 ISBN: 9789052693958

CHAIN COLLABORATION BETWEEN A HOUSING CORPORATION AND TWO GENERAL CONTRACTORS, THE FIRST STEPS

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Abstract
Several housing corporations in the Netherlands have realized they cannot do it alone if they want to renovate their housing stock faster, cheaper and with a higher quality. More and more of these corporations are forming strategic alliances with contractors and other partners to reach these goals. They are applying principles of supply chain integration and lean on the total process of the building lifecycle, under the umbrella concept of Chain Collaboration (Ketensamenwerking in Dutch).
This article draws from active research executed on two projects which started in 2010 and are still under development. It focuses on the definition and design phase and describes the approach applied to implement the chosen strategies.

Keywords: supply chain integration, lean, strategic alliance, housing corporation

1. INTRODUCTION

Under pressure of the current credit crunch and a decreasing need for new homes the coming ten to fifteen years, housing corporations (HC's) in the Netherlands are facing a market where higher quality at a lower price is requested by home buyers and tenants (Wal van der, Arts & Beijer, 2009). The cost HC's make for the production and maintenance of their houses will have to decrease dramatically in order to keep houses affordable (De Wildt and Luijkx, 2011). Faced by these challenges the HC's are looking for ways to produce more value to the end user at a lower price level.

In order to produce more value at a lower price level, HC's are abandoning the traditional design-bid-build approach. HC's are exploring different strategies, most of them under the umbrella concept of Chain Collaboration (*Ketensamenwerking* in Dutch).

The HC subjected to research in this case is applying the following strategy:

- integrating supply chains, with main contractors, subcontractors and suppliers;
- forming strategic alliances and alliance culture;
- applying lean principles and tools in the definition, design and realization phases.

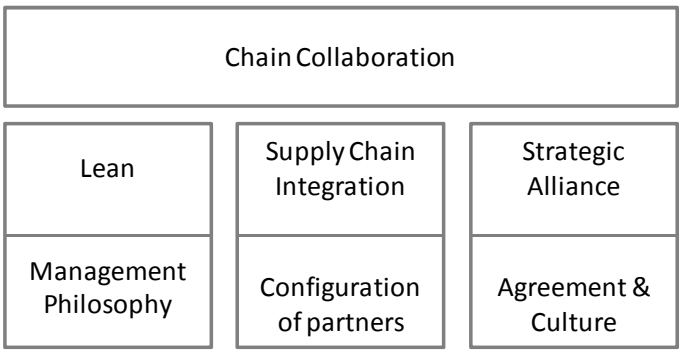

Figure 1: *Strategies part of Chain Collaboration*

In this article two cases of one Dutch HC are presented. The cases consist of two strategic alliances formed by one HC with two different general contractors. The general contractors also forms strategic alliances themselves with several subcontractors.

One alliance is formed for large maintenance projects of low rise houses. The other alliance is formed for the upgrading of apartments so they become more suitable for the elderly (55+). The research is done by action research and focuses primarily on the definition and design phase.

2. METHODOLOGY

This article draws from active research done during the formation of two strategic alliances between a HC, two main contractors and several subcontractors which started in 2010 and is still ongoing. The main goal of these alliances is, by the integration of the supply chains, to develop a faster and cheaper maintenance and upgrading process for existing houses.

This project consists out of two parts. The first part focuses on the definition and design phase. The second on the realization phase. This paper focuses primarily on the first part. Within this part, the traditional process is re-designed to converge to the main goal.

The development of each strategic alliance is managed by two change agents. One agent form the HC and one from the general contractor. Each of the two alliances has its own agents. The change agents work directly under the board of their company.
The change agents are guided by a team consisting out of two consultants and one researcher (the author). The development of the alliances is monitored for two hours a week during the guiding-sessions for a full year. A logbook of these sessions has been kept for ex-post research.

The researcher is actively involved in the process under study in order to identify, promote and evaluate problems and potential solutions. As stated by Fellows and Liu (2008) active research ‘is where the research actively and intentionally endeavors to effect a change in a system. Knowledge is used to effect the change which then creates new knowledge about the process of change and the consequences of change (as well as the change itself). In programmes of action research, the usual cycle of scientific research (problem definition – design – hypothesis – experiment – data collection –analysis – interpretation) is modified

slightly, by purpose of the action rather than by theoretical bases, to become 'research question – diagnosis – plan – intervention – evaluation', the 'regulative cycle'.

