked.

9.3. Recommendations

In addition to the advices mentioned in the framework, recommendations for public clients and (potential) contractors, and for future research are given below.

9.3.1. Recommendations for public clients and (potential) contractors

For both public clients and (potential) contractors, it is important to be aware that:

- Considering processes and activities only at the project level may prevent the recognition of repetitive tasks at other levels. It should be born in mind that:
  - repetitive tasks can occur in the public client’s portfolio as well as in the (potential) contractor’s portfolio;
  - repetitive tasks occur not only in execution tasks (e.g. mowing and asphalting), but also in preparatory tasks at both tactical level (e.g. planning and preparation of an annual plan) and operational level (e.g. scheduling and preparation of an execution plan).
- Repetition occurs not only when the same or similar task is executed consecutively, but also when it is executed simultaneously. Even in these cases, public client and contractor(s) can learn from each other and avoid repeating mistakes.
- Providing insight into the potential of repetitive tasks is important so that it becomes clear why it is worthwhile to follow the advices and recommendations given in this research. The research shows that improving repetitive tasks can lead to time savings, cost savings, improved quality, improved (price) estimates, improved procurement of materials and better information for stakeholders.
- To address the comments found (repetition of mistakes, less critical thinking, boredom and limitation of choice/flexibility), the following are recommended:
  - Avoid repetition of mistakes, less critical thinking and boredom through knowledge retention, knowledge exchange and evaluation within an assignment and across assignments. This will ensure a focus on continuously improving repetitive tasks.

- Avoid limitation of freedom of choice/flexibility by being critical of the use of routines, standardisation and industrialisation, and by continually checking that specific client wishes and requirements are being met.

Supplementary for public clients

The following are the main supplementary recommendations for public clients at three different organisational levels.

Strategic level - top management (e.g. director of strategy and development)

At the strategic level, the challenge is formulated, and the portfolio is distributed. Formulating and distributing the portfolio can affect the occurrence of repetitive tasks. For instance, a challenge can be formulated to apply to a cluster of objects. It is important to provide space to respond to (the potential of) repetitive tasks at the tactical level and operational level. Also consider whether it is desirable to collaborate with other (public) clients to obtain a sufficient volume of repetitive tasks. Finally, it is important to consider ”the goal” pursued by improving repetitive tasks.

Tactical level - middle management (e.g. programme managers)

At the tactical level, there is steering on the execution (Hermans et al., 2022). When translating the goal of improving repetitive tasks, as determined at the strategic level, and determining the demand specification to the market, it is important to give space to repetitive tasks and to exploit the associated potential. To achieve this, a project- and assignment-transcending approach is important, for example by loosening the focus on the effectiveness and efficiency of a single project or assignment. In this way, knowledge can be transferred like a baton from project to project or assignment to assignment, and the lessons learned can be used.

It is useful for the public client to assess whether other (public) clients execute the same or similar tasks. This allows for unification of the demand specification and to benefit from the repeated experiences of contractors and other (public) clients.

Finally, involving contractors at the tactical and operational level requires a different interpretation of public commissioning, particularly in terms of collaboration. This enables the utilisation of contractors' knowledge, expertise and capacity in the context of exploiting the potential of repetitive tasks.

Operational level - operational management (e.g. project managers)

At the operational level, there is steering in the execution (Hermans et al., 2022). In the execution of projects and activities, the people executing the repetitive tasks should be given the space to exploit the potential of repetitive tasks.

Supplementary for (potential) contractors

The following are the main supplementary recommendations for (potential) contractors at three different organisational levels.

Strategic level - top management (e.g. director of strategy and development)

When formulating organisational goals, it is recommended to consider their impact on the occurrence of repetitive tasks and ”the goal” pursued by improving repetitive tasks.

Tactical level - middle management (e.g. programme managers)

Identify repetitive tasks across projects and assignments. As a market party, it is beneficial to assess the possibility of repetition within an assignment and whether a particular process or activity can be executed in the same or a similar way for different (public) clients and/or assignments. Providing (quantitative) insight into the potential of repetitive tasks is useful for both one's own organisation and for (public) clients, for example to show that by exploiting the potential, each subsequent bridge becomes cheaper. Furthermore, by sharing (acquired) knowledge about repetitive tasks with (public) clients and fellow contractors, it is possible to jointly look for ways to exploit the potential of repetitive tasks while respecting the contractor's own interests.

Finally, collaboration between public client and contractor(s) at tactical and operational level requires a different way of working, from a transactional model based interaction to a long-term partnership.

Operational level - operational management (e.g. project managers)

When executing projects and activities, provide employees of your own organisation, subcontractors, and suppliers the opportunity to exploit the potential of repetitive tasks.

9.3.2. Recommendations for future research

Based on the exploratory research performed, topics for future research are suggested below.

- During the interviews and expert evaluations it became clear that internal commissioning is important for exploiting the potential of repetitive tasks. Follow-up research can investigate what a public client needs to arrange in its organisation (internal commissioning) for itself and for contractors to be able to exploit the potential of repetitive tasks.
- It is expected that the design elements 1. Predictability scope, 1.1 Sufficient volume, 4. Smart scheduling, 5. Uniformity, 6. Financial incentive (bonus), 7. Knowledge retention, 7.1 Continuity of parties involved, 8. Knowledge exchange and 9. Evaluation are also relevant for exploiting the potential of repetitive tasks in the internal organisation of public clients and market parties without outsourcing tasks. It could be investigated whether this expectation is correct and whether the design elements and associated advices require adjustment or supplementation.
- This research has only looked at assignments involving collaboration between public client and contractors. It may also be interesting to look at collaboration between semi-public client and contractors, and private client and contractors to exploit the potential of repetitive tasks. Differences between one type of collaboration and another could also be explored.
- One of the advices for public clients is to bundle tasks so that repetition can occur. In some situations it may be interesting to collaborate with other (public) clients for this purpose. It could be investigated whether the design elements and associated advices are also useful when several (public) clients combine their tasks and whether the design elements and associated advices should be adapted or supplemented.
- This research only looked at collaboration between public client and contractors and did not include suppliers and subcontractors (further supply chain). It might be interesting to see how working with a supplier and/or subcontractor affects the exploitation of the potential of repetitive tasks and how contractors and/or public clients can respond to this.
- Due to the small number of SME contractors interviewed, this research did not distinguish between the advices on collaboration with large contractors and those on collaboration with SME contractors. Follow-up research can investigate whether the advices are also useful in the case of SME contractors and whether the advices should be adapted or supplemented.
- The interviews were conducted in the early stages of the cases, meaning that some tasks had not yet been repeated and the effect of some design elements was not yet known (e.g. the financial incentive). Conducting a longitudinal study can provide insight into the effects of the proposed design elements and associated advices for exploiting the potential of repetitive tasks. Additionally, it could provide insight into the differences in effectiveness of the different design elements and associated advices in terms of exploiting the potential of repetitive tasks.
- This research did not examine the impact of the tender procedure and its selection and award criteria on the exploitation of repetitive tasks. Further research could investigate the effect of procurement procedures on the exploitation of repetitive tasks.
- When using routine, standardisation and industrialisation, it remains important to check whether the specific wishes and requirements of a client are still being met and to regularly evaluate whether the routine, standardisation and industrialisation are still up to date. Further research is needed to determine where and to what extent the use of routine, standardisation and industrialisation is desirable.
- Further research could look at quantifying the potential of repetitive tasks. In the expert evaluation it was suggested to consider project portfolio management and in particular the flow method for this purpose. This knowledge can then be used to formulate a bonus scheme, so that contractors are incentivised to keep improving.
- In the expert evaluation it was suggested that it may be relevant to conduct research into the impact of repetitive tasks and the level (tactical or operational) at which a contractor is involved in an assignment in relation to the level of transaction costs.

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Appendices

A

Search queries - literature review

This appendix outlines the search queries utilised to retrieve relevant articles related to repetitive tasks (section 1.3). It is followed by definitions of repetitive construction projects and the utilization of crews in these projects (Table A.4).

A.1. Used search queries

To gain an understanding of repetitive tasks, several search queries were used in Scopus, Emerald Insight and Google Scholar in combination with the snowballing method. The articles that remained underwent a title and abstract scan. This was conducted to determine the relevance of these articles in formulating a definition of (the potential of) repetitive tasks and/or making a statement about the use of crews in performing repetitive tasks and/or the proportion of repetitive tasks in the construction industry. Results for each search query input into Scopus, Emerald Insight and Google Scholar are presented respectively in Table A.1, Table A.2 and Table A.3.

Table A.1: Search queries Scopus

Search query	Total number of articles found in Scopus	Number of public English articles found in Scopus	Number of relevant articles found in Scopus	Articles used	Snowball effect articles
1. repetitive work* AND construction industry	320	71	2	(Gieskes & ten Broeke, 2000; Pereira & Flood, 2017)	(El-Rayes, 2001)
2. repetitive task* AND construction industry	138	32	1	(Tomczak & Jaśkowski, 2022)	(Ammar, 2020; Hegazy et al., 2014; Ioannou Photios & Yang, 2016; Murguia & Urbina, 2018)
3. repetitive activit* AND construction industry	183	34	3 (of which 1 article has already been found previously with search query 1)	(Agrama, 2011; Pereira & Flood, 2017; Ralli et al., 2020)	(Ammar & Elbeltagi, 2001; Lam et al., 2001; Srour et al., 2015)
4. repetitive project* AND construction industry = repetitive construction project* AND construction industry	253	36	5 (all articles had already been found with search queries 1, 2 and/or 3)	(Agrama, 2011; Gieskes & ten Broeke, 2000; Pereira & Flood, 2017; Ralli et al., 2020; Tomczak & Jaśkowski, 2022)	(Ammar & Elbeltagi, 2001)
5. repetitive construction project* AND construction industry	749	135	10 (of which 4 articles have already been found previously with search queries 1, 2, 3 and/or 4)	(Agrama, 2011; Biruk & Rzepecki, 2019; Gieskes & ten Broeke, 2000; Murguia & Urbina, 2018; Nguyen et al., 2022; Ralli et al., 2020; Simonaitis et al., 2023; Tomczak & Jaśkowski, 2022; Tran et al., 2018, 2019)	(Ammar & Elbeltagi, 2001)
6. repetitive construction process*	1016	208	3 (of which 2 articles have already been found previously with search queries 1, 2, 3 and/or 4)	(Biruk & Rzepecki, 2019; Couto & Teixeira, 2005; Gieskes & ten Broeke, 2000)	-

