Continuous Learning Between Projects

'Natural growth of knowledge, a bottom-up approach'

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Preface

This master's thesis 'Continuous Learning Between Projects', is the conclusion of my study at the University of Twente, Department of Civil Engineering and Management (CEM). The research was conducted at Krinkels B.V., Hengelo, the Netherlands.

I would like to thank everybody for their patience and support during my graduation process. I would also like to thank my colleagues and the project members at Krinkels, who were always willing to answer questions regarding Krinkels, lessons learned, learning between projects and my thesis. I would especially like to thank Joop Halman and Hans Boes for their encouragement and continuous support. I would also like to thank my family and friends for their support during this time.

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Abstract

In 2016, recommendations were made to improve learning between projects at Krinkels B.V., a general contractor in the Netherlands, to prevent failure costs at projects with UAV-GCs (Uniforme administratieve voorwaarden – geintegreerde contracten: uniform administrative conditions – integrated contracts). The objective of this research was to determine which recommendations had been implemented, to what degree learning between projects is now in place and what can be done to further improve the process of learning between projects.

To achieve these objectives, an update of the literature review was done to update the list of enablers and barriers for learning noted in the previous research to the latest insights, and, in addition, the theory of the 4I model (Crossan, Lane & White, 1999) was chosen as a frame of reference to compare the current state of learning at Krinkels and where and how improvements can be made.

A desk study was conducted of the Krinkels' internal guidelines and the project documents of two UAV-GC projects to establish what enablers should be in place, according to the guidelines, and what is actually in place, according to the project documents. These results were then presented for validation via interviews with three staff, three project members and two project plan writers at Krinkels.

In addition to enablers and barriers found in the literature in 2016, elven new enablers and eight new barriers were found (Appendix I) during the literature review. During the interviews, four more enablers and one more barrier were found, which is a total of twenty-two enablers and twenty-nine barriers (appendix II). During the desk study and interviews, eight enablers and nineteen barriers of these, were found to be currently present at Krinkels. Four of the most prominently enablers found were: employees with key knowledge involved from the outset, a project-role support and backup, a learning coordinator/manager and taking small clear steps, close to what is known.

There are clear differences among the levels of learning at individual, group and organisational levels. Where individuals learn while executing their specific tasks through intuiting and interpreting, this acquired knowledge is most often retained and integrated into the project of which they are a team member, but it is not integrated into other projects or institutionalised in the organisation.

The barrier most noted in the interviews was time restraints. In addition to the knowledge silo between projects or between projects and the organisation, a knowledge-role silo was found between project members with a specific role and other project members within a project. The level of learning at Krinkels has decreased and recommendations from the 2016 study have not been implemented.

When looking at Crossan, Lane and White's (1999) model, the previous study was presented to top management of the organisation (board of directors and managing directors), but they did not share the information with the groups (branches/projects) or other individuals.

To improve learning at Krinkels, a framework in which barriers and enablers are converted to the proposed requirements to be implemented on first: individual, second: group and third: organisational levels is proposed.

It is a bottom-up, not top-down, process that is feeding away; the learning of individuals is seldom forwarded to other projects or branches (group level), almost never to the organisational level, and it is not integrated or institutionalised. The specific knowledge for successfully managing integrated projects is acquired by individuals involved in these projects. In the past, these individuals shared this knowledge at annual meetings with their colleagues, where they exchanged lessons learned. However, this practice was abandoned due to budget cuts. The current system of sharing by using an improvement form is not adequate to share the lessons learned (as also described by Hartmann and Doree 2015: Learning between projects: More than sending messages in bottles).

The top-down method of writing a report with recommendations and sending these recommendations top-down through the organisation has not been effective. Therefore, instead of the continued use of the same top-down method, it is proposed to commence with what worked for Krinkels in the past and start bottom-up, feeding it forward from individuals to groups, from groups to the organisation and back again. In other words, a natural growth of knowledge for Krinkels through the use of a bottom-up approach.

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1 Introduction

Krinkels B.V., a general contractor in the Netherlands founded in 1956 by Mr. L. Krinkels, has seen a rise in failure costs in projects with UAV-GCs (integrated contracts, e.g., design, build and maintain) since they were first acquired in 2010. In 2016, a study was conducted to determine how to prevent these failure costs from reoccurring.

One of the conclusions of the study conducted in 2016 (Lanting), 'Van ad-hoc leren binnen projecten naar continu leren tussen projecten' was that there was almost no learning between projects.

The main recommendation of the previous study was to improve learning between projects. Several suggestions were made on how to realise this. Despite these recommendations, Despite these recommendations, it was observed that large failure costs in the UAV-GC projects at Krinkels still occurred in 2019. Therefore, the questions of whether the recommendations of the previous research (Lanting, 2016) had been implemented, whether they were effective (if implemented and to what degree) and what further improvements could be made to reduce the amount of failure costs in UAV-GC projects arose.

Objective of this Research
The objectives of this research were, first, to determine which recommendations had been implemented and to what degree learning between projects is now in place, and, second, what can be done to further improve the process of learning between projects through the use of recent insights from the literature regarding continued learning between projects.

To realise these objectives, the following questions were formulated:

- What has been done with the recommendations of the study from 2016?
- Why were recommendations implemented or not implemented?
- What improvements can be made (and how)?

In Section 2, the company background and the challenges in learning at Krinkels at present are described. The method of the research, including the research process model, is explained in Section 3. Section 4 contains the literature review. The previous research (Lanting, 2016) primarily used the theory of the fifth discipline of P. Senge (1990). In this thesis, the literature review is extended and updated (also looking specifically at learning within organisations, project-based learning, lessons learned and organisational culture) and also updated to the latest insights in the literature. In Section 5, the state of learning between projects at Krinkels is described, with a focus on what should be in place (according to guidelines) and what is in place. The synthesis of these findings and design of the improvements can be found in Section 6. The discussion regarding the scientific implication of this research and practical relevance for Krinkels is in Section 7. This research is concluded in Section 8.

2 Company Background

Krinkels B.V. is a general contracting company with a focus on four areas of interest, namely landscaping, roadworks, waterworks and sports. The company was founded in 1956 by Mr. L. Krinkels. The company has a gross turnover of 56 million Euros annually and employs 200 people in the Netherlands. The headoffice is in Breda. Krinkels has branches in Alkmaar, Arnhem, Eindhoven, Heerlen, Hengelo, Nagele, Venlo, Wateringen, Wouw and Zuidwolde.

Krinkels mainly works for the government (local and province) and waterboards (local and national). Their core business is maintenance and the realisation of projects in the four areas mentioned above.

Steps Taken to Improve Continuous Learning
To prevent a repeat of the same failures and corresponding failure costs at projects based on the UAV-GCs, a study was conducted in 2016 (Lanting). Two projects that, seemingly, had learning problems were selected for analysis. The selected projects were the realisation of an artificial turf field in Hengelo and a road maintenance project of Highway A6, both in the Netherlands.

The conclusion of that study was that project teams from Krinkels in UAV-GC projects did learn, but that the acquired knowledge remained within the team, or, mostly, with one person in that team. Lessons learned were not shared among project teams, and the same failures and failure costs were repeated in other projects at Krinkels. Furthermore, when a person with the acquired knowledge leaves Krinkels, the knowledge is lost completely and has to be acquired again. In addition, there was room for improvement for the individuals and teams who were learning. Often the future implications of chosen solutions were not considered, so, sometimes, a chosen solution resulted in new problems and failure costs later on in the project. Moreover, the project teams in the studied cases both started with teams inexperienced in working with the UAV-GC. According to Krinkels' internal guidelines, some systems (e.g., digital forms, project evaluation and lesson sharing between teams by the quality manager) should be in place; however, forms and lessons were seldom shared. During this research, 20 barriers to learning between projects and seven enablers were found (see Appendix I). To overcome these barriers and utilise the enablers to improve learning between projects, 12 recommendations were made (see figure 5.4).

This study analyses what has been done with those recommendations, why they were implemented, or not implemented and what (further) improvements can be made to continued learning at Krinkels to prevent failure costs.

3 Method

This section explains the research process model and the steps taken to achieve the objectives of this research.
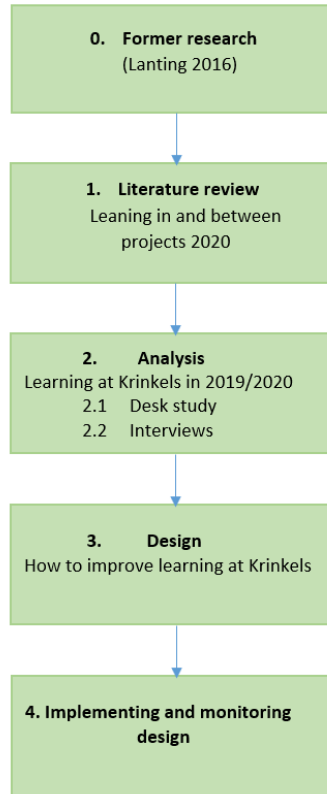
Figure 3-1: Research process model

0. The starting point (figure 3-1) is the previous research (Lanting, 2016), its results and which enablers and barriers were found in the literature and at Krinkels in 2016.

1. This research started with a literature review to find the latest insights into learning between projects. The result of this review is an updated list of enablers and barriers for learning in and between projects from the literature up to 2020. The theory chosen, the 4I Model of Crossan, Lane and White (1999), presents a frame of reference to compare the current state of learning at different organisational levels in Krinkels, compared to what could/should in place and, in addition, what improvements can be made.