The main research question for this project is: How should the process of the definition and design phase be redesigned in order to (1) incorporate the know-how of the several alliance partners and (2) filter out the waste, in terms of lean, from the definition and design phase?
The method applied to diagnose the situation is value stream mapping (VSM) (Hines and Rich, 1997). At first the 'current state' of the (traditional) definition and design phase, together with the underlying process characteristics (lead time, process time,etc), was defined. This was done by the guiding team together with the change agents, the projectmanagers of the HC and general contractor, architects and other advisors. For both alliances a current state has been described.
Based on this value stream map possible interventions for filtering out waste and the integration of alliance-partner knowledge where identified. At the time of writing this article, the possible interventions where defined, but not fully developed.

In the follow up, which falls outside of the scope of this paper, the initiatives will be further developed in smaller teams and implemented into the process following a standard DMAIC-method (define, measure, analyse, improve, control). When an initiative is implemented, a new process map can be drawn up making the future state (or new current state). After this, new initiatives can be defined and developed, and the cycle starts again. The use of the VSM is further explained in chapter 4.

3. STRATEGY APPLIED BY THE HOUSING CORPORATION

This section will describe the three strategies used for the development and implementation of Chain Collaboration as presented in the first paragraph.

3.1 Supply chain management and relations

The supply chain has been defined as 'the network of organizations that are involved, through upstream and downstream linkages, in the different processes and activities that produce value in the form of products and services in the hands of the ultimate customer' (Christopher 1992). Instead of looking at just the next entity, the concept of Supply Chain Management (SCM) looks across the entire supply chain and aims to increase transparency and alignment of the supply chain's coordination and configuration, regardless of functional or corporate boundaries (Cooper and Ellram 1993). According to Koskela and Vrijhoef (1999) the actors in the supply chain are dependent on each other for implementing the supply chain methodology successfully.

Supply chain relations are often described in terms of the level of integration, interconnectedness, or interdependence among trading partners within the chain (Lockamy and Smith, 2000). The level of partnership is, for example, identified by Cooper et al. (1997) and Tyndall et al. (1998). They identified four levels of partnership.
At the lowest level, the trading partners rely on what Tyndal et al. (1998) calls open market negotiations characterized by arm's length transactional business practices. The competitive imperatives, not management initiatives, determine the nature of the relationship.
In the next level Tyndall et al. (1998) trading partners formalize their cooperation. They construct specialized transactional processes that better serve their needs. To secure the benefits, partners enter into long term agreements and they commit to sharing information

about the volume and timing of product and service. This to further reduce uncertainty in their relationship.
The third level of partnership aims to create relationships rich enough to support joint efforts to simplify supply chain operations. Coordinated efforts are deployed to, for example, reduce inventories or the amount of transaction.
The fourth level is where partners reach the collaboration stage. In this stage partners engage in joint efforts to develop and improve products and in joint efforts to enhance the value and satisfaction provided by customers. In this stage, management devotes considerable energy to building trusting supply chain relationships and to negotiating equitable arrangements for sharing the risks and rewards of supply chain improvements.

According to Handfield and Nichols (2002) integrating a supply chain, as in level 4, represents a major change in the way companies do business. In creating integrated supply chains, companies must rethink how they see their customers and suppliers. They must concentrate not just on their own profits, but also on how to maximize the success of all organizations in the supply chain. When the organizations involved focus on these goals, they may discover the need to re-design the entire structure of their supply chains.

3.2 Strategic alliance agreement

Arrangements that counteract adversarial relationships with each other are needed to enlarge the magnitude of Supply Chain Management (Koskela and Vrijhoef,1999). Similar conclusions can be drawn from Khalfan and McDermott (2006) which conducted multiple case studies on long term framework arrangements applied in construction.
In this case the partners are aiming for a level 3-4 of supply chain relation (see paragraph 3.1 for explanation) where a contractor and subcontractors become involved in the early design stages of a project. The strategic alliance agreement between the HC, general contractors and sub-contractors therefore forms the fundament for the collaboration effort.

There are many definitions of ‘partnering’ and ‘alliancing’ (Barlow et al., 1997). The strategic alliance subjected to research in this case is a long term contractual agreement between the client, general contractor and several strategic partners (suppliers and subcontractors). According to Doz and Hamel (1998) such an alliance would be called a non-equity alliance.
The features of this strategic alliance are that the collaborators work together on multiple (housing) projects, towards joint goals, sharing parts of the projects risks and profits. The joint goals in this case are to produce more value to the end user at lower cost and at a higher speed. The performance is measured through performance indicators. An aligned development process, unanimous decision making, open book accounting, a fair payment, and trust are the basis of the arrangement.

The compensation model the partners are developing for these alliances is target costing based on a cost-plus pricing system. There are several approaches possible. For further reading about these approaches, the author suggests to read Lockamy and Smith (2000). The Target Costing approach falls outside the scope of this paper.