Table A.2: Search queries Emerald Insight

Search query	Total number of articles found in Emerald Insight	Number of relevant articles found in Emerald Insight	Articles used	Snowball effect articles
1. operations AND repetition AND construction	About 1.000 results; *only articles published from 2018 onwards and limited to the first 150 articles*	3	(Godsell et al., 2018; Maylor et al., 2018; Vestola et al., 2021)	(Construction Task Force, 1998; Karim & Nekoufar, 2012; Larsson & Larsson, 2020; Larsson et al., 2014)

Table A.3: Search queries Google Scholar

Search query	Total number of articles found in Google Scholar	Number of relevant articles found in Google Scholar	Articles used	Snowball effect articles
1. repetitive construction project*	About 863.000 results; *only first 25 pages viewed*	18	(Altuwaim & El-Rayes, 2018, 2021; Bakry et al., 2014; Baqerin et al., 2016; Biruk & Rzepecki, 2019; El-Rayes, 2001; Gottlieb & Haugbølle, 2010; Huang & Sun, 2005; Hyari & El-Rayes, 2006; Ioannou Photios & Yang, 2016; Monghasemi & Abdallah, 2021; Nguyen et al., 2022; Simonaitis et al., 2023; Tomczak & Jaśkowski, 2020, 2022; Tran et al., 2018, 2019; Yang & Chang, 2005)	(Ammar, 2020; Economic Commission for Europe, 1965; Hegazy et al., 2014; Ioannou Photios & Yang, 2016; Murguia & Urbina, 2018; Pearson & Wisner, 1993; Pellegrino et al., 2012; Vorster & Bafna, 1992; Yang & Chang, 2005)
2. repetitive projects AND scheduling	About 19.30 results; *only articles published in 2021*	1	(Ulusoy & Hazır, 2021)	-
3. repetitive work* AND construction industry	About 468.000 results; *only first 10 pages viewed*	6 (all articles were already found with search query 1)	(Altuwaim & El-Rayes, 2021; Biruk & Rzepecki, 2019; Gottlieb & Haugbølle, 2010; Nguyen et al., 2022; Simonaitis et al., 2023; Tomczak & Jaśkowski, 2020)	(Pellegrino et al., 2012)
4. repetitive task* AND construction industry	About 319.000 results; *only first 10 pages viewed*	2 (all articles were already found with search query 1)	(Biruk & Rzepecki, 2019; Tomczak & Jaśkowski, 2022)	(Ammar, 2020; Hegazy et al., 2014; Ioannou Photios & Yang, 2016; Murguia & Urbina, 2018)
5. repetition AND portfolio AND construction industry	About 51.000 results; *only first 10 pages viewed*	5 (of which 2 articles have already been found previously with search query 1)	(Bakker et al., 2011; Blismas et al., 2004; Delisle, 2019; Simonaitis et al., 2023; Yang & Chang, 2005)	-
6. repetitieve werkzaamheden	About 667 results; *only first 10 pages viewed*	1	(Molaei et al., 2023)	(Molaei et al., 2022) -> (Brady & Davies, 2004; Davies & Brady, 2016; Delisle, 2019; Engwall, 2003; Lundin & Söderholm, 1995) -> (Davies & Hobday, 2005a, 2005b; Davies et al., 2009)
7. definition of repetitive activities in manufacturing	About 199.000 results	1	(Spencer & Cox, 1995)	-
8. routine maintenance AND repetition	About 223.000 results	1	(Budai et al., 2006)	-
9. repetitive activities in infrastructure projects	About 17.000 results; *only articles published from 2023 onwards*	1	(X. Zhang et al., 2023)	-
10. industrialisation in renovation AND repetition	About 815 results; *only articles published from 2022 onwards*	1	(Konstantinou & Heesbeen, 2022)	(Richard, 2005)
11. maintenance infrastructure AND repetition	About 16.900 results; *only articles published from 2021 onwards*	1	(Vestola et al., 2021)	(Larsson & Larsson, 2020; Larsson et al., 2014)
12. repetitive activities in infrastructure projects	About 5.380 results; *only articles published from 2024 onwards*	1	(S. Zhang et al., 2024)	-
13. exploitative learning AND repetition AND construction	About 43.600 results; *only first 15 pages viewed*	6 (of which 3 articles have already been found previously with search query 6)	(Brady & Davies, 2004; Davies & Brady, 2000, 2016; Denicol & Davies, 2022; Eriksson & Szentes, 2017)	-
14. exploitative learning AND construction AND repetitive	About 35.500 results; *only first 10 pages viewed*	1	(Liu et al., 2021)	(Eriksson & Leiringer, 2015)

A.2. Definitions repetitive (construction) project(s)

Definitions found in relevant articles on repetitive (construction) project(s) are listed in Table A.4. Definitions relating to the use of construction crews in repetitive tasks are given in Table A.5.

Table A.4: Definitions of repetitive (construction) project(s) found in literature

Definition repetitive (construction) project(s)
“Construction projects that contain many identical units, wherein activities repeat from one unit to another, are characterized as repetitive projects.” (Agrama, 2011, p. 179)
“Construction projects that contain several identical or similar units are usually referred to as repetitive or linear projects.” (Ammar & Elbeltagi, 2001, p. 292)
“Repetitive construction projects are identified as construction projects formed of recurring units, each unit consisting of the same group of sequential activities.” (Bakry et al., 2014, p. 145)
“A repetitive construction project involves a considerable amount of identical or similar tasks performed repeatedly in various locations of the project.” (Baqerin et al., 2016, p. 1) ”Repetitive projects are characterized by having a number of large-scale activities that are recurring in nature.” (Baqerin et al., 2016, p. 1)
“Plenty of construction projects are composed of processes which are repeated a number of times on identical or similar structures or their sections called construction units.” (Biruk & Rzepecki, 2019, p. 1)
“A repetitive construction project is a project whose activities are repeated in similar or identical units.” (Nguyen et al., 2022, p. 1500)
“Repetitive construction projects refer to projects that involve the construction of recurring units, where each unit consists of the same group of sequential activities.” (Simonaitis et al., 2023, p. 2)
“Repetitive construction projects (RCPs) are projects that can be divided into a finite number of working units where the same set of construction processes needs to be conducted and where the quantities of works related with these processes are similar unit to unit.” (Tomczak & Jaśkowski, 2020, p. 1)
“Construction projects that involve repetitive operations are often referred to as repetitive construction projects.” (Tomczak & Jaśkowski, 2022, p. 422) “the execution of a project [involving] repeating some activities (construction processes or works) in different units (locations).” (Tomczak & Jaśkowski, 2022, p. 423)
“Repetitive projects (RPs) are quite common in the construction industry, repetition can be due to geometric and location layouts or due to multiplications of units.” (Tran et al., 2018, p. 160)
“Repetitive projects […] involve the production or construction of similar units in batches.” (Ulusoy & Hazır, 2021, p. 381)

Table A.5: Use of construction crews in repetitive (construction) project(s) according to literature

Construction crews in repetitive (construction) projects
“Repetitive construction projects require construction crews to repeat their work in a number of locations in the same project, moving from one location to the next.” (Altuwaim & El-Rayes, 2018, p. 59)
“The same kind of processes is conducted by construction crew during the works involving many objects or sections of a similar construction type. The crews carry out the same kind of processes on different units and at the next building sites.” (Biruk & Rzepecki, 2019, p. 1)
“RPs often require resources (such as crews) to perform the same task in various units (locations, segments) by moving from one unit to the next (Vanhoucke, 2006).“ (Tran et al., 2019, p. 323)
“In [repetitive construction] projects, a construction crew is often required to repeat the same task in a number of repetitive units in the project, moving from one unit to another.” (El-Rayes, 2001, p. 199)
“construction crews are often required to repeat the same work in various locations of the project, moving from one location to another.” (Hyari & El-Rayes, 2006, p. 11)
“construction crews (resources) repeat the same tasks from one unit to the next, such as from floor to floor, or station to station.” (Ioannou Photios & Yang, 2016, p. 1)
“In repetitive projects, the construction crews are required to move and repeat the same activity in a defined number of units (floors, houses, spans, etc.).” (Nguyen et al., 2022, p. 1500)
Repetitive projects “often require resources (e.g., crews) to perform the same task in various units (locations, segments) by moving from one unit to the next unit in the project.” (Tran et al., 2018, p. 160)
“In repetitive projects, the workers (crews) perform identical, or very similar work as they move from one workstation to another or continue doing the identical work at a fixed location workstation.“ (Ulusoy & Hazır, 2021, p. 381)
“[…] crews perform similar or identical tasks from one working location to another.” (Yang & Chang, 2005, p. 546)

B

Data gathering – empirical research

B.1. Analysed case documents

For each case, the documents analysed are listed in Table B.1.