2. The second step was to analyse which recommendations of the 2016 study had been implemented by means of a desk study of the guidelines and project documents at Krinkels, and, in addition, this desk study is supplemented and validated with the interview results. Furthermore, the desk study and interviews are used to determine why recommendations were implemented or not, and to determine which enablers or barriers are present at Krinkels in 2020.

    After a comparison of the enablers and barriers for learning during and between projects from the literature, the desk study and the interviews, the improvements required were concluded and how they can be improved (3).

3.1   Desk study

The desk study consisted of an analysis of the guidelines at Krinkels (what enablers for continued learning should be in place) and 'what is in place', based on project and internal registrations (such as project management and quality plans).

The documents reviewed were Krinkels' general national guidelines, branch guidelines and general project guidelines for the artificial turf field in Hengelo and the project of the maintenance for Highway A6, both in the Netherlands. A list of the specific guidelines used can be found in Appendix I.I and I.II.

These documents were also used to determine whether enablers and barriers found in literature are present at Krinkels, or if, perhaps, new ones (not found in the previous research or in the literature) could be found and also to determine whether the recommendations of the previous research had been implemented and to what effect.

To determine whether (some of) the recommendations had been implemented and if it has resulted in improvements, it was necessary to compare the status of learning between then and now. The level of learning at Krinkels was determined in 2016. Therefore, the results of this desk study are also expressed on a five-point Likert-scale, in terms of no (never), seldom, sometimes, often and always.

3.2   Interviews

The interviews were conducted to determine, first, the interviewees' views regarding the enablers and barriers present at Krinkels, and, second, what has been done with the recommendations from the previous research and, if they have been implemented, what the effects are, and, if not, why they are not implemented, and, third, to validate the results of the desk study. To achieve all of this, eight employees of Krinkels were interviewed, including one member of the board of directors, the head of -information management, the head of quality control, two UAV-GC plan writers and three UAV-GC project staff members. The questions in the interviews concerned internal procedures at Krinkels, so, therefore, only employees of Krinkels were interviewed for this study.

From the combined results of the desk study and the interviews, conclusions regarding the state of learning at Krinkels were derived, such as, were the improvements suggested by Lanting in 2016 implemented or not, and has learning at Krinkels improved, remained the same or decreased, and why?

The enablers and barriers found in the literature, the desk study and interviews were compared and combined in an updated list.

3. The next step was to construct a design (plan) based on these finding to improve learning at Krinkels. The main design requirements were based on what was found in the desk study and interviews, which enablers do work at Krinkels and how can we build on that, to further implement these and other enablers and to overcome learning barriers.

4. Implementing the design (do).To continuously improve learning at Krinkels, the implementation has to be analysed (checked) and the design updated (acted on). How this can be done is part of the design described in Chapter six, using the Deming's Quality Circle (1950).

4 Literature Review

The previous study (Lanting, 2016) focused on types of learning but not specifically on learning within organisations, between projects or lessons learned. Since this information is relevant to identify and improve learning between projects, it was added to this literature review. The literature review was also conducted to find the latest insights on learning between projects since the theory in P.M. Senge's the Fifth Discipline is from 1990.

The literature review started with the levels of learning, than learning in organisations, project-based learning, interproject learning, organisational culture and, finally, the barriers and enablers for learning.

Thereafter the framework for this research was chosen. To improve learning at Krinkels, it necessary (Lanting, 2016) to improve the processes for learning in the organization. Therefore, the framework to improve learning at Krinkels should contain a method that can be applied in and between all organisational levels. In addition, it should be possible to compare the findings of this study to those of the previous research study (Lanting, 2016).

Levels of Learning
The definition of a learning organisation is 'a place where people continually expand their capacity to create the results they truly desire, new and expansive patterns of thinking are nurtured, collective aspiration is set free, and people are continually learning to see the whole together' (Senge, 1990).

Learning can be present at three different levels (Ajmal & Koskinen, 2008; Crossan, Lane & White, 1999; Nonaka & Takeuchi, 1995):

- Individual, the origin of knowledge is in individuals and transferred to other levels in an organisation. It is primarily a social phenomenon (Simon, 1991).

- Groups or project teams, knowledge transfers between groups in what can been seen as a social process (Simon, 1991), which is an opportunity to exchange ideas.

- Organisation, knowledge can be transferred and is formally implemented organisation-wide (Crossan, Lane & White, 1999). The knowledge transfer changes principles and assumptions and, eventually, changes common procedures and systems in the organisation.

Learning Organisations

Crossan, Lane and White (1999) developed a conceptual framework (the 4I Model) for organisational learning (figure 4-I).
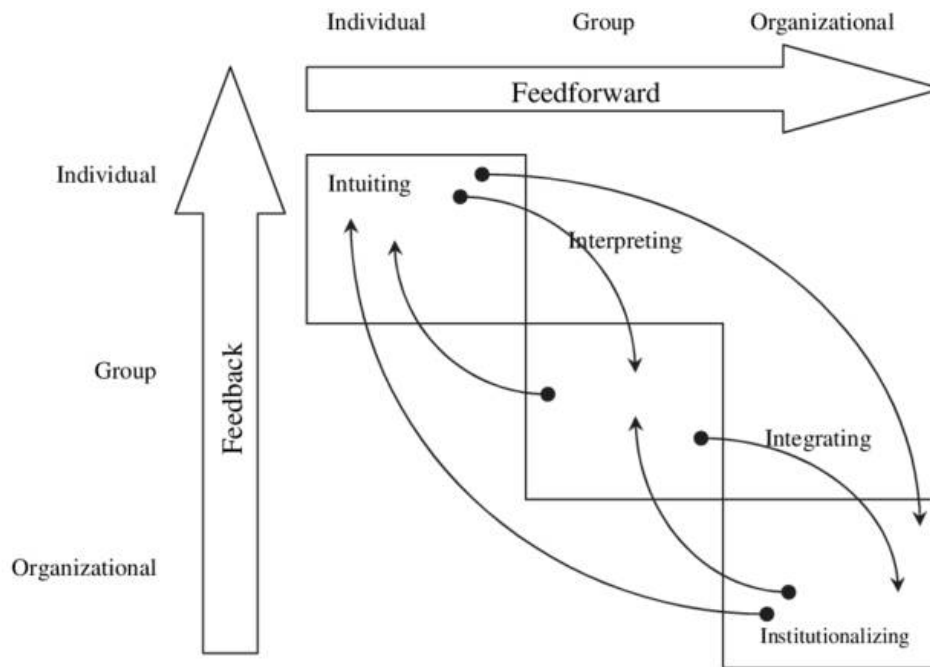
Figure 4-1: 4I Model, organisational learning as a dynamic process (Crossan, Lane & White, 1999).

The model consists of four social and psychological processes, namely intuiting, interpreting, integrating and institutionalising. The processes are present at the three levels of learning, individual, group and organisational. The levels form the structure, and the processes are the 'glue' that connects them. On the individual level, there are individual competencies, capabilities and motivation. In the group learning level, it is group dynamics and common understanding, and, on the organisational level, it is non-human storage of learning, systems, structures, strategies, procedures and the culture in a competitive environment.

Project-based Learning

Project-based learning is part of organisational learning (Keegan & Turner, 2001). Project-based organisations (PBOs) are characterised by their uniqueness, uncertainty, and complexity; PBOs are different from other business organisations in many respects. These differences extend to the requirements regarding knowledge transfer. The ability to manage what they know is often constrained by their capabilities for creating, valuing, absorbing and sharing knowledge (Ajamal & Koskinen, 2008). Project teams often consist of people with diverse skills working together for a limited period of time; indeed, a project team often includes members who had never worked together previously and do not expect to work together again (Burns & Stalker, 1961). According to Scarbrough et al. (2004), the diversity of team members' experiences only becomes a positive stimulus to reflection at the point when the project team is able to identify itself as a unit working towards a set of common goals.

Adaptability in the face of variations in the quantity and quality of projects is important in terms of survival and success in project-based organisations (Sveiby 1997). A key approach is to retain

knowledge by ensuring that the knowledge is shared and diffused amongst employees in the organisation. By institutionalising various personalised knowledge-sharing mechanisms to help individuals share knowledge with a group of other individuals, organisations can ensure that person-to-person knowledge sharing is not simply serendipitous but more systematic (Boh, 2007). A problem for project-based organisations is that the knowledge acquired during a project is not necessarily used in other projects or contexts. As each new project starts, there is a tendency to 'reinvent the wheel' rather than learn from the experiences of previous projects (Prusak, 1997). Project-based firms seem to focus their efforts on outcomes rather than on the process of codification and organisational mechanisms for learning between projects (Prencipe & Tell, 2001).

Interproject Learning

Interproject learning is the combining and sharing of lessons learned across projects to apply and develop new knowledge (Kotnour, 2000). Lessons learned aim to capture the positive and negative aspects of projects to learn from experience, thereby avoiding the repetition of mistakes that can be costly and damaging to the company's reputation. Lessons learned need to adhere to a process to ensure that they are validated as relevant to future projects (Carrillo 2005). Senge (1994: 49) defines learning in an organisation as 'the continuous testing of experience, and the transformation of that experience into knowledge – accessible to the whole organisation, and relevant to its core purpose'. Some state as an accepted fact that lessons-learned activities and learning from projects generally occurs in practice (Williams, 2008). In most cases, the transfer of knowledge from individual projects to the wider organisation rely significantly on social rather than ICT (Information and Communications Technology) -based, networks (Newel, Bresnan, Edelman, Scarbrough & Swan, 2006). Contrary to the sender/receiver perspective, Hartmann and Doree (2015) regard social interactions from which learning occurs as contextually embedded and collaborative efforts in projects. From their point of view, learning across projects and in projects occur as a social activity rooted in the historical, organisational and cultural context of previous and current projects (the imperative of continuity). Companies that use knowledge effectively predominantly pursue one strategy and use a second strategy to support the first. Hansen, Nohria and Tierney (1999) think of this as an 80–20 split: 80% of the knowledge sharing follows one strategy, 20% the other.

Kotnour (2000) uses the plan-do-study-act cycle to describe the learning process in a project-based organisation. 'Plan' outlines the steps to solve a problem. 'Do' is the implementation of the solution, and 'study' is the evaluation of the effects of the 'do' phase and what has been learned. In the 'act' phase, it is determined whether this improvement cycle should be continued, adapted or stopped. The lessons learned are also input, because the lessons learned are potentially useful to other projects that can benefit from the knowledge.

Lessons learned are not automatically dispersed to project managers (Prencipe & Tell, 2001). Projects are not sender/receiver islands. They are connected through their organisational setting, tools and norms, and the experiences of the project team members. Orientation towards project goals, project-overarching ambitions or developmental trajectories help to facilitating learning (Hartmann and Doree, 2014). From Hartmann's and Doree's point of view, learning across projects occurs as a social activity rooted in a historical, organisational cultural context of previous and current projects.

Organisational Culture

An organisation's culture consists of practices, symbols, values and assumptions that the members of the organisation share with regard to appropriate behaviour (Schein, 1990). To be truly effective, knowledge management requires an understanding of the culture in which the knowledge is embedded (De Long and Fahey, 2000; Fong and Kwok, 2009). This understanding is imperative because organisational culture shapes members' knowledge-sharing behaviours and influences how they learn (Wiewiora, Trigunarsyah, Murphy & Coffey, 2013). Lipshitz et al (2002) found that values promoting learning are transparency, integrity, issue-orientation, inquiry and accountability.

Barriers and Enablers Found in the Literature

This subsection provides an overview of the main additional barriers and enablers that were found in the literature review in this study. Together with the barriers and enablers found during the previous research, the desk study and interviews presented in next section; these will constitute the unified list of barriers and enablers introduced in this research. The list of additional barriers and enablers found during the literature review update is shown in figure 4-2.

Barriers (this research)	**Enablers** (this research)
1. Organisational culture	1. Lessons learned are recorded regularly
2. Motivation	2. Organisational culture
3. Ignorance of knowledge available	3. Motivation
4. Knowledge available is unusable	4. Collective and interactive sharing between different project managers
5. Autonomy of projects (knowledge silo)	5. Visualisation of lessons learned
6. Output has te be input	6. Standard template
7. Key-figure knowledge	7. Evaluate difference between process and knowledge
8. Knowledge drain (if people leave / incomplete records)	8. Learning is part of the work process
	9. Clear context
	10. Social network / informal dialogue
	11. Test pilot before implementing in the whole organization

Figure 4-2: Additional barriers and enablers found (literature review update)

Recommendations

In the previous study, twelve recommendations were proposed (figure 4-3) to overcome the barriers and enable learning. They are divided into four categories, namely tools, implementation, support and attitude. These categories meant that some 'tools' (like checklists, digital data bank) had to be developed, while there were tools already in place that had not been 'implemented', that 'support' from within the organisation (managing board) was required to accomplish this change and the 'attitude' or personal or group thinking needed to change. Although, in most cases, a recommendation can be categorised in more than one category, these recommendations are only presented in the main category that it fits best in the following overview.

Tools	1) Increase the knowledge of project members about UAVgc at projects (eg. Education/study).
	2) Sharing experiences / mailing / newsletter / personal / otherwise.
	3) Integrate acquired knowledge in knowledge bank
	4) The need for sharing and acquiring knowledge is different per person, map this out per person.
	5) Be aware of the five disciplines of Senge and use them to overcome barriers.
Implementation	6) Sharing of lessons learned between other project teams.
	7) Use the entire Deming circle not just plan and do, but also check and act (eg. Sharing of what has been learned).
	8) Identify problems which occur at multiple projects and analyse if former 'solutions' are not the cause of these problems.
Support	9) Define a shared project mission and vision.
	10) Stimulate an open culture of speaking one's mind.
	11) Realistic planning.
Attitude	12) Act more active and proactive instead of reactive.

Figure 4-3: Twelve recommendations to improve learning between projects at Krinkels (Lanting, 2016).

Conclusion Literature Review

There are several theories regarding learning in organisations. Ajamal & Koskinen, (2008), Crossan, Lane and White (1999) and Nonaka and Takeuchi (1995) identify three levels, namely, individual, groups/projects teams and organisation. Simon (1991) and Senge (1994), however, focus on two levels (individuals and groups). Several other theories have one specific main focus, such as Keegan and Turner (2001), Sveiby (1997) and Burns and Stalker (1961) who focus on project-based organisations. In addition, several theories focus on the difficulties of sharing lessons learned in a project-based organisation, such as Hartmann and Doree (2015) and Prencipe and Tell (2001). Furthermore, there are theories that emphasise the organisational culture (Wiewiora et al., 2013; Lipshitz et al., 2002) because it influences the behaviour in the organisation and the way an organisation learns.

To create a framework for learning at Krinkels, all three organisational levels should be included. Ajamal and Koskinen (2008) mention several enablers and barriers, focus on our core cultures and preparing the organisation for learning (knowledge-transfer activities). The focus on the type of organisation is necessary to improve learning. Crossan, Lane and White (1999) propose a framework (the 4I model) to allow the entire organisation to learn by feeding information forward and back, from the individual, group and organisational levels. Nonaka and Takeuchi (1995) focus on transforming tacit knowledge into explicit knowledge.

Considering the problems at Krinkels and the research questions, the 4I model of Crossan, Lane and White (1999) is the best fit. To improve intuiting, interpreting, integrating and institutionalising, the enablers and barriers for learning are taken into account, which allows for a comparison of the findings of this research to those of the previous research.

Eight additional barriers to and eleven additional enablers for learning were found during the literature review (see Figure 4.2). In total, twenty-eight barriers and a total of eighteen enablers for learning were found in the literature (see Appendix I, Figure I.2).

5 Findings, State of Learning Between Projects

5.1 Desk study

Of the 20 barriers found in the previous research, only four were found in the desk study in the review of project documents, such as project management plan and work reports. However, six of the seven enablers found in the research were present in Krinkels' business plan. The one not mentioned is 'lessons learned are shared with other project members'.

When looking at the new-found barriers only (Figure 4.2), the additional '7 key-figure knowledge' was found as a concern in Krinkels's documents (see appendix I.I and I.II). The enablers mentioned are the following: 1) lessons learned are recorded regularly, 2) organisational learning culture and 6) standard template. None of the other enablers were found in the desk study.

In total, Krinkels defines eighteen processes to overcome the total of five barriers and nine enablers to improve learning. An overview of these processes are given in figure 5-I.

Difference Between what Should Be in Place and what is in Place
The barriers and enablers identified at Krinkels have been translated into rules/regulation and eighteen processes by Krinkels. The following section of the research, with a further desk study and interviews, determined whether these 18 processes are indeed in place or whether they are only rules and regulations. In total, twenty-four types of documents were analysed, twelve at the 'Nagele' branch and twelve at the 'Hengelo' branch (see Appendix I.II). In figure 5-1 the difference between what should be in place (process found in the desk study) and the answers to what is, and how often it is in place, are presented (see also appendix III).

Number	Proces found in the desk study	Answer (No, seldom, sometimes, often, always)
1	All VAK-formulieren are visible to all Krinkels employees on Intranet.	Sometimes
2	PDCA should be in place always for al critical processes.	Sometimes
3	It is Krinkels vision to be the most qualitative and most innovative service provider in the Netherlands.	Sometimes
4	Krinkels claims in their EMVI-plans to be proactive.	Seldom
5	There is a specific budget for learning available (3% of total wages at Krinkels).	Seldom
6	The right person at the right place.	Sometimes
7	Flat orgnisation structure.	Sometimes
8	Improvements, deviations and complains are generally reported using a digital VAK-formulier.	Often
9	Projects are being monitored on cost, quality, organization, information, planning and risk.	Seldom
10	Krinkels will invest in assets management and project management systems.	Sometimes
11	Data management and ICT create a distinct asset.	Seldom
12	The orientation is regional, autonomous branches.	Seldom
13	Projectrequirements or monitored in a verification matrix or program like Relatics.	No
14	Large projects should be evaluated.	Seldom
15	Sharing information between all levels in the organization.	Sometimes
16	Staff facilitates the organization.	Seldom
17	VAK-formulieren are shared with the clients.	Seldom
18	Every year an audit (extern/intern) to check Krinkels's quality system according to the ISO 9001/ 55001.	Seldom

Figure 5-1: Results of the desk study, processes in place to stimulate learning at Krinkels

In short, one process was not found to be at all in place (number 13), nine seldom, seven sometimes (50/50) and one was found to be often (number 8) in place. None was present in all of the documents.

Therefore, during the desk study, it was concluded that, of the 18 processes described in guidelines that should be in place, none were found to be in place all the time, although one was found to be often in place, some (seven) every now and then and the others were seldom or, in one case, never in place.