Table B.1: Documents analysed per case

Case	Document name	Document date	Document code
WL	Selectieleidraad Buitenschil en algemene ruimte	2022	A1
	Selectieleidraad Bij de bewoner binnen	Jan 2022	A2
	Gunningsleidraad Buitenschil en algemene ruimte WP1	May 2022	A3
	220517 Concept overeenkomst voor meerjarig integraal onderhoud en verbetering	may 2022	A4
	Ambitiedocument	May 2022	A5
	220517 Concept model Samenwerking en Coordinatieovereenkomst	May 2022	A6
	202303024 Uitgangspuntendossier	March 2023	A7
	GL6.9 Bijlage Visie Wonen Limburg op samenwerking	May 2022	A8
	VS1.5.1 Bijlage Definities onderhoud Wonen Limburg	May 2022	A9
	VS1.5.5 Bijlage Integriteitsbeleid Wonen Limburg	April 2018	A10
	basisdocument VS2	May 2022	A11
	VS2.4.1 Bijlage Overlegstructuur	May 2022	A12
	VS2.4.7 Bijlage eisen aan vorm en inhoud MJOP en Jaarplan	May 2022	A13
	VS2.4.8 Bijlage eisen aan vorm en inhoud uitvoeringsplan	May 2022	A14
	VS2.4.9 Bijlage eisen aan vorm en inhoud Voortgangsrapportage	May 2022	A15
	VS2.4.10 bijlage eisen aan vorm en inhoud Eindrapportage	May 2022	A16
	VS2.4.11 Bijlage eisen aan Front Office functie	May 2022	A17
	VS2.5.26 Bijlage Strategische koers Wonen Limburg	n.d.	A18
	VS2.5.28 Bijlage Visie op netwerksamenwerking	May 2022	A19
	VS2.5.33 Bijlage opzet Uitgangspuntendossier	May 2022	A20
	GL6.8 Bijlage visie WL op dienstverlening	July 2022	A21
	VS2.4.13 (revisie) Bijlage eisen aan prijsvorming en indexering WP1	May 2022	A22
	VS2.4.14 Bijlage scope en afkoopregeling	May 2022	A23
	basisdocument VS1 wp1	May 2022	A24
	220517 Annexen	May 2022	A25
IPS Schoolgebouwen	AI 2022-0001_Bijlage 8 Rapportage Spanning op de bouwmarkt	may 2020	B1
	AI 2022-0001_Informatiebrochure Innovatiepartnerschap Schoolgebouwen 20220126	Jan 2022	B2
	AI 2022-0001_Onderhandelingsleidraad 20220314	March 2022	B3
	AI 2022-0001_Overeenkomst OO fase 20220314	March 2022	B4
	AI 2022-0001 Raamovereenkomst commerciele fase 20220314	March 2022	B5
	AI 2022-0001_Selectieleidraad Innovatiepartnerschap Schoolgebouwen 20220314	Jan 2022	B6
	Marktconsultatie Innovatiepartnerschap (IPS) schoolgebouwen	April 2021	B7
	AI2022-0001 Bijlage 1 - Procedure minicompetitie	March 2023	B8
WOUW	Aanbestedingsleidraad	Aug 2021	C1
	Toelichting Vooraankondiging	July 2021	C2
	Waardengedreven OnderhoudsContract Uiterwaarden	Aug 2021	C3
	Projectvisie	Aug 2021	C4
	Generieke IPH uiterwaarden	July 2021	C5
	Presentatie Startbijeenkomst WOUW	Aug 2021	C6
	Powerpoint presentatie WOUW_4	n.d.	C7
	Appendix 4 Demarcatiedocument dd. 26 augustus 2021	Aug 2021	C8

B.2. Additional information cases

B.2.1. Additional information WL

Requirements from WL

For maintenance, WL works with a pre-defined set of conditions included in so-called quality cards [**A1; A24**]. For improvement programmes, qualitative performance agreements are made, such as: energy label A applies to complexes X, Y and Z [**A1**]. Through the performance agreements made with the network partners, WL aims to ensure that result-oriented work is carried out and evaluated. WL uses cyclical go/no-go moments where the performance of a network partner is used to consider whether or not to continue the collaboration [**A1**]. Through the use of penalties and discounts, WL seeks to

incentivise network partners to meet agreed performance [**A4; A35**].

Annual assignment process

Annually, WL provides the so-called ”baseline file”, the framework within which the MYMP and the annual plan must comply. The network partner then draws up an MYMP and an annual plan, and WL aims to give the network partner room for interpretation. In this way, WL tries to ”use everyone’s knowledge and experience to complement the frameworks and to explore and analyse together the best outcome” [**A8**]. As WL indicates, ”the result of the joint search for optimisation is recorded in annual plans” [**A8**]. As also shown in Figure B.1, once approved by WL, the annual plan is converted into a task order, after which the network partner begins the work, and is ultimately judged on its performance. In this way, WL tries to maintain ”an appropriate balance between steering well, keeping a grip, and jointly optimising and learning” [**A8**]. In their annual plans, network partners have to demonstrate to WL that they are continuously improving the way they work, by ”increasing the number of jobs that are done well in one go, or resolving cases faster/smarter” [**A13; A15**]. At the end of the year there is an annual evaluation. During the annual evaluation, feedback is given not only on any deviations from the annual plan, but also on improvements for the coming year, which the network partner has included in its final report. In addition, the network partner reflects in its final report on its achievements in terms of improvements [**A16**]. Optimisation can refer to both doing more work for the same budget and/or adding qualitative value [**A4**].

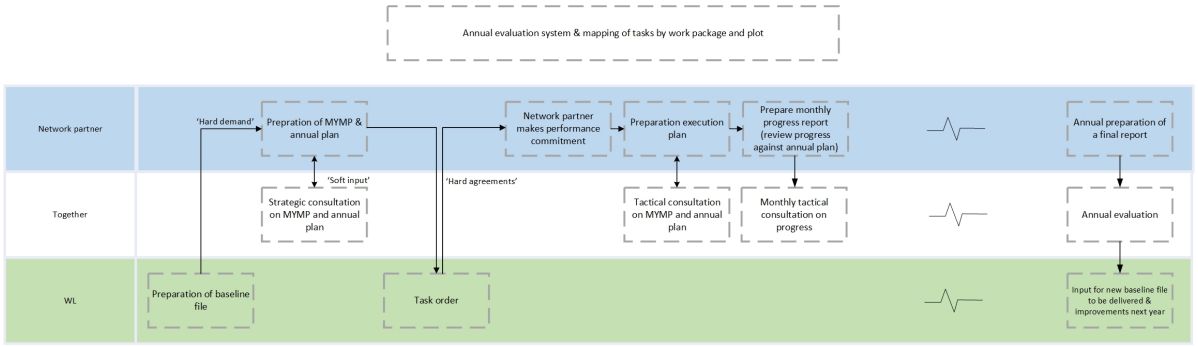

Figure B.1: Evaluation system used by WL

Reward system

- For repairs, the network partners specified a surrender value in the bidding process, which bought off all repair maintenance [**A23**].
- For planned and preventive maintenance, the network partner submitted unit prices. These unit prices, combined with WL’s provided baseline file (which includes portfolio data), annually determine the price the network partner receives [**A22**].
- For programmatic improvements, a combination of using stated unit prices during tendering and an open budget is applied, as the scope is still unknown and will be determined in collaboration between WL and the network partner [**A22**].
- For tenant improvements, price books of WL are used [**A22**].

Relational design

WL expects its network partners, like WL, to:

- act honestly and transparently, take responsibility and commit to collaboration [**A1; A2**];
- achieve their own and common goals on the basis of trust [**A1; A2; A5**];
- recognise and respect each other’s interests [**A5**];
- share responsibility and work with mutual respect [**A8**];
- have a sufficient degree of self-reflection about their role in the collaboration [**A19**].

In addition, WL indicates that openness and trust are desirable as they are the basis for “continuous learning, continuous improvement and working together to achieve the best outcome for residents” [**A5**]. During the tendering process, WL searched for network partners who shared the same values and drivers, with a focus on establishing a ”cultural fit” [**A8; A19**].

After awarding the assignment to seven network partners, WL decided to organise a Start Up Collaboration meeting with the aim of shaping the new collaboration together with the network partners on an equal footing. During this meeting, the underlying principles of the collaboration were discussed and a code of conduct was jointly drawn up [**A8; A11; A19**]. The code of conduct is seen as “sharpening the way we deal with each other in order to get the special collaboration under this contract off to a good start and to maintain it well thereafter” [**A11**].

Ingrowth period

It is noteworthy that **A25** describes a grow-in period that starts after the agreement is signed and lasts until the end of the first year (2023). This period is used by both WL and the network partners to become better acquainted with the new type of maintenance and the processes involved, and is partly due to the unfamiliarity of some of the included properties (work packages 1 and 2). During the grow-in period, wider margins will be applied to the MYMP, annual plan, service requirements and data handling.

B.2.2. Additional information IPS Schoolgebouwen

Number of bundled school buildings

As described in subsection 3.2.2, the municipality of Amsterdam wants to build fifty primary schools and ten secondary schools by 2040. However, IPS Schoolgebouwen only includes part of the demand for school buildings, only part of the primary schools, because the municipality of Amsterdam wanted to include school buildings that are all similar: ”stand-alone” and new construction [**B2**]. In addition, the ten-year contract period means that not all the required school buildings can be realised [**B2**].

The uncertainty regarding the exact number of school buildings to be realised in the commercial phase (min. 9, max. 30) is related to the uncertainty regarding the residential development [**B2**]. Furthermore, school boards and municipalities within the Amsterdam Metropolitan Region can participate during the commercial phase and have school buildings included in the framework agreement [**B2**] (Gemeente Amsterdam, 2023).

Relational design

The municipality of Amsterdam has included the following sentence in **B5**: “It is important to trust each other and to hold each other accountable for the way we work together”. To achieve this, the municipality of Amsterdam uses performance measurement. For this purpose, questionnaires on attitudes and behaviour are filled in by both the client and the contractor [**B2**].

Background information procurement procedure the innovation partnership

The municipality of Amsterdam used the innovation partnership, because it enables innovation-oriented collaboration [**B2**] and provides sufficient scale and opportunities for the application of innovation by market parties [**B2**]. A special feature of the innovation partnership is that after the R&D phase has been completed, no new procurement procedure has to be carried out to procure the developed innovative solution(s) (Tweede Kamer der Staten-Generaal, 2015). In addition, the use of a framework agreement means that no European tender has to be applied for the distribution of further assignments (Pianoo, n.d.-d).

B.2.3. Additional information WOUW

Reward system

There is a fixed price for each plot based on the available budget, within which the tasks are defined [**C1; C3**]. The pricing process and determination of the tasks per year is done jointly by the public client and the contractor, due to the uncertainty of the maintenance assignment and the creation of maximum client value [**C1; C2; C3**]. In addition to price, risk allocation is also taken into consideration [**C1**]. The contractor’s actual payment is determined by the tasks executed [**C1**], and the principle of ”fair pay for fair work” is applied.

Relational design
In collaboration, RWS considers it important that equivalence is sought and that any obstacles are negotiable [**C2; C4**]. Equivalence was also reflected by RWS in the contractor's approach term: assignment partner (in Dutch: opdrachtpartner) [**C4**]. In addition, the expertise of the parties involved is recognised, used and respected [**C4**]. RWS also aims to "give the plot teams as much freedom as possible on the basis of trust and a shared vision" [**C6**].

A project start-up phase was carried out separately by RWS with the three contracted contractors after the tender process, in order to jointly (RWS and the contractor) "get to the bottom of the assignment and set goals", to get to know each other better and to increase the success of the single IPM team (Rijkswaterstaat, 2023b) [**C1**].

B.3. Interview protocol

Interview protocol in Dutch
In deze bijlage bevindt zich het interviewprotocol gebruikt voor de interviews met mensen werkend voor een publieke opdrachtgever betrokken in één van de drie bestudeerde casussen (zie subsection B.3.1). Daarnaast is het interviewprotocol opgenomen dat is gebruikt voor de interviews met mensen werkend voor een marktpartij betrokken in één van de drie bestudeerde casussen (zie subsection B.3.2). Omdat de interviews gezamenlijk met dr.ir. Maedeh Molaei zijn afgenomen in het kader van een breder onderzoek, zijn de vragen specifiek relevant voor dit onderzoek aangegeven in blauw. Het interviewprotocol is hieronder in het Nederlands, omdat de interviews allemaal in het Nederlands zijn afgenomen.