When focusing on the three levels (individual, group and organisational) and looking at the four 'I's' (Crossan, Lane & White, 1999), the following can be concluded:

Although all the documents reviewed concerned issues at a group (project) level, it is clear that one person is responsible for generating these documents most of the time. Even on the individual improvement forms (VAK-formulieren), the same names were found, with a complete absence of the others working on the reviewed projects and branches. Therefore, on an individual level, intuiting and interpreting do occur, but there is a significant lack of integration. Institutionalisation of lessons learned on an individual level to an organisational level was not found during the documents review.

Intuiting and interpreting at a group level was found in the minutes of the project meetings. Some additions to working procedures at the project were integrated and became 'standard' practice at this project. However, the institutionalising of some of these procedures in the remainder of the organisation was not found.

Institutionalising of regulation through the use of checklists and general manuals, to be used at projects, was often found during the desk study. However, they seem not to have been written for integrated projects (UAV-GC) so they had to be modified by individuals for use in the UAV-GC projects. In some cases, individuals had to generate an entire new approach or new document format. These newly created procedures and documents were not found to be institutionalised.

In general, individuals and groups are learning; however, sharing and institutionalising of new information was seldom found. This is in line with the finding that the 18 processes to improve learning at Krinkels at all levels are seldom (sometimes) present.

5.2 Validation of the Results

Eight employees of Krinkels were interviewed; these employees are project leaders at UAV-GC projects (3), staff members (3), or UAV-GC plan writers (2). Of the three staff members, one is an operational director, one head of quality control and the other head of Information Technology. The overall results are shown in Appendix IV.

Validation of Desk Study

The interviewees were asked about the 18 processes in place at Krinkels (figure 5-2). It was determined that two were not in place, five are seldom in place, four sometimes in place, another four often in place and three are always in place. Overall, a better result than what was found before in the desk study.

Number	Processes validated during the interviews	Answer (No, seldom, sometimes, often,
1	All VAK-formulieren are visible to all Krinkels employees on Intranet.	No
2	PDCA should be in place always for al critical processes.	Sometimes
3	It is Krinkels vision to be the most qualitative and most innovative service provider in the Netherlands.	Sometimes
4	Krinkels claims in their EMVI-plans to be proactive.	Sometimes
5	There is a specific budget for learning available (3% of total wages at Krinkels).	Often
6	The right person at the right place.	Seldom
7	Flat orgnisation structure.	Often
8	Improvements, deviations and complains are generally reported using a digital VAK-formulier.	Seldom
9	Projects are being monitored on cost, quality, organization, information, planning and risk.	Seldom
10	Krinkels will invest in assets management and project management systems.	Sometimes
11	Data management and ICT create a distinct asset.	Often
12	The orientation is regional, autonomous branches.	Often
13	Projectrequirements or monitored in a verification matrix or program like Relatics.	Seldom
14	Large projects should be evaluated.	Seldom
15	Sharing information between all levels in the organization.	No
16	Staff facilitates the organization.	Always
17	VAK-formulieren are shared with the clients.	Always
18	Every year an audit (extern/intern) to check Krinkels's quality system according to the ISO 9001/ 55001.	Always

Figure 5-2: Validated results of the desk study

Although these results were better than those of the documents review, there is still a significant gap between what should be in place and what is in place.

At the individual level, it was found that all individuals had to mostly learn on their own in their specific roles at Krinkels. Most of them (six out of eight) indicated a lack of coaching, but all admitted that they could have shared the lessons learned more to the project group or the organisation. The reasons for this were mostly a lack of time, and the issues of the day are what matters most. They know about the 18 processes but, again, due to a lack of time, do not always use them.

One difference that was mentioned regarding participation in a standard project (UAV) or integrated project (UAV-GC) is the difference in the knowledge holder. At a standard project, there is one general foreman who knows every detail regarding the project, but, at the integrated projects, there are different roles (e.g., project manager, contract manager, risk manager, manager project control and an environment/stakeholder manager) with different key knowledge that is not shared with other team-members. This is reinforced by the separation of the different role members (contractor-

principal) by having separate meetings and, therefore, creating role-knowledge silos. Interpreting information in a new role is difficult but doable, as evidenced by the successful completion of the projects. However, they do not know how to integrate the new information into the organisation and, generally, do not know what information is important to others. This means that individuals in groups learn and, therefore, the group learns; however, that is only one person in that group . The lessons learned are not integrated into the organisation.

On an organisational level, ten years after the first integrated contract, there are still no separate manuals or checklists for integrated projects. If lessons shared during integrated contracts have been shared outside the project, this information could not be found in the general rules or regulations. Therefore, these lessons are not integrated into the organisation.

This means that, although these eighteen processes are sometimes or often present, they do not lead to lessons learned being shared or integrated into the organisation.

Implementation of Previous Recommendations
Of the twelve recommendations from the previous study, (see figure 4-3), four were found to have been implemented (see figure 5-3).

Tools	**1) Increase of knowledge of project members about AUVgc at projects (eg Educations/study)**
	2) Sharing experiences / mailing/ newsletter/ personal/ otherwise
	3) Integrate acquired knowledge in knowledge bank
	4) The need for sharing and acquiring knowledge is different per person, map this out per person
	5) Be aware of the five disciplines of Senge and use them to overcome barriers
Implementation	6) Sharing of lessons learned between other projects teams
	7) Use the entire Deming circle not just plan and do, but also check and act (eg sharing of what has been learned)
	8) Identify problems which occur at multiple projects and analyse if former 'solutions' are the cause of these problems
Support	*9) Define a shared project mission and vission*
	10) Stimulate an open culture of speaking one's mind
	11) Realistic planning
Attitude	12) Act more active and proactive instead of reactive

Figure 5-3: Implemented recommendations (in bold).

No record was found of the implementation of the remaining recommendation in the desk study, and there was no mention of these points in the interviews. For example, none of the interviewees could name an example of an implemented recommendation.

However, except for the recommendation for shared project mission and vision (9), and the five disciplines (5), they were all convinced that implementing the other ten recommendations would have a positive effect.

Comparison of the Results of 2016 and 2019
From the validated findings of the desk study and the interviews, it is clear that no action had been taken to implement the recommendations of the 2016 study or improve learning at Krinkels in another way. If fact, learning at Krinkels has even decreased from 3 to 2.5 on a 5-point Likert scale (from (1) never, seldom, sometimes, often and (5) always). Therefore, the answer to the question: *'What has been done with the recommendations of the study from 2016?'* is that none of the recommendations were implemented.

5.3   Analysis of the Findings

The results of desk study and interviews show that, although some processes might be reflected in the rules and regulations (guidelines), they are either not in place or in place to a far lesser degree than recommended. A comparison of the data of 2016 and 2019 shows no implementation of the recommendations; the results even show a 'decline' in the level of learning. Almost none of the recommendations were found during either the desk study or the interviews, or as part of standard practice/procedure.

One of the key findings is that there is no-one specifically responsible for continued learning at Krinkels. No-one monitors successes or failures within projects (other than financial). It is left to individual employees to learn from their mistakes with no platform to share their learning and no-one to share with. This might be due to the uniqueness of projects and/or the role of the person in the project team (e.g., there are not that many contract managers at Krinkels, only approximately three). Therefore, a contract manager has two colleagues with some specific knowledge that he or she acquired that could be useful, but, due to the uniqueness of projects, no systems in place for sharing knowledge, time constraints and doubt about whether the information might be helpful, colleagues are left to their own devices. Unless colleagues ask or institute an active search for information, knowledge is not shared between projects. Therefore, intuiting and interpreting at the individual level is present; however, integrating and institutionalising are not.

An enabler mentioned by two interviewees is to have two people in the same role, one leading and the other 'just' as support and to learn. The two interviewees had done this on two projects out of necessity because, for example, one building foreman in a meeting with five people from the client is not efficient (lack of support for the foreman). Therefore, a project leader or contract manager from the same project team was included. The benefits were not only support at the meetings but also a backup, in the event that the foreman went on vacation, became ill, or perhaps even left the firm.

Another key finding is the barrier that seems to be present between project stages and project members (knowledge project and role silo). The employees who formulate a quote for the project and the employees involved in the implementing stage are seldom involved together. Most of the time, a project is calculated by a team, and, after the project is acquired, a different team with little to no interaction with the calculating team will execute the project. Afterwards (after completion of the project), there is little or no feedback to the calculation team to improve their calculations. In addition, information remains with one person (role silo) in a project team.

In addition, another enabler that was mentioned is the involvement of someone with key knowledge (e.g., experienced project members) from the outset to help to implement lessons learned from former projects.

The answer to the question *'Why were recommendations implemented or not?'* is (in general) they are not implemented due to the presence of several barriers and a lack of several enablers (see Appendix II).

More specific the barriers:
- Lessons learned were not shared in the organisation
- General processes to share lessons learned are not in place
- No one is accountable to share lessons learned
- Output (lessons learned) has to be input
- Key-figure knowledge (only a few people with this knowledge)

And a lack of the following enablers:
- Lessons learned shared with other (project) members
- Collective and interactive sharing among project managers
- Learning coordinator/manager

Level of Support for the Recommendations
The recommendations were shared with the interviewees. They all agreed that the recommendations are sound (except the shared mission and vision) but fairly generic, for example, recommendations 2 and 8, the sharing of lessons learned with other project teams and acting more active and proactive rather than reactive. They supported these recommendations, but, even if they had known of these recommendations before, they do not know how to implement them. Therefore, the following enabler was identified, namely to take small clear steps, close to home.