B.3.1. Interview protocol - Public client

Inleiding
De verwachte duur van de interviews is ongeveer 60 minuten en de interviews worden afgenomen door Maedeh Molaei en Heleen Smit. De informatie die wordt verkregen gedurende de interviews, wordt vastgelegd met audio-opnames en schriftelijke aantekeningen. Voorafgaand aan elk interview wordt aan de geïnterviewden gevraagd om een toestemmingsformulier ('informed consent form') te ondertekenen. Hierin is opgenomen wat het doel is van de interviews en hoe wordt omgegaan met de verkregen data uit de interviews. Na afloop van de interviews worden de uitgewerkte transcripties voorgelegd aan de geïnterviewden en worden na goedkeuring gebruikt voor de data analyse.

1 Deel I: Introductie [5 min]
Allereerst de geïnterviewde bedanken voor zijn/haar deelname aan het onderzoek, waarna Maedeh en Heleen zichzelf en het onderzoek introduceren. Vervolgens aangeven dat het interview ongeveer een uur zal duren en vragen of de geïnterviewde akkoord is als het interview wordt opgenomen. De geïnterviewde krijgt een samenvatting van het interview met de vraag of zij/hij het met de inhoud eens is. De audio-opname wordt na transcriptie verwijderd.

1.1 Wat is uw huidige functie en hoe lang bent u werkzaam in uw huidige functie?
1.2 Welke rol vervult u in [casus]?

Voordat we beginnen, zullen we kort de scope van het onderzoek toelichten. Met "samenwerking" bedoelen we het proces van het faciliteren en opereren in inter-organisatorische arrangementen om (maatschappelijke) problemen op te lossen die niet of niet gemakkelijk door een enkele organisatie kunnen worden opgelost (O'Leary et al., 2006). Hiermee bedoelen we niet per se de individuele overeenkomst die uw organisatie heeft met [naam van de opdrachtgever] of met andere partners [opdrachtnemers] in het consortium. Het betreft het gehele systeem dat is opgezet om een probleem op te lossen.

2 Deel II: Ambitie en bedoeling [15 min]
De eerste stap in de samenwerking is het vastleggen van het "waarom" de deelnemende organisaties deelnemen aan de samenwerking (hun ambitie en bedoeling). De volgende vragen gaan over de ambitie en bedoeling van deze samenwerking.

Vastleggen van de doelstellingen van de moederorganisaties
2.1 Hoe sluit de samenwerking in [casus] aan op de bedrijfsambities en doelstellingen van [naam van

de opdrachtgever]?

Vaststellen noodzaak tot samenwerking en vastleggen van de samenwerkingsvisie
2.2 Heeft u het idee dat de samenwerkingsvisie van [naam opdrachtgever] in [casus] duidelijk was voor de [netwerkpartners (WL), innovatiepartners (IPS), opdrachtpartners (WOUW)]?

- 2.2.1 Zo ja, hoe hebben jullie hiervoor gezorgd?
- 2.2.2 Zo nee, waarom denkt u dat de samenwerkingsvisie niet duidelijk is voor de marktpartijen?
- 2.2.3 Maken jullie ook gebruik van tussentijdse terugkoppelingen op de samenwerkingsvisie? En zo nee, waarom?

Het identificeren van samenhangende deelopgaven en oog voor de repetitie in dat verband
2.3 Hoe zou u repetitieve werkzaamheden definiëren en kunt u voorbeelden noemen van repetitieve werkzaamheden in [casus]?

In [casus] hebben wij verschillende vergelijkbare werkzaamheden teruggevonden, zoals onderhoudswerkzaamheden aan verschillende complexen (WL), de opeenvolgende bouw van schoolgebouwen (IPS) en onderhoudswerkzaamheden aan uiterwaarden op verschillende locaties (WOUW).

In [casus] valt op dat voor het realiseren van de opgave, gebruik is gemaakt van bundeling van opdrachten (IPS)/werkzaamheden in verschillende werkpakketten (WL)/werkzaamheden in verschillende percelen (WOUW). Allereerst zal worden gevraagd naar de bundeling vanuit het perspectief van de opdrachtgever.

2.4 Waarop is de keuze voor de bundeling van werkzaamheden in werkpakketten en/of percelen (WOUW en WL) / bundeling van opdrachten (IPS) in [casus] gebaseerd?

- 2.4.1 Is bij deze manier van bundeling rekening gehouden met repetitie van bepaalde werkzaamheden vanuit het portfolio perspectief van de opdrachtgever? Zo ja, hoe? En zo nee, waarom?

Hierna zal worden gevraagd naar de bundeling vanuit het perspectief van de opdrachtnemer.

2.5 Is met bepaling van het volume van de werkpakketten en/of percelen rekening gehouden met de bedrijfsvoering van de gecontracteerde marktpartijen en hun capaciteit? Zo ja, hoe is hiervoor gezorgd? En zo nee, waarom niet?

- 2.5.1 Is bij deze manier van bundeling rekening gehouden met het vergroten van het aantal repetitieve werkzaamheden voor opdrachtnemers?

2.6 Op welke manier is rekening gehouden met deelname van het mkb aan [casus]? Kunt u daar voorbeelden van geven?

Keuze en vormgeving van de samenwerkingsvorm
2.7 Op welke manier wijkt het huidige ontwerp van [casus] af van eerdere (vergelijkbare) opdrachten vormgegeven door [naam van de opdrachtgever] en waarom is hiervoor gekozen?
2.8 Hoe sluit de gekozen contractinrichting (langjarig contract met verdeelde werkpakketten danwel percelen (WL en WOUW) danwel raamovereenkomst met mini-competitie (IPS)) aan op de opgave-doelstellingen?

3 Deel III: Inrichten van de samenwerking en potentieel van repetitieve werkzaamheden daarin [15 min]
Elke organisatie heeft zijn eigen cultuur, normen en waarden. Dit kan van invloed zijn op de samenwerking met andere organisaties.
Ontwerpuitgangspunten samenwerking
3.1 In hoeverre waren de normen en waarden van de opdrachtgever van invloed op de vormgeving van de samenwerking? Zo ja kunt u hier voorbeelden van noemen? Zo nee, waarom denkt u van niet?
3.2 Wat was de invloed van de normen en waarden van de opdrachtpartners op de vormgeving van de

samenwerking?

Lerend vermogen en potentieel van repetitieve werkzaamheden benutten in de samenwerking
Het repetitieve karakter biedt kansen op het gebied van leren van eerdere ervaringen en aanbrengen van verbeteringen voor toekomstige (vergelijkbare) werkzaamheden.
3.3 Wat is volgens u het potentieel van repetitieve werkzaamheden in [casus]? 3.4 Ziet u ook dat repetitieve werkzaamheden zich goed lenen om te leren (van opgedane ervaringen) en verbeteren?

- 3.4.1 Wordt hier binnen de samenwerking in [casus] ook ruimte voor geboden? Zo ja (met onderstaande sub vragen erachter komen op welke manier hier in de samenwerking invulling aan is gegeven):
  -Welke elementen in de samenwerking **dragen** volgens u bij aan het (kunnen) benutten van het potentieel van repetitieve werkzaamheden en waarom? *(bijv. bepaalde overlegstructuren, kennisborging, bundeling, type contract, risicoverdeling, prijsbepaling)*
  -Welke elementen in de samenwerking **belemmeren** volgens u het benutten van het potentieel van repetitieve werkzaamheden en waarom?
  -Welke elementen in de samenwerking **ontbreken** volgens u om in staat te zijn het potentieel van repetitieve werkzaamheden te benutten en waarom?
  -Zouden uw antwoorden op bovenstaande vragen anders zijn als specifiek wordt gevraagd naar samenwerking met het mkb of grote bedrijven en waarom?
- 3.4.2 Zo nee, wat is er volgens u in een samenwerking nodig om te leren en verbeteren? En welke elementen in de samenwerking en ontwerpelementen van een opdracht zouden volgens u het benutten van het potentieel van repetitieve werkzaamheden belemmeren?

3.5 Zou u voorbeelden kunnen noemen van verbeteringen die zijn doorgevoerd in [casus] en zijn toe te wijzen aan de repetitie? / Zou u voorbeelden kunnen noemen waaruit blijkt dat het potentieel van repetitieve werkzaamheden in [casus] is benut?

- 3.5.1 Hoe zijn deze verbeteringen tot stand gekomen en wat was er voor nodig?

3.6 In hoeverre worden de lessen uit dagelijkse werkzaamheden in [casus] gedeeld en/of gebruikt in het kader van een overeenkomst tussen de opdrachtgever en bijbehorende gecontracteerde marktpartij?
3.7 In hoeverre worden de lessen uit [casus] gedeeld en/of gebruikt tussen de gecontracteerde marktpartijen en de opdrachtgever voor vergelijkbare werkzaamheden binnen [casus (het hele programma)]?
3.8 In hoeverre denkt u dat samenwerking tussen publieke opdrachtgever en opdrachtnemer(s) essentieel is voor het benutten van het potentieel van repetitieve werkzaamheden?

Rollen, taken, verantwoordelijkheden en besluitvorming
De volgende vragen gaan over de rollen, taken en verantwoordelijkheden van de deelnemende partijen in de onderliggende overeenkomst(en) van de samenwerking in [casus].

3.9 Hoe duidelijk zijn de rollen, taken en verantwoordelijkheden van de partijen?

- 3.9.1 Welke taken en verantwoordelijkheden heeft u binnen het contract?
- 3.9.2 Welke taken en verantwoordelijkheden heeft de andere contractant?
- 3.9.3 Werkt dat zo ook in de praktijk?

Contractuele prikkels
3.10 Hoe worden contractuele prikkels geregeld in het contract?

- 3.10.1 Wat was de risicoverdeling volgens het contract? Kunt u daar voorbeelden van geven?
- 3.10.2 Wordt ook op die manier gehandeld in de praktijk? En zo nee, wat is het verschil?

3.11 Werken de contractuele prikkels mee in het kader van de doelstellingen van de samenwerking (zowel positief / belonend / kansen als negatief / ‘afrekenend’ / malus)? Zo ja, hoe? Zo nee, waarom

niet en welke andere contractuele prikkels ontbreken?