Due to these findings, the unified list of barriers and enablers (Appendix I) was updated as follows.

Enablers:
- Learning coordinator/manager
- Project role support and backup
- Employees with key knowledge involved from the outset
- Small clear steps, close to the familiar for implementation

Barrier:
- Barrier between calculation/project preparation and project implementation

Therefore, the list in Appendix II is expanded with the barrier and enablers from figure 5-4.

9. Barrier between calculation/ project preparation and project implementation	12. Learning coordinator/manager 13. Project role support and backup 14. Employees with key knowledge involved from the start 15. Small clear steps for implementation, close to what is known

Figure 5-4: Additional barriers and enablers found during the interviews

4I
Intuitive learning occurs to a large degree, but feeding this forward by interpreting it to the group (e.g., projects) only occurs to a smaller degree, and there is no integration of the learning on an organisational level. Some, top-down, institutionalising seemed to be in place (rules and procedures), but only on paper and not in practice. However, there is no oversight to ensure that these rules regarding learning are followed, and, therefore, there is almost no feedback of lessons learned from the organisation to the group/projects or from projects to individuals.

Therefore, in the next section, a design to transform Krinkels to a continuous learning organisation is suggested.

6 Design of Learning at Krinkels

To answer the question *'What improvements can be made (and how)',* a design for learning at Krinkels is proposed. The design of the implementation commences with utilising the enablers to overcome the barriers.

Requirements
Based on the results of the literature study, desk study and interviews, several requirements have to be met for this design to succeed. This means implementing the enablers and overcoming the barriers noted in the desk study and mentioned in the interviews (Appendix V). In addition, the 4I model (Figure 6-1) is suggested (Crossan, Lane & White, 1999) because of its closeness to Krinkels' internal processes and also because of the specific attention to sharing information between different levels within the organization.
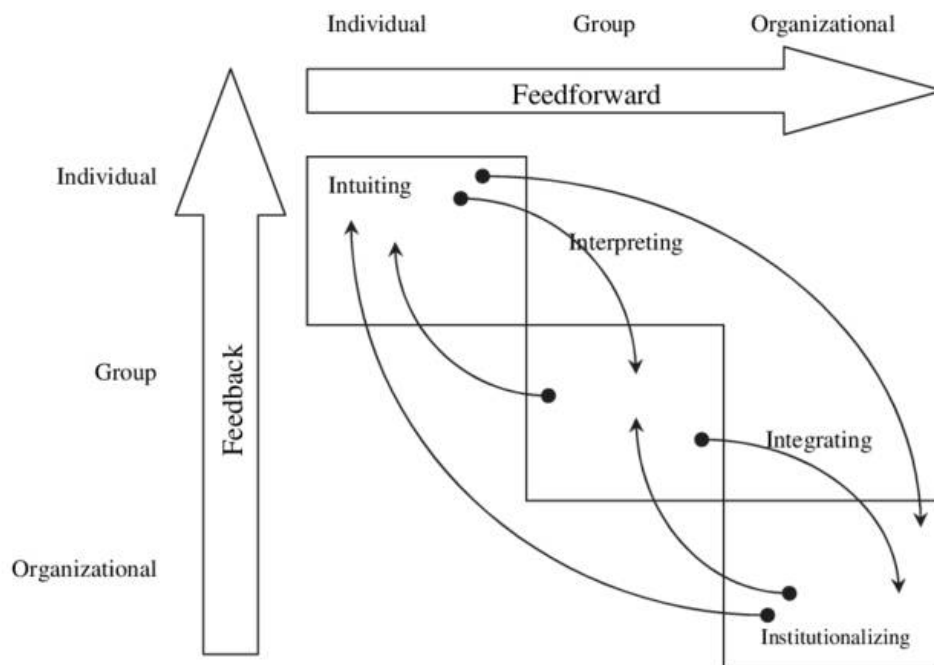
Figure 6-1: 4I model, organisational learning as a dynamic process (Crossan, Lane & White, 1999).

However, to commence the sharing of lessons learned, the design will start at the top left (individual), feeding forward into the organisation.

The reason for this is because individuals at Krinkels learn, as do project teams to some degree, but the organisation as a whole mostly does not; therefore, the approach is bottom-up, in other words, starting with what already works at Krinkels and expanding on it. This involves interpreting information for use in other groups/project teams, integrating it into the organisation (including possible feedback from the groups) and institutionalising and feeding it back to other groups and individuals.

The requirements for doing so are divided into four categories, namely functional requirements, user requirements, boundary conditions and design limitations (Aken, Berends, & Bij, 2007).

The list of barriers (B) and enablers (E) converted into requirements according to the four categories is shown in figure 6-2. I, G, O, stands for Individual-, group- and organisational-level. It is not to say that these enablers are only implemented and barriers overcome on the level, but is the level where it could be initiated.

Functional requirements					
Acces to specific knowledge (eg. Uavgc)	B1	I			
Clear location were knowledge can be found	B4/B23	G			
Clear which people possess certain knowlegde	B5	I			
Learning Coach / Learning champion	B6	G	Learning coordinator/manager	E19	O
Education	B7	O	Evaluate difference between process and knowledge	E14	G
Learning from former problems and sollutions	B12	G			
Project evaluation	B13	O	Lessons learned are recorded regularly	E8	I
Clear registration	B14	O			
Employs with the right skills	B15	O	Visualisation of lessons learned	E12	G
Sharing between projects and devisions	B25/B29	G	Willingness of other project members to help (even if from a different Krinkels project)	E6	I
			Collective and interactive sharing between different project managers	E11	G
Employees with key-figure knowledge are clear	B27	I, G	Employees with key knowledge involved from the start	E21	O
			Social network / informal dialogue	E17	I
			Test pilot before implementing in the whole organization	E18	I
Knowledge available is unusable	B24	G			
User requirements					
Time available for learning/evalation activities	B2	G			
Sharing lessons learned	B15	G	Lessons learned are shared with other project members	E7	G
General processes in place	B19	G	Organisational culture	E9	I
			Standard template	E13	I
			Learning is part of the work process	E15	G
			Small clear steps for implementation, close to what is known	E22	I
Boundary conditions					
Learning driven decissions	B8	G	Freedom to make their own decisions	E1	G
Shared vision or mission	B9	G	Own initiative is being stimulated	E2	O
Using plan, do but also check and act	B11	G	Openness to new ideas	E3	I
Accountabilty	B20	I	Willingness to learn	E4	I
			Motivated employees	E5	I
Design limitations					
Not knowing or seeing all outcomes of today's decisions	B3				
Stuck in mental models	B10				
No start up period	B16				
Proactiv not only reactive	B18				
Organisational culture	B21				
Knowledge drain (if people leave / incomplete records)	B28				
Barrier between calculation/ project preparation and project implementation	B29				

Figure 6-2: Barriers and enablers, converted into design requirements

In the next section, a concept framework to overcome barriers and implement enablers for continuous learning between projects is proposed, utilising the 4I model and the design requirements.

Framework and the PDCA Loop

Individual Level

Starting with small steps, close to what is known (E22), the first barrier to overcome is finding individuals with key knowledge in the organisation (B1 and B5), individuals who learn (E4), and who grasp the importance of sharing lessons learned and are willing to do so (E3/E5/E6). To implement the recommendations among project teams and in the entire organisation, support from the managing board of Krinkels is required (E9). In addition, some tools have to be developed (E13) to record lessons learned (E8).

Since the study is about learning between UAV-GC projects, the individuals involved should be individuals with key knowledge (B27) regarding the UAV-GC projects, for example, project

members.

These individual enablers had already been found among the interviewees, and five of them are (former) project leaders, one is a regional director and the other one the manager of the Information Technology Department. These seven selected individuals should initiate the pilot test (E17) on how to transform Krinkels into a learning organisation. One should the leading coordinator/manager (E18) for guiding and guarding the progress (also to ensure that somebody is responsible or held responsible (B20)).

Group level
The individuals in this (pilot) group should start sharing with the others at Krinkels (E7/B25/B29), important lessons learned and the impact on the organisation of what was learned or not learned (problems repeating (B12) while working at Krinkels. To design a working process (sharing lessons learned (B15)), it is proposed to start with the top three lessons learned on an individual level, which will then be shared in the group (E11), feeding it forward. A appointed learning coordinator (B6) is a member of this pilot group (see organisational level).

The next step is to determine how these lessons can be further shared, for example, by creating a standard template (E13) with a visualisation of the lesson learned (E12), and to ensure that others know where to find this information (B4). However, it has to be decided first what lessons are relevant to whom (B23 and B24). One approach to this is studying the financial impact of failure and the lesson learned from that failure. If the financial impact is more than a specified amount, all members of UAV-GC projects should be actively informed, and, if below that amount, the information will be available in a database. However, the core values of Krinkels, working safely, transparency, reliability, pragmatism and sustainability, can also be utilised as a starting point (B9). Therefore, after the financial impact (B8), the impact on these core values should be considered and, if significant (measurement to be determined), should be actively shared in the entire organisation. These actions will emphasise the importance of taking the time (B2) to record and share lessons learned, and key-figure knowledge (B27) will be shared.

In short, the individuals in this suggested pilot-group create a framework (E14) for sharing lessons learned within Krinkels by using some examples and determining why, with whom and how they should be shared (E1).

If the group establishes a working format, this format can be implemented in another group, a test-project group.

Since Krinkels is used to working with Deming's quality circle (1950), the plan should be introduced to the project team that should execute (do) the plan, and the project team and the pilot group should then evaluate whether the plan is working and what needs to be adjusted (act). If the approach is successful, the next step can be taken (B11) and repeating problems can be eliminated (B12). So general processes (B19) for improvement/learning between projects, are adjusted to fit the lessons learned in testing and tuning the framework (E15).

Organisation Level
Feeding this success forward to the remainder of the organisation is key in the sharing of lessons learned and overcoming the knowledge silo between people and projects. The approach of small steps close to home should be continued (E21), implemented with all UAV-GC projects, and become

mandatory and part of rules and procedures (checklists/evaluations (B13), registration (B14) with supporting IT (Information Technology) tools, feeding the experience back to groups and individuals (B15)). It is key that there is support for this framework on the organisation level (E2), a Learning coordinator (E19) is appointed and that there is a budget for learning/education (B7), for now (starting from what is known) this could be one of the individuals in the pilot group.

Monitoring and fine-tuning this implementation is necessary to improve the framework and keep it and the lessons learned up to date. The key responsibility of monitoring lies with the learning coordinator/manager.

7 Discussion

Most barriers to learning found in the literature but only some of the enablers are present at Krinkels.

The steps mentioned in Section 6 can be regarded as a pilot test to establish a format that might also work with other types of projects at Krinkels. Although it is not part of this research, failure cost also occurs at other Krinkels projects (the ones based on UAV, non-integrated contracts). The method and tools derived from this research might also be applicable to those projects and turn Krinkels into a true continuous learning organisation, not only on the UAV-GC contracts.

Krinkels is not unique in this. Several other similar organisations (e.g., Donkergroen and Sight Landscaping) and also other general contractors, or even other organisations besides contractors, might recognise several of the problems and barriers mentioned in this thesis and will, hopefully, now have some tools to overcome the problems by using or creating the enablers step by step and fine-tuning these tools during implementation.

The findings in this study could also be used to make strategic decisions. For example, does Krinkels still want to continue with UAV-GC projects? However, that is not part of this research. Perhaps a business case could be compiled in an additional study to assist with this decision.

Although most of the recommendations of the former research were not implemented and some processes to stimulate learning between projects are even less implemented today than they were in 2016, it is as yet unclear whether this has resulted in more significant failure cost (as a percentage and absolute) than before. If not, this might perhaps explain the lack of implementation of the recommendations. However, it would be interesting to know why the levels of learning at Krinkels have dropped and why their seems to be a lack of attention to improve learning at Krinkels. This is not part of this research and could be a focus of an additional study.

Since most of the recommendations of the former research were not implemented, a different approach is proposed in this paper, bottom up instead of top down, starting from what has worked in the past (growing Krinkels according to the cell theory of E. Wintzen, from small to large), and with employees who have and are still learning within their own project task. However, although the interviewees support this approach and they are members of different divisions within Krinkels this does not automatically mean that there is a (broad) support within the rest of the organisation at Krinkels (between different projects and branches). Two additional approaches to support the implementation of the recommendations in this research might be possible. First is the approach as has been used during this research: interviewing employees and to listen and use their views in addition to the rest and improvement of the research (then implementation). Second might be how the former study in 2016 came to be. It was conducted because there were large failure costs at two UAV-GC projects. Therefore the research was deemed necessary by the board of directors at Krinkels in order to prevent these failure costs from happing in the future. Therefore it might contribute to (further) commitment, for the board members and other employees to calculate the amount of money the failures and in particular, not learning from failures has cost.

In addition to the findings in the 2016 study, nine new barriers and 14 new enablers were identified (see Appendix I in blue), eight new barriers and 11 enablers from the literature update and one new barrier and three enablers from the interviews.

In addition to the barriers found in the literature, another barrier was found between project stages, although this is similar to the autonomy of the projects (knowledge silo).

Three additional enablers were found, namely employees with key knowledge involved from the outset, a project-role supporter and backup and a learning coordinator/manager.

8 Conclusion

When comparing the results of the 2016 study and this research, it becomes clear that the level of learning at Krinkels has deteriorated and that the recommendations from the 2016 study have not been implemented.

Fifteen additional enablers and nine additional barriers were found during this research in a literature review and interviews (see appendix II). There are clear differences in the levels of learning at individual, group and organisational levels. While individuals learn while executing their specific tasks through intuiting and interpreting, this acquired knowledge most often remains with this person and is integrated into the project of which they are a team member but not integrated into other projects or institutionalised into the organisation.

The barrier highlighted in the interviews is time restraints. In addition to the knowledge silo between projects or projects and the organisation, knowledge role silos exist between project members with specific roles and other project members. In the smaller standard (UAV) projects, currently, one general foreman has a complete and in-depth overview.

When looking at Crossan, Lane and White's (1999) model, the previous study had been presented to top management of the organisation (board of directors and managing directors) but they did not communicate the information to the groups (branches/projects) or other individuals.

It should be a bottom-up and not top-down process that needs to be implemented. The learning of individuals is seldom forwarded to other projects or branches (group level), almost never to the organisational level, and it is not integrated or institutionalised. The specific knowledge on how to successfully manage integrated projects is acquired by individuals involved with these projects. In the past, these individuals shared this knowledge at, for example, annual meetings with their fellow colleagues, where they exchanged information pertaining to lessons learned. However, this practice was abandoned due to budget cuts, and the system of sharing through an improvement form (VAK-formulieren) is not adequate to share the lessons learned (as also described by Hartmann and Doree 2015: Learning between projects: More than sending messages in bottles).

The top-down method of writing a report with recommendations and sending these recommendations top-down through the organisation has not worked. Therefore, instead of using the same top-down method again, it is proposed to start bottom-up with what worked at Krinkels in the past, feeding it forward from individuals to groups, from groups to the organisation and back again.

The specific approach to achieve this is described in Chapter six, utilising a number of the interviewees (see Chapter 5) who support the creation of a continuously learning organisation. Starting with individuals who learn, continuous learning between projects can be created and institutionalised.

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1 APPENDIX

Continuous Learning Between Projects

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Appendix I Barriers and enablers

Barriers (previous research)	Enablers (previous research)
1. Knowledge (about UAV-gc)	1. Freedom to make their own decisions
2. Time restraints	2. Own initiative is being stimulated
3. Not knowing or seeing all outcomes of today's decisions	3. Openness to new ideas
4. Where to find knowledge within the organization (ict)	4. Willingness to learn
5. Where to find knowledge within the organization (people)	5. Motivated employees
6. Lack of coaching	6. Willingness of other project members to help (even if from a different Krinkels project)
7. Lack of people with knowledge about certain topics at Krinkels	7. Lessons learned are shared with other project members
8. Money driven decisions	
9. No shared vision or mission	
10. Stuck in mental models	
11. PDCA, mostly plan and do, less or no check and/or act	
12. Problems keep repeating themselves	
13. No or almost none project evaluations/ lessons learned	
14. No clear registration of lessons learned	
15. Lessons learned are not shared within the whole organization	
16. No start up period	
17. Availability of people with the right skills (at Krinkels and in general)	
18. Not proactive mostly reactive	
19. General processes to share lessons learned are not in place	
20. No one is accountable to share lessons learned	

Figure 0-1: Barriers and enablers for learning between projects (Lanting, 2016).

Barriers (previous research)	Enablers (previous research)
1. Knowledge (about UAV-gc)	1. Freedom to make their own decisions
2. Time restraints	2. Own initiative is being stimulated
3. Not knowing or seeing all outcomes of today's decisions	3. Openness to new ideas
4. Where to find knowledge within the organization (ict)	4. Willingness to learn
5. Where to find knowledge within the organization (people)	5. Motivated employees
6. Lack of coaching	6. Willingness of other project members to help (even if from a different Krinkels project)
7. Lack of people with knowledge about certain topics at Krinkels	7. Lessons learned are shared with other project members
8. Money driven decisions	
9. No shared vision or mission	
10. Stuck in mental models	
11. PDCA, mostly plan and do, less or no check and/or act	
12. Problems keep repeating themselves	
13. No or almost none project evaluations/ lessons learned	
14. No clear registration of lessons learned	
15. Lessons learned are not shared within the whole organization	
16. No start up period	
17. Availability of people with the right skills (at Krinkels and in general)	
18. Not proactive mostly reactive	
19. General processes to share lessons learned are not in place	
20. No one is accountable to share lessons learned	
Barriers (this research)	**Enablers (this research)**
1. Organisational culture	1. Lessons learned are recorded regularly
2. Motivation	2. Organisational culture
3. Ignorance of knowledge available	3. Motivation
4. Knowledge available is unusable	4. Collective and interactive sharing between different project managers
5. Autonomy of projects (knowledge silo)	5. Visualisation of lessons learned
6. Output has te be input	6. Standard template
7. Key-figure knowledge	7. Evaluate difference between process and knowledge
8. Knowledge drain (if people leave / incomplete records)	8. Learning is part of the work process
	9. Clear context
	10. Social network / informal dialogue
	11. Test pilot before implementing in the whole organization

Figure 0-2: Barriers and enablers for learning between projects, green for those found in the research in 2016 and blue for the additional barriers and enablers found in the updated literature review in 2020.