- 3.11.1 Hoe wordt ruimte gecreëerd voor ontwikkeling en leren?

Steun van topmanagement
Leiderschap speelt een cruciale rol in de kans van slagen van de samenwerking. Steun van topmanagement op strategisch niveau, zoals de stuurgroep die bestaat uit portfoliomanagers en directeuren van bedrijven, kunnen de samenwerking bijvoorbeeld bevorderen.

3.12 Hoe ervaart u de steun van het topmanagement van uw organisatie in deze samenwerking?
3.13 Hoe ervaart u de steun van het topmanagement van marktpartijen in deze samenwerking?

4 Deel IV: Resultaat van de samenwerking [15 min]
Hierna zouden we u graag verschillende vragen willen voorleggen die betrekking hebben op het resultaat van de samenwerking (tot nu toe).
4.1 Wat is volgens u het belangrijkste resultaat in de samenwerking in [casus]?

5 Deel VI: Afsluiting/afronding [5 min]
Als ik het goed heb begrepen, ….. (check-vraag, korte samenvatting).

5.1 Als u iets zou mogen veranderen/toevoegen aan de contracten/samenwerkingsovereenkomsten van [casus], wat zou dat zijn?
5.2 Zijn er onderwerpen niet aan bod gekomen in dit interview die u wellicht nog belangrijk vindt om te bespreken?
5.3 Heeft u voor ons eventueel nog relevante documenten betreffende ontwerpaspecten van de samenwerking gebruikt in [casus], repetitieve werkzaamheden etc.?

Na afloop van het interview wordt de audio-opname gebruikt voor de transcriptie. Zou u de (belangrijkste resultaten van de) transcriptie voorafgaand aan het verder verwerken van interviewgegevens willen inzien en indien nodig aanpassen? Zou u geïnteresseerd zijn in de resultaten van ons onderzoek?

Referenties
O'Leary, R., Gerard, C., & Bingham, L. B. (2006). Introduction to the symposium on collaborative public management. *Public administration review*,*66*, 6-9.

B.3.2. Interview protocol - Contractor

Inleiding
De verwachte duur van de interviews is ongeveer 60 minuten en de interviews worden afgenomen door Maedeh Molaei en Heleen Smit. De informatie die wordt verkregen gedurende de interviews, wordt vastgelegd met audio-opnames en schriftelijke aantekeningen. Voorafgaand aan elk interview wordt aan de geïnterviewden gevraagd om een toestemmingsformulier ('informed consent form') te ondertekenen. Hierin is opgenomen wat het doel is van de interviews en hoe wordt omgegaan met de verkregen data uit de interviews. Na afloop van de interviews worden de uitgewerkte transcripties voorgelegd aan de geïnterviewden en worden na goedkeuring gebruikt voor de data analyse.

1 Deel I: Introductie [5 min]
Allereerst de geïnterviewde bedanken voor zijn/haar deelname aan het onderzoek, waarna Maedeh en Heleen zichzelf en het onderzoek introduceren. Vervolgens aangeven dat het interview ongeveer een uur zal duren en vragen of de geïnterviewde akkoord is als het interview wordt opgenomen. De geïnterviewde krijgt een samenvatting van het interview met de vraag of zij/hij het met de inhoud eens is. De audio-opname wordt na transcriptie verwijderd.

1.1 Wat is uw huidige functie en hoe lang bent u werkzaam in uw huidige functie?
1.2 Valt het bedrijf waarin u werkzaam bent onder de definitie van het mkb?
1.3 Welke rol vervult u in [casus]?
1.4 Hoe groot aandeel van de bedrijfsomzet van het bedrijf waarin u werkzaam bent, is afkomstig uit de opdracht van [casus]?

Voordat we beginnen, zullen we kort de scope van het onderzoek toelichten. Met "samenwerking" bedoelen we het proces van het faciliteren en opereren in inter-organisatorische arrangementen om (maatschappelijke) problemen op te lossen die niet of niet gemakkelijk door een enkele organisatie kunnen worden opgelost (O'Leary et al., 2006). Hiermee bedoelen we niet per se de individuele overeenkomst die uw organisatie heeft met [naam van de opdrachtgever] of met andere partners [opdrachtnemers] in het consortium. Het betreft het gehele systeem dat is opgezet om een probleem op te lossen.

2 Deel II: Ambitie en bedoeling [15 min]
De eerste stap in de samenwerking is het vastleggen van het "waarom" de deelnemende organisaties deelnemen aan de samenwerking (hun ambitie en bedoeling). De volgende vragen gaan over de ambitie en bedoeling van deze samenwerking.

Vastleggen van de doelstellingen van de moederorganisaties
2.1 Hoe sluit de samenwerking in [casus] aan op de bedrijfsambities en doelstellingen van [naam van de opdrachtgever]?

- 2.1.1 Kunt u in uw eigen woorden uitleggen wat de doelstellingen zijn van [casus]?

2.2 Waarom heeft u als opdrachtnemer besloten deel te nemen aan de samenwerking?

Vaststellen noodzaak tot samenwerking en vastleggen van de samenwerkingsvisie
2.3 Wat is de samenwerkingsvisie van uw bedrijf binnen [casus] en waarom heeft uw bedrijf gekozen om deel te nemen aan deze samenwerking?

- 2.3.1 Hebben de [netwerkpartners (WL)/ innovatiepartners (IPS)/opdrachtpartners (WOUW)] in uw consortium dezelfde visie?

Het identificeren van samenhangende deelopgaven en oog voor de repetitie in dat verband
2.4 Hoe zou u repetitieve werkzaamheden definiëren en kunt u voorbeelden noemen van repetitieve werkzaamheden in [casus]?

In [casus] hebben wij verschillende vergelijkbare werkzaamheden teruggevonden, zoals onderhoudswerkzaamheden aan verschillende complexen (WL), de opeenvolgende bouw van schoolgebouwen (IPS) en onderhoudswerkzaamheden aan uiterwaarden op verschillende locaties (WOUW).

In [casus] valt op dat voor het realiseren van de opgave, gebruik is gemaakt van bundeling van opdrachten (IPS)/werkzaamheden in verschillende werkpakketten (WL)/werkzaamheden in verschillende percelen (WOUW). Allereerst zal worden gevraagd naar de bundeling vanuit het perspectief van de opdrachtgever.

2.5 Sluit de inhoud, capaciteit en volume van de werkpakketten en/of percelen aan op de bedrijfsvoering van het bedrijf waarin u werkzaam bent?
2.6 Biedt de gehanteerde manier van bundeling in [casus] (meer) mogelijkheden voor repetitieve werkzaamheden (in uw portfolio)? En zo ja, waarom en zo nee, waarom niet?

Keuze en vormgeving van de samenwerkingsvorm
2.7 Heeft u het idee dat de vormgeving van [casus] anders is dan van eerdere (vergelijkbare) opdrachten vormgegeven door [naam van de opdrachtgever], waarom denkt u dat hiervoor is gekozen en ziet u hier meerwaarde in?
2.8 Hoe sluit de gekozen contractinrichting (langjarig contract met verdeelde werkpakketten danwel percelen (WL en WOUW) danwel raamovereenkomst met mini-competitie (IPS)) aan op de bedrijfsvoering van het bedrijf waarin u werkzaam bent?

- 2.8.1 Biedt de samenwerkign voldoende opschalingsmogelijkheden?

3 Deel III: Inrichten van de samenwerking en potentieel van repetitieve werkzaamheden daarin [15 min]

Elke organisatie heeft zijn eigen cultuur, normen en waarden. Dit kan van invloed zijn op de samenwerking met andere organisaties.

Ontwerpuitgangspunten samenwerking
3.1 In hoeverre waren de normen en waarden van de opdrachtgever van invloed op de vormgeving van de samenwerking? Zo ja kunt u hier voorbeelden van noemen? Zo nee, waarom denkt u van niet?
3.2 Wat was de invloed van de normen en waarden van de opdrachtpartners op de vormgeving van de samenwerking?

Lerend vermogen en potentieel van repetitieve werkzaamheden benutten in de samenwerking
Het repetitieve karakter biedt kansen op het gebied van leren van eerdere ervaringen en aanbrengen van verbeteringen voor toekomstige (vergelijkbare) werkzaamheden.

3.3 Wat is volgens u het potentieel van repetitieve werkzaamheden in [casus]? 3.4 Ziet u ook dat repetitieve werkzaamheden zich goed lenen om te leren (van opgedane ervaringen) en verbeteren?

- 3.4.1 Wordt hier binnen de samenwerking in [casus] ook ruimte voor geboden? Zo ja (met onderstaande sub vragen erachter komen op welke manier hier in de samenwerking invulling aan is gegeven):
  -Welke elementen in de samenwerking **dragen** volgens u bij aan het (kunnen) benutten van het potentieel van repetitieve werkzaamheden en waarom? *(bijv. bepaalde overlegstructuren, kennisborging, bundeling, type contract, risicoverdeling, prijsbepaling)*
  -Welke elementen in de samenwerking **belemmeren** volgens u het benutten van het potentieel van repetitieve werkzaamheden en waarom?
  -Welke elementen in de samenwerking **ontbreken** volgens u om in staat te zijn het potentieel van repetitieve werkzaamheden te benutten en waarom?
  -Zouden uw antwoorden op bovenstaande vragen anders zijn als specifiek wordt gevraagd naar samenwerking met het mkb of grote bedrijven en waarom?
- 3.4.2 Zo nee, wat is er volgens u in een samenwerking nodig om te leren en verbeteren? En welke elementen in de samenwerking en ontwerpelementen van een opdracht zouden volgens u het benutten van het potentieel van repetitieve werkzaamheden belemmeren?

3.5 Zou u voorbeelden kunnen noemen van verbeteringen die zijn doorgevoerd in [casus] en zijn toe te wijzen aan de repetitie? / Zou u voorbeelden kunnen noemen waaruit blijkt dat het potentieel van repetitieve werkzaamheden in [casus] is benut?

- 3.5.1 Hoe zijn deze verbeteringen tot stand gekomen en wat was er voor nodig?

3.6 In hoeverre worden de lessen uit dagelijkse werkzaamheden in [casus] gedeeld en/of gebruikt in het kader van een overeenkomst tussen de opdrachtgever en bijbehorende gecontracteerde marktpartij?
3.7 In hoeverre worden de lessen uit [casus] gedeeld en/of gebruikt tussen de gecontracteerde marktpartijen en de opdrachtgever voor vergelijkbare werkzaamheden binnen [casus (het hele programma)]?
3.8 In hoeverre denkt u dat samenwerking tussen publieke opdrachtgever en opdrachtnemer(s) essentieel is voor het benutten van het potentieel van repetitieve werkzaamheden?

Rollen, taken, verantwoordelijkheden en besluitvorming
De volgende vragen gaan over de rollen, taken en verantwoordelijkheden van de deelnemende partijen in de onderliggende overeenkomst(en) van de samenwerking in [casus].

3.9 Hoe duidelijk zijn de rollen, taken en verantwoordelijkheden van de partijen?

- 3.9.1 Welke taken en verantwoordelijkheden heeft u binnen het contract?
- 3.9.2 Welke taken en verantwoordelijkheden heeft de andere contractant?
- 3.9.3 Werkt dat zo ook in de praktijk?

Contractuele prikkels
3.10 Hoe worden contractuele prikkels geregeld in het contract?

- 3.10.1 Wat was de risicoverdeling volgens het contract? Kunt u daar voorbeelden van geven?
- 3.10.2 Wordt ook op die manier gehandeld in de praktijk? En zo nee, wat is het verschil?

3.11 Werken de contractuele prikkels mee in het kader van de doelstellingen van de samenwerking (zowel positief / belonend / kansen als negatief / 'afrekenend' / malus)? Zo ja, hoe? Zo nee, waarom niet en welke andere contractuele prikkels ontbreken?

- 3.11.1 Hoe wordt ruimte gecreëerd voor ontwikkeling en leren?

Steun van topmanagement
Leiderschap speelt een cruciale rol in de kans van slagen van de samenwerking. Steun van topmanagement op strategisch niveau, zoals de stuurgroep die bestaat uit portfoliomanagers en directeuren van bedrijven, kunnen de samenwerking bijvoorbeeld bevorderen.

3.12 Hoe ervaart u de steun van het topmanagement van uw organisatie in deze samenwerking?
3.13 Hoe ervaart u de steun van het topmanagement van marktpartijen in deze samenwerking?

4 Deel IV: Resultaat van de samenwerking [15 min]
Hierna zouden we u graag verschillende vragen willen voorleggen die betrekking hebben op het resultaat van de samenwerking (tot nu toe).
4.1 Wat is volgens u het belangrijkste resultaat in de samenwerking in [casus]?

5 Deel VI: Afsluiting/afronding [5 min]
Als ik het goed heb begrepen, ….. (check-vraag, korte samenvatting).
5.1 Als u iets zou mogen veranderen/toevoegen aan de contracten/samenwerkingsovereenkomsten van [casus], wat zou dat zijn?
5.2 Zijn er onderwerpen niet aan bod gekomen in dit interview die u wellicht nog belangrijk vindt om te bespreken?
5.3 Heeft u voor ons eventueel nog relevante documenten betreffende ontwerpaspecten van de samenwerking gebruikt in [casus], repetitieve werkzaamheden etc.?

Na afloop van het interview wordt de audio-opname gebruikt voor de transcriptie. Zou u de (belangrijkste resultaten van de) transcriptie voorafgaand aan het verder verwerken van interviewgegevens willen inzien en indien nodig aanpassen? Zou u geïnteresseerd zijn in de resultaten van ons onderzoek?

Referenties
O'Leary, R., Gerard, C., & Bingham, L. B. (2006). Introduction to the symposium on collaborative public management. *Public administration review*,*66*, 6-9.

C

Answers semi-structured interviews

In this appendix, the answers given during the semi-structured interviews are tabulated for each case. For each case, the topics include (1) examples of repetitive tasks, (2) required design elements to exploit the potential, (3) promoting design elements, and (4) hindering design elements. The responses of both the public clients and contractors interviewed are included in each table. If the answers of an interviewed public client and an interviewed contractor match, the answers are included in the table on the same row. If only one interviewed public client or one interviewed contractor gave a particular answer, [-] and the answer are used.

C.1. Obtained answers - WL

C.1.1. Examples of repetitive tasks

Table C.1: Mentioned examples of preparatory tasks

Public client	Contractor
Work preparation [PWL.1]	Planning of painting tasks [cWL.5]
Planning and directing: schedule the same type of tasks every year [PWL.1]	Scheduling of repetitive tasks [CWL.4, cWL.6]
[-]	Processing receipts [CWL.4]
[-]	Procurement of materials [cWL.6]

Table C.2: Mentioned examples of execution tasks

Public client	Contractor
Kitchen repairs [PWL.1] and void repairs [PWL.2]	Repairs [cWL.6] and void repairs [CWL.4, cWL.5]
Planned maintenance (roof maintenance [PWL.1], inspections [PWL.2])	Planned maintenance (painting, roof maintenance [CWL.4], replacing jointing) [cWL.5]
Preventive maintenance [PWL.2]	[-]
Corrective maintenance [PWL.2]	[-]
Replacement maintenance [PWL.2]	Replacing housing elements project-based [cWL.6]
[-]	Energy and sustainability projects [CWL.4]
[-]	Bathroom, kitchen and toilet renovations [CWL.4]

C.1.2. Required to exploit the potential

Table C.3: Mentioned required design elements to exploit the potential

Public client	Contractor
Collaboration – Knowledge exchange between public client and contractor for testing [PWL.1, PWL.2]	Collaboration – Knowledge exchange between public client and contractor for testing [CWL.4]
[-]	Collaboration and knowledge exchange at tactical level between public client and contractor and between contractors [cWL.5]
[-]	Knowledge exchange between contractors [CWL.4, cWL.6]
[-]	Collaboration - budget public client [cWL.6]
Tacking maintenance data [PWL.1]	[-]
[-]	Good scheduling – working in trains [CWL.4]
[-]	Sufficient volume of tasks combined with continuity [CWL.4]
[-]	Preferably, multiple repetitions because of the payback opportunity [cWL.6]
[-]	Agree on KPIs [cWL.5]
[-]	Real estate data in order [cWL.6]

C.1.3. Promoting design elements

Table C.4: Mentioned promoting design elements

Public client	Contractor
Contractor responsible for large volume of maintenance tasks [PWL.1]	[-]
Bundling of uniform property [PWL.1]	[-]
Surrender value repair maintenance [PWL.1]	Surrender value repair maintenance [cWL.5, cWL.6]
Integrality of maintenance tasks [PWL.2]	Integrality of maintenance tasks and contractor involved in planning and directing [CWL.4]
Long-term collaboration with the same parties [PWL.2]	Long-term contract with the same public client and the same houses – providing continuity [CWL.4]
[-]	Long-term contract – benefit from improvements [cWL.5, cWL.6]
Reflecting [PWL.2]	[-]
[-]	Contractor responsible for preparing MYMP [cWL.5]
[-]	Contractor involved at tactical level [cWL.6]
[-]	Quoted unit prices promote efficient working [CWL.4]

C.1.4. Hindering design elements

Table C.5: Mentioned hindering design elements

Public client	Contractor
Lack of KPIs and therefore no bonus scheme [PWL.1]	[-]
[-]	Lack of clarity in demarcation [CWL.4]
[-]	Lack of clarity strategy real estate complexes [cWL.5]
[-]	Unclear or unavailable (real estate) data [cWL.6]

C.2. Obtained answers - IPS Schoolgebouwen

C.2.1. Examples of repetitive tasks

Table C.6: Mentioned examples of preparatory tasks

Public client	Contractor
(Process of a) mini-competition [PIPS.1, PIPS.2]	(Process of a) mini-competition [cIPS.6]
As a contractor, make a design and verify it with the client [PIPS.2, PIPS.3, SIPS.7]	Design each school building [cIPS.6] in BIM [CIPS.4]

Table C.7: Mentioned examples of execution tasks

Public client	Contractor
Elements in building concept [PIPS.3]	Element in building concept [cIPS.6]: every time the same column, the same connection to floor slabs [CIPS.4]
Technique in school buildings [PIPS.1]	[-]
Construction of school buildings [PIPS.1], similar classrooms, entrance hall, gym, crèche [PIPS.2, SIPS.7]	[-]
[-]	Work plans [CIPS.4]: because laying a foundation in the same way
[-]	The assembly process of (recurring) 2D elements (due to prefabrication of elements) [CIPS.5]
[-]	80-90% of the building concept (product and process) [cIPS.6]

C.2.2. Required to exploit the potential

Table C.8: Mentioned required design elements to exploit the potential

Public client	Contractor
Adjusting formulation of demand specification [PIPS.1, PIPS.2, PIPS.3]	Adjusting formulation of demand specification [cIPS.6] Use of the same programme of requirements every time [CIPS.5]
Evaluation [PIPS.1, SIPS.7]	[-]
[-]	Early involvement of contractor: design and realisation [CIPS.4]
[-]	Sale guarantee [cIPS.6]
[-]	The same skilled people involved in executing repetitive tasks [cIPS.6]
[-]	Knowledge exchange between public client and contractor [cIPS.6]

C.2.3. Promoting design elements

Table C.9: Mentioned promoting design elements

Public client	Contractor
Evaluation after each mini-competition [PIPS.1, PIPS.2, PIPS.3] – (added after the first mini-competition [PIPS.2])	[-]
Mini competition [PIPS.2] [PIPS.2] in which assessment is based on quality [PIPS.1, PIPS.3]	[-]
Bundling of a minimum of 9 and a maximum of 30 similar school buildings [PIPS.1, PIPS.2, PIPS.3, SIPS.7]	Bundling of several school buildings [CIPS.4, cIPS.6]
Performance measurement [PIPS.1]	[-]
Long-term collaboration [PIPS.2, SIPS.7]	[-]
Generic programme of requirements with functional specifications [PIPS.2]	Generic programme of requirements [CIPS.4, CIPS.5]
Early involvement of contractor: design and realisation [PIPS.2, PIPS.3]	Early involvement of contractor and adaption of demand specification [CIPS.4, CIPS.5]

C.2.4. Hindering design elements

Table C.10: Mentioned hindering design elements

Public client	Contractor
Mini-competitions: mutual competition and uncertainty [PIPS.1, PIPS.2, SIPS.7] – adjustment: elimination race (added during R&D phase)	Mini-competition: mutual competition and hindering upscaling [CIPS.5, cIPS.6]
Use of requirements by school boards [PIPS.1] – adjustment: specific programme of wishes (added after the first mini-competition) [PIPS.2]	Use of requirements by school boards [CIPS.5]
Client (school board) varies per school building [PIPS.1, PIPS.2, PIPS.3]	Client (school board) varies per school building [CIPS.4, cIPS.6]
Limited number of school buildings [PIPS.2, PIPS.3]	Limited number of school buildings [CIPS.5]