9. Barrier between calculation/ project preparation and project implementation	12. Learning coordinator/manager
	13. Project role support and backup
	14. Employees with key knowledge involved from the start
	15. Small clear steps for implementation, close to what is known

Figure 0-3: Additional barriers and enablers found during the interviews

Appendix I.I Guidelines used for the desk study

National guidelines
Business plan Krinkels
Mission statement
National objectives
Key preformance indicators
Improvement forms (Dutch: VAK / Verbeteringsformulieren)

Branch guidelines
Branch plan
Educational plan

Project guidelines A6 / Artificial turf project
Project management plan
Quality plan
Risk (reduction) plan
Safety plan (Dutch: KAM plan)
Economic most advantageous lan (Dutch: EMVI plan)
Construction meeting reports

Figure 0-4: Reviewed guidelines used in the desk study

Appendix I.II Project documents used in the desk study

Nagele	Hengelo
Quality plan	Project quality plan
Risk files	Risk files
Verification files	Verification files
Delivery files	Delivery report
Improvementforms	Improvementforms
Minutes	Minutes
Safety plan	Safety fiels
Data managementplan	Inspection files
Projectmanagementplan	Deviation files
Projectcommunicationplan	Communication files
Reports of safety meetings	Reports of safety meetings
Workplace inspection forms	Workplace inspection forms

Figure 0-5: Documents reviewed in the desk study

Appendix II List of barriers and enablers

Barriers	Enablers
1. Knowledge (about UAV-gc)	1. Freedom to make their own decisions
2. Time restraints	2. Own initiative is being stimulated
3. Not knowing or seeing all outcomes of today's decisions	3. Openness to new ideas
4. Where to find knowledge within the organization (ict)	4. Willingness to learn
5. Where to find knowledge within the organization (people)	5. Motivated employees
6. Lack of coaching	6. Willingness of other project members to help (even if from a different Krinkels project)
7. Lack of people with knowledge about certain topics at Krinkels	7. Lessons learned are shared with other project members
8. Money driven decisions	8. Lessons learned are recorded regularly
9. No shared vision or mission	9. Organisational culture
10. Stuck in mental models	10. Motivation
11. PDCA, mostly plan and do, less or no check and/or act	11. Collective and interactive sharing between different project managers
12. Problems keep repeating themselves	12. Visualisation of lessons learned
13. No or almost none project evaluations/ lessons learned	13. Standard template
14. No clear registration of lessons learned	14. Evaluate difference between process and knowledge
15. Lessons learned are not shared within the whole organization	15. Learning is part of the work process
16. No start up period	16. Clear context
17. Availability of people with the right skills (at Krinkels and in general)	17. Social network / informal dialogue
18. Not proactive mostly reactive	18. Test pilot before implementing in the whole organization
19. General processes to share lessons learned are not in place	19. Learning coordinator/manager
20. No one is accountable to share lessons learned	20. Project role support and backup
21. Organisational culture	21. Employees with key knowledge involved from the start
22. Motivation	22. Small clear steps for implementation, close to what is known
23. Ignorance of knowledge available	
24. Knowledge available is unusable	
25. Autonomy of projects (knowledge silo)	
26. Output has te be input	
27. Key-figure knowledge	
28. Knowledge drain (if people leave / incomplete records)	
29. Barrier between calculation/ project preparation and project implementation	

Figure 0-6: Barriers and enablers found during interviews (in light green) and not found (in yellow)

Barriers	Enablers
1. Knowledge (about UAV-gc)	1. Freedom to make their own decisions
2. Time restraints	2. Own initiative is being stimulated
3. Not knowing or seeing all outcomes of today's decisions	3. Openness to new ideas
4. Where to find knowledge within the organization (ict)	4. Willingness to learn
5. Where to find knowledge within the organization (people)	5. Motivated employees
6. Lack of coaching	6. Willingness of other project members to help (even if from a different Krinkels project)
7. Lack of people with knowledge about certain topics at Krinkels	7. Lessons learned are shared with other project members
8. Money driven decisions	8. Lessons learned are recorded regularly
9. No shared vision or mission	9. Organisational culture
10. Stuck in mental models	10. Motivation
11. PDCA, mostly plan and do, less or no check and/or act	11. Collective and interactive sharing between different project managers
12. Problems keep repeating themselves	12. Visualisation of lessons learned
13. No or almost none project evaluations/ lessons learned	13. Standard template
14. No clear registration of lessons learned	14. Evaluate difference between process and knowledge
15. Lessons learned are not shared within the whole organization	15. Learning is part of the work process
16. No start up period	16. Clear context
17. Availability of people with the right skills (at Krinkels and in general)	17. Social network / informal dialogue
18. Not proactive mostly reactive	18. Test pilot before implementing in the whole organization
19. General processes to share lessons learned are not in place	19. Learning coordinator/manager
20. No one is accountable to share lessons learned	20. Project role support and backup
21. Organisational culture	21. Employees with key knowledge involved from the start
22. Motivation	22. Small clear steps for implementation, close to what is known
23. Ignorance of knowledge available	
24. Knowledge available is unusable	
25. Autonomy of projects (knowledge silo)	
26. Output has te be input	
27. Key-figure knowledge	
28. Knowledge drain (if people leave / incomplete records)	
29. Barrier between calculation/ project preparation and project implementation	

Figure 0-7: *Unified list of barriers and success factors*

Appendix III.I Number of times the process was found in the desk study

In terms of: No (never), seldom, sometimes, often and always.

Number	Proces found in the desk study	Answer (No, seldom, sometimes, often, always)
1	All VAK-formulieren are visible to all Krinkels employees on Intranet.	Sometimes
2	PDCA should be in place always for al critical processes.	Sometimes
3	It is Krinkels vision to be the most qualitative and most innovative service provider in the Netherlands.	Sometimes
4	Krinkels claims in their EMVI-plans to be proactive.	Seldom
5	There is a specific budget for learning available (3% of total wages at Krinkels).	Seldom
6	The right person at the right place.	Sometimes
7	Flat orgnisation structure.	Sometimes
8	Improvements, deviations and complains are generally reported using a digital VAK-formulier.	Often
9	Projects are being monitored on cost, quality, organization, information, planning and risk.	Seldom
10	Krinkels will invest in assets management and project management systems.	Sometimes
11	Data management and ICT create a distinct asset.	Seldom
12	The orientation is regional, autonomous branches.	Seldom
13	Projectrequirements or monitored in a verification matrix or program like Relatics.	No
14	Large projects should be evaluated.	Seldom
15	Sharing information between all levels in the organization.	Sometimes
16	Staff facilitates the organization.	Seldom
17	VAK-formulieren are shared with the clients.	Seldom
18	Every year an audit (extern/intern) to check Krinkels's quality system according to the ISO 9001/ 55001.	Seldom

Figure 0-8: Overview results of the desk study, number of times found

Appendix III.2 Number of times the process was found in the desk study, validated by the interviews

Number	Processes validated during the interviews	Answer (No, seldom, sometimes, often, always)
1	All VAK-formulieren are visible to all Krinkels employees on Intranet.	No
2	PDCA should be in place always for al critical processes.	Sometimes
3	It is Krinkels vision to be the most qualitative and most innovative service provider in the Netherlands.	Sometimes
4	Krinkels claims in their EMVI-plans to be proactive.	Sometimes
5	There is a specific budget for learning available (3% of total wages at Krinkels).	Often
6	The right person at the right place.	Seldom
7	Flat orgnisation structure.	Often
8	Improvements, deviations and complains are generally reported using a digital VAK-formulier.	Seldom
9	Projects are being monitored on cost, quality, organization, information, planning and risk.	Seldom
10	Krinkels will invest in assets management and project management systems.	Sometimes
11	Data management and ICT create a distinct asset.	Often
12	The orientation is regional, autonomous branches.	Often
13	Projectrequirements or monitored in a verification matrix or program like Relatics.	Seldom
14	Large projects should be evaluated.	Seldom
15	Sharing information between all levels in the organization.	No
16	Staff facilitates the organization.	Always
17	VAK-formulieren are shared with the clients.	Always
18	Every year an audit (extern/intern) to check Krinkels's quality system according to the ISO 9001/ 55001.	Always

Figure 0-9: Overview results desk study, number of times found, validated by the interviews

Appendix IV Interviews results

In total eight people were interviewed. The results of the answers are shown in figure 1-10.