C.3. Obtained answers - WOUW

C.3.1. Examples of repetitive tasks

Table C.11: Mentioned examples of preparatory tasks

Public client	Contractor
Prepare annual plan [PWOUW.1, PWOUW.2], go through annual plan cycle [PWOUW.3]	Prepare annual plan, monthly report [CWOUW.4, cWOUW.6]
Asset management & environmental management [PWOUW.1]	Environmental management [CWOUW.5]
Maintenance of asset management system [PWOUW.2]	[-]
Run through PDCA annually [PWOUW.1]	[-]

Table C.12: Mentioned examples of execution tasks

Public client	Contractor
Dredging channels and restoring banks [PWOUW.1, PWOUW.2]	Channel maintenance [CWOUW.5], countering erosion of banks [cWOUW.6]
Mowing [PWOUW.3], material removal [PWOUW.2], grubbing up [PWOUW.3]	Mowing [CWOUW.5]
[-]	Inspection [cWOUW.6] (of culverts, channels, banks, ecology), culvert spraying [CWOUW.4]
[-]	Removal of trees [CWOUW.5]

C.3.2. Required to exploit the potential

Table C.13: Mentioned required design elements to exploit the potential

Public client	Contractor
Sufficient volume of repetitive tasks – sufficient repetitions [PWOUW.1, PWOUW.2, PWOUW.3]	[-]
Same parties responsible for executing the same tasks [PWOUW.1, PWOUW.2]	Same parties responsible for executing the same tasks [CWOUW.4]
Reflect and secure the lessons learned [PWOUW.1, PWOUW.2]	[-]
Knowledge exchange between public client and contractor [PWOUW.1]	Knowledge exchange between public client and contractor [CWOUW.4]
Cross-plot knowledge exchange [PWOUW.1]	[-]
Knowledge retention [PWOUW.2]	Knowledge retention [CWOUW.4, CWOUW.5, cWOUW.6]
Public client needs to facilitate innovation through room in budget [PWOUW.1, PWOUW.2]	Consult with public client on innovation and room in budget [CWOUW.5]
Early involvement of contractor, at tactical level [PWOUW.3]	[-]

C.3.3. Promoting design elements

Table C.14: Mentioned promoting design elements

Public client	Contractor
Same parties responsible for maintaining the same areas over a long period of time [PWOUW.1, PWOUW.2, PWOUW.3]	Long-term contract [cWOUW.6]
Relatively large plots [PWOUW.1, PWOUW.2, PWOUW.3]	[-]
Bundling of uniform tasks in one contract [PWOUW.3]	[-]
Use of one IPM team [PWOUW.1, PWOUW.2, PWOUW.3]	Use of one IPM team [CWOUW.4, CWOUW.5, cWOUW.6]
Involvement of contractor at tactical level [PWOUW.3]	[-]
Cross-plot knowledge exchange: consultation structures [PWOUW.1, PWOUW.2] and lack of competition [PWOUW.3]	Cross-plot knowledge exchange: consultation structures [CWOUW.5] and lack of competition [CWOUW.4, cWOUW.6]
Providing room in budget [PWOUW.1]	Providing room in budget [CWOUW.5]
Attention to reflection, including using intention manager [PWOUW.1] and paying particular attention to mistakes [PWOUW.2]	[-]
Establishing asset management system [PWOUW.2]	Establishing asset management system [cWOUW.6]

C.3.4. Hindering design elements

Table C.15: Mentioned hindering design elements

Public client	Contractor
Lack of financial incentive [PWOUW.1, PWOUW.3]	Not pricing out risks [CWOUW.5]
Role ambiguity public client <-> customer [PWOUW.2]	Role ambiguity public client <-> customer [CWOUW.4, CWOUW.5, cWOUW.6]
Extension option of the contract [PWOUW.1, PWOUW.3]	[-]
Autonomy of plot teams and associated diversity [PWOUW.1]	[-]

D

Framework development

D.1. Initial framework

Definition repetitive tasks

*"Construction processes and activities that are executed more than once (repeatedly) **on/for** the same or different (parts of) structures at one or more locations without the result having to be the same."*

*Repetition in **new construction**, **maintenance** and **renovation***

*Repetition in **preparation** and **execution phase***

*Repetition in **process** and **product***

*Repetition in tasks executed **consecutively** or **simultaneously***

*Repetition in tasks of **client** and **contractor***

Explanation

Preparatory tasks: processes and activities performed after contract award in preparation for execution tasks.

Tip: Make an inventory of repetitive tasks beyond the programme or project level: look at your activities and processes. If you limit yourself to looking at the project level, it could lead to repetitive tasks not being identified. Repetitive tasks can occur even if the result of a project is unique. In short, don't exclude repetitive tasks (in advance).

Examples of repetitive tasks derived from studied cases

	Preparation	Execution
Residential – maintenance & renovation	- Scheduling tasks - Preparation of the annual plan - Processing receipts - Purchasing materials	- Reparations - Void repairs - Roof maintenance - Paintwork

Utility – new construction	- Designing a school building
	- (Process of a) mini-competition
		- Elements in school buildings/building concept
		  * column
		  * technique
		  * connection floor plates

Civil engineering - maintenance	- Preparation of the annual plan - Environmental management	- Dredging channels - Restoring banks - Mowing grass

Definition potential repetitive tasks

*"Repetitive tasks are characterised by one or more repetitions of the same or similar tasks. The potential of repetitive tasks involves the possibility that these tasks – when repeated – will be executed better each time, and that the **improvements** will then be applied each time and contribute to more efficient and effective achievement of [**the goal**]."*

Explanation
Improve in ways such as:

- Learning by acquiring practical and theoretical knowledge and skills – e.g. through routine
- Standardising
- Industrialising

Innovation can be either a special repetitive task or an improvement of a repetitive task.

To avoid losing knowledge and skills of the improvement, continuity and retention of practical and theoretical knowledge is important.

The goal of the potential of repetitive tasks is variable: The goal can be purely economic (executing the same or similar tasks in less time and money), or it can be complemented or replaced by societal challenges such as sustainability.

Note factors that make it difficult to exploit the potential (comment): repeating mistakes, less critical thinking (making assumptions), boredom, limitation of choices/flexibility.

Examples of the potential of repetitive tasks derived from studied cases

Residential – maintenance & renovation

- Building on lessons learned: advancing insight
- "You know exactly what to do" (predictability) enables good scheduling, purchasing and informing of residents

Utility – new construction

- Learning and improving building concepts and mini-competitions through lessons learned
- Time reduction, delivering more quality for less money
- Standardisation and industrialisation, resulting in cost reduction that can be used for higher quality
- Improve procurement and reduce failure costs through predictability

Civil engineering - maintenance

- Predictability "you know better what, when and where to do something" -> use to perform tasks more efficiently and effectively, better programme and organise, and better inform stakeholders

Advices on exploiting the potential of repetitive tasks

If a (public) client is considering exploiting the potential of repetitive tasks, the following advice is provided. The specific interpretation of the advices may vary from assignment to assignment, depending on circumstances such as laws and regulations, the client's portfolio, stakeholders, availability of data, the client's competence and the duration of the assignment. For contractors, it is recommended that the following aspects are considered: smart scheduling, continuity of parties involved, evaluation and uniformity.

Points to consider when defining an assignment

1) Sufficient volume* (sale guarantee)	promote sufficient volume to increase the chances of repetition and provide room for improvement (through learning (gaining experience and building on it, developing and using routine), standardisation, industrialisation and innovation). The more often a task is repeated, the greater the payback opportunity and the incentive to keep improving and innovating. For maintenance tasks, promote the bundling of maintenance cycles.
2) Predictability scope	ensure continuity and provide clarity on the tasks to be executed and their timeframe, enabling early identification of repetitive tasks and their potential for both client and contractor; promote predictability of what needs to be done. Increasing clarity on the number of times a task will be repeated and the timeframe in which it will be repeated, for example, provides an opportunity for the contractor to innovate and make use of "intelligent scheduling".
i. Smart scheduling	ensure that the same specialised people (construction crew) (stable teams) execute the same or similar tasks sequentially ("in trains") => efficiency. Possibly develop and use routine (learning through routine).
3) Early involvement contractor	involve the contractor at the tactical level rather than just the operational level (preparation and execution), so that the contractor can use and add repetition to the assignment (use market expertise). Question the challenge rather than the solution.
4) Facilitating assignment requirements	promote through the (wording of the) assignment requirements to increase the chances of repetition and provide room for improvement for both client and contractor. It can be helpful if the client is clear in advance about what is standard and where there is freedom of design.

Points to consider after awarding an assignment

1) Knowledge retention	promote building on acquired knowledge**** and experience and avoid losing knowledge (reinventing the wheel).
i. Continuity of parties involved	promote that people involved in the assignment (both client and contractor) change as little as possible, so that knowledge**** and experience gained can be reused and there is certainty between the parties about what is expected of each other.
2) Knowledge exchange* **	
i. Public client – Contractor**	discuss the possibility of repetitive tasks and their potential, and provide an opportunity for the parties to consult on the processes involved.
ii. Contractor – Contractor**	promote learning by exchanging knowledge**** and inspiring each other, especially when repetitive tasks are executed "simultaneously". Promote, for example, discussion of mistakes made in order to avoid repetition (remedy comment).
3) Evaluation	avoid repetition of mistakes and less critical thinking (remedy comment) by evaluating: what have we done, what can be improved and what is needed to do so, and is the standard applied still appropriate? The frequency and design of the evaluation depends on the (size of the) task (annual plan versus replacing a window) and the people doing it. Promote the use of routine.
4) Uniformity	promote uniformity of tasks to be executed within an assignment where multiple contractors are involved and contractors are executing the same or similar tasks, thereby increasing the chances of repetition and its potential (e.g. learning from each other) for both the client and the contractors. Consider this before awarding the assignment and, if necessary, develop it further with the contractor after the award.

*Of the same or similar tasks.
**It should be noted that in the cases studied, where a programmatic approach with long-term collaboration was applied, market parties are called assignment partners, innovation partners, network partners.
***Be aware that competition in the assignment can hinder knowledge exchange.
****Knowledge refers to the ability to do a task better next time. It includes both practical and theoretical knowledge.

D.2. Expert evaluation protocol

Expert evaluation protocol in Dutch

Voor het evalueren van het raamwerk ”Innovative approach to repetitive tasks” is gebruik gemaakt van drie expert evaluatie interviews en één focusgroep. Aan de expert evaluaties hebben zes personen deelgenomen werkzaam in verschillende sectoren binnen de bouw, verschillende perspectieven belichtend (publieke opdrachtgever, opdrachtnemer, adviseur, universiteit) en (bij voorkeur) ervaring met een programmatische aanpak. Voor deze selectiecriteria is gekozen, om de toepasbaarheid van het raamwerk te vergroten en omdat in de casus analyse is gekeken naar overeenkomsten en verschillen tussen verschillende sectoren. De deelnemers waren niet eerder betrokken in dit onderzoek. Omdat alle deelnemers Nederlands zijn, volgt hieronder het gehanteerde expert evaluatie protocol in het Nederlands.

Tijdens de expert evaluaties is het volgende tijdschema aangehouden.

1. Introductie afstudeeronderzoek
    - Toelichting geven van afstudeeronderzoek (onderwerp en toegepaste onderzoeksmethoden)
    - Uitleg geven over doel en opzet van expert evaluatie
    - Toestemming vragen voor audio-opname expert evaluatie
    - Introductierondje
2. Presenteren en bespreken raamwerk
    - Toelichting geven op de elementen in het raamwerk
    - Vragen of elementen worden herkend
    - Vragen of elementen aanpassing behoeven en/of sprake is van ontbrekende elementen
    - Vragen of raamwerk zinvol is en nuttig voor toepassing in de praktijk (voor wie?)
3. Afsluiting
    - Vragen of er aanbevelingen zijn voor toekomstig onderzoek en/of onderzoek van Maedeh Molaei
    - Bedanken voor deelname van de deelnemers en aanbieden doorsturen afstudeeronderzoek rapport

D.3. Final framework

Definition repetitive tasks

*"Construction processes and activities that are executed more than once (repeatedly) **on/for** the same or different (parts of) structures at one or more locations without the result having to be the same."*

*Repetition in **new construction**, **maintenance** and **renovation***

*Repetition in **preparatory** and **execution tasks***

*Repetition in **process** and **product***

*Repetition in tasks executed **consecutively** or **simultaneously***

*Repetition in tasks of **(public) client** and **contractor***

Explanation

With the above definition, it is possible to identify repetitive tasks not only at project or programme level, but also at portfolio level.

Preparatory tasks: processes and activities executed after contract award in preparation for execution tasks.

Tip: Make an inventory of repetitive tasks beyond the programme or project level: look at your activities and processes. If you limit yourself to looking at the project level, it could lead to repetitive tasks not being identified. Repetitive tasks can occur even if the result of a project is unique. In short, don't exclude repetitive tasks (in advance).

Examples of repetitive tasks derived from studied cases

	Preparation	Execution
Residential – maintenance & renovation	- Scheduling tasks - Preparation of the annual plan - Processing receipts - Purchasing materials	- Reparations - Void repairs - Roof maintenance - Paintwork
Utility – new construction of schools	- Designing a school building - (Process of a) mini-competition	- Elements in school buildings/building concept * column * technique * connection floor plates
Civil engineering – maintenance of floodplains	- Preparation of the annual plan - Environmental management	- Dredging channels - Restoring banks - Mowing grass

TU Delft

Recurring Cyclical repetitive Returning Repeating

Definition potential repetitive tasks

*"Repetitive tasks are characterised by one or more repetitions of the same or similar tasks. The potential of repetitive tasks involves the possibility that these tasks – when repeated – will be executed better each time, and that the **improvements** will then be applied each time and contribute to more efficient and effective achievement of [**the goal**]."*

Explanation
Improve in ways such as:

- Learning by acquiring practical and theoretical knowledge and skills – e.g. through routine
- Standardising
- Industrialising

Innovation can refer to a special repetitive task. Special because it is a market-ready task and, by definition, aimed at improvement.

To avoid losing knowledge and skills of the improvement, continuity and retention of practical and theoretical knowledge is important.

The goal of the potential of repetitive tasks can vary: The goal can be purely economic (executing the same or similar tasks in less time and money), or it can be complemented or replaced by societal challenges such as sustainability.

Note factors that make it difficult to exploit the potential (comment): repeating mistakes, less critical thinking (making assumptions), boredom, limitation of choices/flexibility.

To address the comments found, the following are recommended:

- Avoid repetition of mistakes, less critical thinking and boredom through knowledge retention, knowledge exchange and evaluation within an assignment (see design element 7, 8 and 9 on the next page) and across assignments. This will ensure a focus on continuously improving repetitive tasks.
- Avoid limitation of freedom of choice/flexibility by being critical of the use of routines, standardisation and industrialisation, and by continually checking that specific client wishes and requirements are being met.

Examples of the potential of repetitive tasks derived from studied cases

Residential – maintenance & renovation

- Building on lessons learned: advancing insight
- "You know exactly what to do" (predictability) enables good scheduling, purchasing and informing of residents

Utility – new construction of schools

- Learning and improving building concepts and mini-competitions through lessons learned
- Time reduction, delivering more quality for less money
- Standardisation and industrialisation, resulting in cost reduction that can be used for higher quality
- Improve procurement and reduce failure costs through predictability

Civil engineering – maintenance of floodplains

- Predictability "you know better what, when and where to do something" -> use to perform tasks more efficiently and effectively, better programme and organise, and better inform stakeholders

Advices on exploiting the potential of repetitive tasks

If a public client is considering exploiting the potential of repetitive tasks, the following is recommended. Firstly, at a portfolio level, a public client should inventory repetitive tasks and determine "the goal" of improving repetitive tasks. It is then recommended to consider the design elements and advices listed below. The interpretation of the advices may vary from one assignment to another, depending on circumstances such as laws and regulations, a public client's portfolio, stakeholders, availability of data, competence of the public client and duration of an assignment. The term assignment is derived from the procurement law and refers to the execution of tasks at tactical level and/or operational level. The design elements and associated advices are divided into the following phases: (1) at the time of defining an assignment, (2) at the time of defining & after awarding an assignment, (3) after awarding an assignment. The design elements are numbered, but the numbering is not intended as a ranking. The design element and associated advice labelled with the letter S is recommended at strategic level, with the letter T at tactical level and with the letter O at operational level. The successful implementation of the advices below for public clients also depends on the cooperation of the contractor(s), especially in 2. Early involvement contractor, 4. Smart scheduling, 5. Uniformity, 7. Knowledge retention, 8. Knowledge exchange and 9. Evaluation.

	Design element	Advice
At the time of defining an assignment	**1. Predictability scope [S, T, O]**	promote continuity and provide clarity about the tasks to be executed and the associated timeframe, thereby enabling early identification of repetitive tasks and their potential for both public client and contractor; promote predictability about what needs to be done. Increasing clarity regarding the number of times a task will be repeated and the timeframe in which it will be repeated, for example, allows the contractor to use "smart scheduling" (4) and determine whether innovation can be recouped. Provide clarity on which parts of the assignment are (still) uncertain and how this will be dealt with (processes), so that the contractor can respond accordingly.
	1.1 Sufficient volume* (sale guarantee)	promote sufficient volume to increase the likelihood of repetition and provide room for improvement (through learning (gaining experience and building on it, developing and using routine), standardisation, industrialisation and innovation). The more often a task is repeated, the greater the payback opportunity for both public client and contractor, and the incentive to keep improving and innovating. For example, bundle maintenance cycles in the case of maintenance tasks.
	2. Early involvement contractor [T]**	involve the contractor at tactical level rather than only at operational level (preparation and execution) after awarding the assignment, so that the contractor can use and add repetition to the assignment (exploitation of market knowledge, both design and execution knowledge). Question the challenge rather than the solution.
	3. Facilitating demand specification [S, T]	formulate the demand specification in such a way as to increase the likelihood of repetition and to provide room for improvement for both public client and contractor. As the public client, clarify in advance what is standard and where there is design freedom. Determine whether aligning with demand specifications of other assignments from your own organisation (internal) or other public clients (external), in which the same or similar tasks are executed, is feasible.
At the time of defining & after awarding an assignment	**4. Smart scheduling [T, O]**	promote that the same (specialised) people (construction crew) (stable teams) execute the same or similar tasks sequentially (“in trains”) for efficiency. Possibly develop and use routine (learning by routine).
	5. Uniformity [T, O]	promote uniformity in the tasks to be executed within an assignment where multiple contractors are involved and contractors are executing the same or similar tasks. This will increase the chance of repetition and its potential (e.g. learning from each other) for both public client and contractors. Consider this when defining an assignment and, if necessary, work it out with the contractors after the assignment has been awarded.
	6. Financial incentive (bonus) [T, O]	promote contractors to (continue to) improve repetitive tasks by applying a financial incentive, for example in the form of a bonus.
After awarding an assignment	**7. Knowledge retention [T, O]**	promote building an acquired knowledge**** and experience and avoid losing knowledge (reinventing the wheel).
	7.1 Continuity of parties involved	promote that people involved in the assignment (both public client and contractor) change as little as possible, so that knowledge**** and experience gained can be reused and there is certainty between the parties about what is expected of each other.
	8. Knowledge exchange* [T, O]**	exchange knowledge on repetitive tasks and their potential, and identify whether processes within the organisation hinder the exploitation of the potential of repetitive tasks and adjust them if possible.
	8.1 Knowledge exchange Public client – Contractor**	exchange knowledge about repetitive tasks and their potential, and identify whether processes within the public client's and/or contractor's organisation are hindering the use of the potential of repetitive tasks, and adjust them where possible.
	8.2 Knowledge exchange Contractor – Contractor**	promote learning by exchanging knowledge**** and inspiring each other, even when executing repetitive tasks "simultaneously". For example, encourage discussion of mistakes made.
	9. Evaluation [T, O]	avoid repeating mistakes and less critical thinking through evaluation. During the evaluation, consider questions such as: what repetitive tasks have we executed, what can be improved, what is needed to improve, and is the standard used still appropriate? Frequency and design of the evaluation will depend on the nature and scope of the tasks (annual plan versus replacing a window) and the people executing the tasks. Use routine to exploit the potential of repetitive tasks.

*Of the same or similar tasks.
**In the cases studied, where a programmatic approach was applied, the market parties are called network partners (case WL), innovation partners (case IPS Schoolgebouwen), assignment partners (case WOUW).
***Be aware that competition in the assignment can hinder knowledge exchange.
****This concerns practical and theoretical knowledge that can be used to execute a task better next time.