Number	Question	Answer (no, seldom, sometimes, often, always)
I.	**Registering and sharing of knowledge /availability knowledge documents**	
1	Knowledge is secured by registering best practices and lessons learned.	Sometimes
2	All processes are controlled and improved by using het Quality Circle of Deming.	Sometimes
3	Before solving a problem, one first finds out how the problem cam in to existence and what the long term effect is of the possible solutions.	Sometimes
4	Personal experiences / lessons learned at former projects are shared within the new project team.	Seldom
II.	**Strategical approach**	
5	There is always a clear project mission and vision.	Seldom
6	Employees act proactive in order to prevent problems from occurring.	Seldom
	Availability knowledgeable employees	
7	There is a emphasis on learning / acquiring knowledge for the project members.	Sometimes
8	The problems which occurred are registered including risks and effects.	Sometimes
9	Speaking ones mind is been promoted.	Often
10	Experiences / lessons learned are shared between projects.	Seldom
III.	**Obstacle: time (Lanting, 2016)**	
11	The long term planning is manageable.	Sometimes
IV.	**Extra questions**	
12	Are there systems in place, at Krinkels, to share and secure knowledge ?	Seldom
13	Are there any project management manual available ?	Seldom
14	Are there any prescribed project management manuals ?	No
15	Are they obligations, promised in the EMVI-plans being guarded ?	Seldom
16	Is there any evaluation done of the EMVI-plan (during the project or after the project has finished) ?	Sometimes
17	Is the necessary knowledge for a project team being safeguarded ?	Seldom
18	Is knowledge shared with other projects ?	Seldom
19	Is there a clear lead form the Head office to promote (continues) learning ?	Seldom
20	Do you see other obstacles which prevent (continuous) learning between projects ?	Sometimes

Figure 0-10: Overview interview answers

Number	Question	Summary of the given answers
I.	Registering and sharing of knowledge /availability knowledge documents	
1	Knowledge is secured by registering best practices and lessons learned.	When writing EMVI plan, yes, otherwise no, some evaluation takes place and some lesson learned are documented on the central server, however there is no active sharing , some knowledge is only know by a few people, evaluations are also shared with the branch manager every 3 months.
2	All processes are controlled and improved by using het Quality Circle of Deming.	Sometimes but using pdca with all processes is unworkable, yes within the project but no exchange between projects about what has been learned, only if things went really really wrong, we say we do in plans but most of the time we don't.
3	Before solving a problem, one first finds out how the problem cam in to existence and what the long term effect is of the possible solutions.	Yes wo do when writing an EMI plan, within the project team yes, outside no, therefore some problems are repeated at other projects, sometimes we try but no registration or sharing of this information,.
4	Personal experiences / lessons learned at former projects are shared within the new project team.	Yes , when writing EMVI-plan, We started in 2016 with sharing lesson learned with new employees, they were very enthusiastic about it, now we stopped however because KSP (Krinkels Special Projects) ceases tot exist, hardly any sharing is
II.	Strategical approach	
5	There is always a clear project mission and vision.	Sometimes, once or twice in a year, no we don't do that.
6	Employees act proactive in order to prevent problems from occurring.	We don't register this but i belief we are quit proactive, hardly people don't listen to experience (it shared) form other project, some ICT systems are difficult to work with, no handling now is called pragmatism and is reactive.
	Availability knowledgeable employees	
7	There is a emphasis on learning / acquiring knowledge for the project members.	Yes sometimes however when writing an EMVI plan you want to use innovations not just old information on how things are done, it is difficult to hire experienced people. No hardly.
8	The problems which occurred are registered including risks and effects.	Yes when writing EMVI-plans always, no new project teams start all over, 'inventing the wheel again', the risk will increase since KSP is closed down and now the branches will run the large UAV-gc projects, somethings but almost never is lack of
9	Speaking ones mind is been promoted.	Yes, absolutely yes we try to, but the structure with project team hardly leads to sharing this information to other project
10	Experiences / lessons learned are shared between projects.	Seldom, to my experience it means keeping checklists up to date which is often forgotten. Yes we started to in 2016 however this is now being cancelled due to shutting down KSP, only sometimes if people form different projects know each other well or if the have to (if things went wrong).
III.	Obstacle: time (Lanting, 2016)	
11	The long term planning is manageable.	Yes most of the time, yes but only for the short term planning, sometimes we do sometimes we don't.
IV.	Extra questions	
12	Are there systems in place, at Krinkels, to share and secure knowledge ?	De EMVI-database, Metrix, (epidemic/bvp), Mett page, Facility apps, vak-formulier, relatics, power BI, internet and intranet.
13	Are there any project management manual available ?	Some books are availably, no none.
14	Are there any prescribed project management manuals ?	No, sometimes we use previous projects project management plans as an example.
15	Are they obligations, promised in the EMVI-plans being guarded ?	A verfication matrix is made, sometimes Relatics is used, no almost never, this is the responsibility of the branch
16	Is there any evaluation done of the EMVI-plan (during the project or after the project has finished) ?	Seldom, sometimes i ask, no not if the project has already finished, sometimes.
17	Is the necessary knowledge for a project team being safeguarded ?	No its is not, no we use/hire who is available, so based on availability and chance, the project manager should do this.
18	Is knowledge shared with other projects ?	If you want to you get the information by contacting other project members from other projects, or you can ask your team leader, we started to do this in 2016 but know KSP is cancelled so not any more. Only by trying to use the same people for the same kind of projects, sometimes but not structural.
19	Is there a clear lead form the Head office to promote (continues) learning ?	No, you promote continues learning yourselves, no their are not enough employees with the right experience and knowledge, no information has the be collected, registered and shared by implementing daily, weekly and monthly stand ups, It should be the culture of the organization to share
20	Do you see other obstacles which prevent (continuous) learning between projects ?	For me no, it is always good to learn some more, not enough employees with the wright experience/knowledge, it takes about a year to learn so invest now into new employees, A change has to be made into creating a truht learning organization.

Figure 0-11: Summary interview answers

Number	Proces found during the desk study	Question	Answer (no, seldom, sometimes, often, always)
			(No does not happen, happens seldon, happens sometimes, yes this happens often, yes this happens always)
I.	**Registering and sharing of knowledge /availability knowledge documents**		
1	All improvement forms ar visible to all Krinkels employees on the Intranet	Knowledge is secured by registering best practices and lessons learned.	Sometimes
2	PDCA should always be in place for critical processes	All processes are controlled and improved by using het Quality Circle of Deming.	Sometimes
3	None	Before solving a problem, one first finds out how the problem cam in to existence and what the long term effect is of the possible solutions.	Sometimes
4	None	Personal experiences / lessons learned at former projects are shared within the new project team.	Seldom
II.	**Strategical approach**		
5	It is Krinkels's vision to be the most qualitative and most innovative service provider in the Netherlands.	There is always a clear project mission and vision.	Seldom
6	Krinkels claims to be pro-active in their EMVI-plans	Employees act proactive in order to prevent problems from occurring.	Seldom
	Availability knowledgeable employees		
7	There is a specific budget for learning available (3% of total wages at Krinkels)	There is a emphasis on learning / acquiring knowledge for the project members.	Sometimes
8	The right person at the right place	The problems which occurred are registered including risks and effects.	Sometimes
9	None	Speaking ones mind is been promoted.	Often
10	Improvements, deviations and complains are generally reported using a digital improvement form	Experiences / lessons learned are shared between projects.	Seldom
III.	**Obstacle: time (Lanting, 2016)**		
11	Project are being monitored on cost, quality, organization, information, planning and risks.	The long term planning is manageable.	Sometimes
IV.	**Extra questions**		
12	Krinkels will invest in assets management and project management systems	Are there systems in place, at Krinkels, to share and secure knowledge ?	Seldom
13	Data management and ICT create a distinct asset	Are there any project management manual available ?	Seldom
14	The orientation is regional, autonomous branches	Are there any prescribed project management manuals ?	No
15	Projectrequirements are monitored in a verification matrix or software program like Relatics	Are they obligations, promised in the EMVI-plans being guarded ?	Seldom
16	Large projects should be evaluated	Is there any evaluation done of the EMVI-plan (during the project or after the project has finished) ?	Sometimes
17	Sharing information between all levels in the organization	Is the necessary knowledge for a project team being safeguarded ?	Seldom
18	All improvement forms are visible to all Krinkeles employees on the Intranet	Is knowledge shared with other projects ?	Seldom
19	Staff facilitates the organization	Is there a clear lead form the Head office to promote (continues) learning ?	Seldom
20	None	Do you see other obstacles which prevent (continuous) learning between projects ?	Sometimes

Figure 0-12: Overview of desk study and interview answers combined

Appendix V Barriers and enablers, requirements for design

Barriers	Enablers
1. Knowledge (about UAV-gc)	1. Freedom to make their own decisions
2. Time restraints	2. Own initiative is being stimulated
4. Where to find knowledge within the organization (ict)	3. Openness to new ideas
5. Where to find knowledge within the organization (people)	4. Willingness to learn
6. Lack of coaching	5. Motivated employees
7. Lack of people with knowledge about certain topics at Krinkels	6. Willingness of other project members to help (even if from a different Krinkels project)
8. Money driven decisions	7. Lessons learned are shared with other project members
9. No shared vision or mission	8. Lessons learned are recorded regularly
11. PDCA, mostly plan and do, less or no check and/or act	9. Organisational culture
12. Problems keep repeating themselves	11. Collective and interactive sharing between different project managers
13. No or almost none project evaluations/ lessons learned	12. Visualisation of lessons learned
14. No clear registration of lessons learned	13. Standard template
15. Lessons learned are not shared within the whole organization	14. Evaluate difference between process and knowledge
17. Availability of people with the right skills (at Krinkels and in general)	15. Learning is part of the work process
18. Not proactive mostly reactive	17. Social network / informal dialogue
19. General processes to share lessons learned are not in place	18. Test pilot before implementing in the whole organization
20. No one is accountable to share lessons learned	19. Learning coordinator/manager
23. Ignorance of knowledge available	20. Project role support and backup
24. Knowledge available is unusable	21. Employees with key knowledge involved from the start
25. Autonomy of projects (knowledge silo)	22. Small clear steps for implementation, close to what is known
27. Key-figure knowledge	
28. Knowledge drain (if people leave / incomplete records)	
29. Barrier between calculation/ project preparation and project implementation	

Figure 0-13: Barriers and enablers, requirements for design

Barriers	Enablers
3. Not knowing or seeing all outcomes of today's decisions	
10. Stuck in mental models	
16. No start up period	
21. Organisational culture	
28. Knowledge drain (if people leave / incomplete records)	
29. Barrier between calculation/ project preparation and project implementation	

Figure 0-14: Barriers and enablers not used since not found in the desk study or mentioned during the interviews