3.3 Lean

Koskela (1992) states that the traditional way of managing is essentially based on a conversion view on production, whereas Supply Chain Managment is based on a flow view of production. The conversion view suggests that each stage of production is controlled independently whereas the flow view focuses on the control of the total flow of production (Koskela, 1992).
There is a large toolbox of methods available to analyze various issues in order to integrate and improve the performance of the supply chain (Vrijhoef and Koskela 1999). For this case the lean philosophy and tools where used for the redesign, control and improvement of the supply chain.

Lean manufacturing is a generic process management philosophy derived mostly from the Toyota Production System (TPS) and identified as "Lean" in the 1990s. The term was first coined by John Krafcik in a 1988 article, "Triumph of the Lean Production System," published in the Sloan Management Review (Holweg, 2007).

Lean stresses a supply chain perspective, seeing the internal production operations as a part of a value stream from the sub-suppliers to the end customer (e.g. Rother & Shook, 1998; Jones & Womack, 2002). This perspective fits the highly fragmented AEC industry (Arbulu & Tommelein, 2002).
Lean considers the expenditure of resources for any goal other than the creation of value for the end customer to be wasteful, and thus a target for elimination. Working from the perspective of the customer who consumes a product or service, "value" is defined as any action or process that a customer would be willing to pay for.

The first step in lean is to understand what value is. The second step is to understand what activities and resources are absolutely necessary to create that value. Once this is understood, everything else is waste. According to Monden (1993) waste can be categorized into:

- non-value adding
- necessary but non-value adding
- value adding

The original Toyota seven wastes are defined by Shingo in 1989 (see table 1 below).

The seven forms of waste	
Overproduction	Producing more than is needed or before it is needed
Motion	Any wasted motion to pick up parts, stack parts, wasted walking
Correction	Rework or Repair
Waiting	Any non-work time, waiting for tools, supplies, drawings, parts, etc.
Processing	Doing more work than is necessary
Inventory	Maintaining excess inventory
Conveyance	Wasted effort in transferring goods etc.

Table 1: *the seven forms of waste (Shingo, 1989)*

Many other wastes have been added since Shingo defined the first seven (Bicheno and Holweg, 2009).

For many, Lean is the set of "tools" that assist in the identification and steady elimination of waste. As waste is eliminated quality improves while production time and cost are reduced. Examples of such tools are Value Stream Mapping, Five S, Kanban (pull systems), and poka-yoke (error-proofing). In this case Value Stream Mapping has been used to diagnose the situation and to plan further action.

4. METHOD FOR DIAGNOSES: VALUE STREAM MAPPING

The method used in this case to assess and redesign the activities and resources, in order to create value is value stream mapping (VSM).

VSM was created by practitioners at Toyota to "make sustainable progress in the war against muda" ('muda' is the Japanese word for 'waste') (Rother and Shook 1998). VSM includes creating a map of the complete value adding (and nonvalue adding) process, from conception of requirement back through to raw material source and back again to the consumer's receipt of product. A current-state map of in-company value streams then serves as the basis for developing future-state maps that leave out wasted steps while pulling resources through the system and smoothing flow (Arbulu and Tommelein, 2002). In a CS-map all steps that are performed to complete the work as it is operating in todays environment as well as the issues and performance (metrics) of the process are mapped. The difference between the current state and potential future states provides a road map to start the implementation of performance improvements.

A value stream perspective should look across individual functions, activities, departments, and organizations, and focus on system efficiency rather than local efficiency within any one of these (Arbulu and Tommelein, 2002).

When setting up a VSM, a product family has to be defined and then map its current-state value stream before analyzing production data and metrics. A product family is a group of products or services that pass through similar process steps. In this case two product families of this HC where defined:

- large maintenance projects of low rise houses which where build in the 70's and 80's;
- (rather small) upgrading of existing apartments from the 70's and 80's so they become more suitable for seniors (55+).

Although every project in construction has its own dynamics and characteristics, the projects that are part of this 'product family' can be seen as comparable. The data is gathered through VSM-workshops with the change agents, the project managers of the HC and general contractors, architects and other advisors, all having experience with projects belonging to these product families. The data gathered therefore provide approximate durations instead of measured durations.

The scope of the VSM (current state) is restricted to the HC and it's first tier suppliers who are involved in the definition and design phase of a traditional project. This paper presents a current state maps of both projects and considerations for supply chain performance improvement (interventions).

5. CASE ANALYSIS

This section will describe the VSM's of two cases that have been produced through the VSM workshops.

5.1 Case 1: Large maintenance project of low rise houses

Using VSM the current state (CS) of the definition and design phase was drawn (see figure 2).

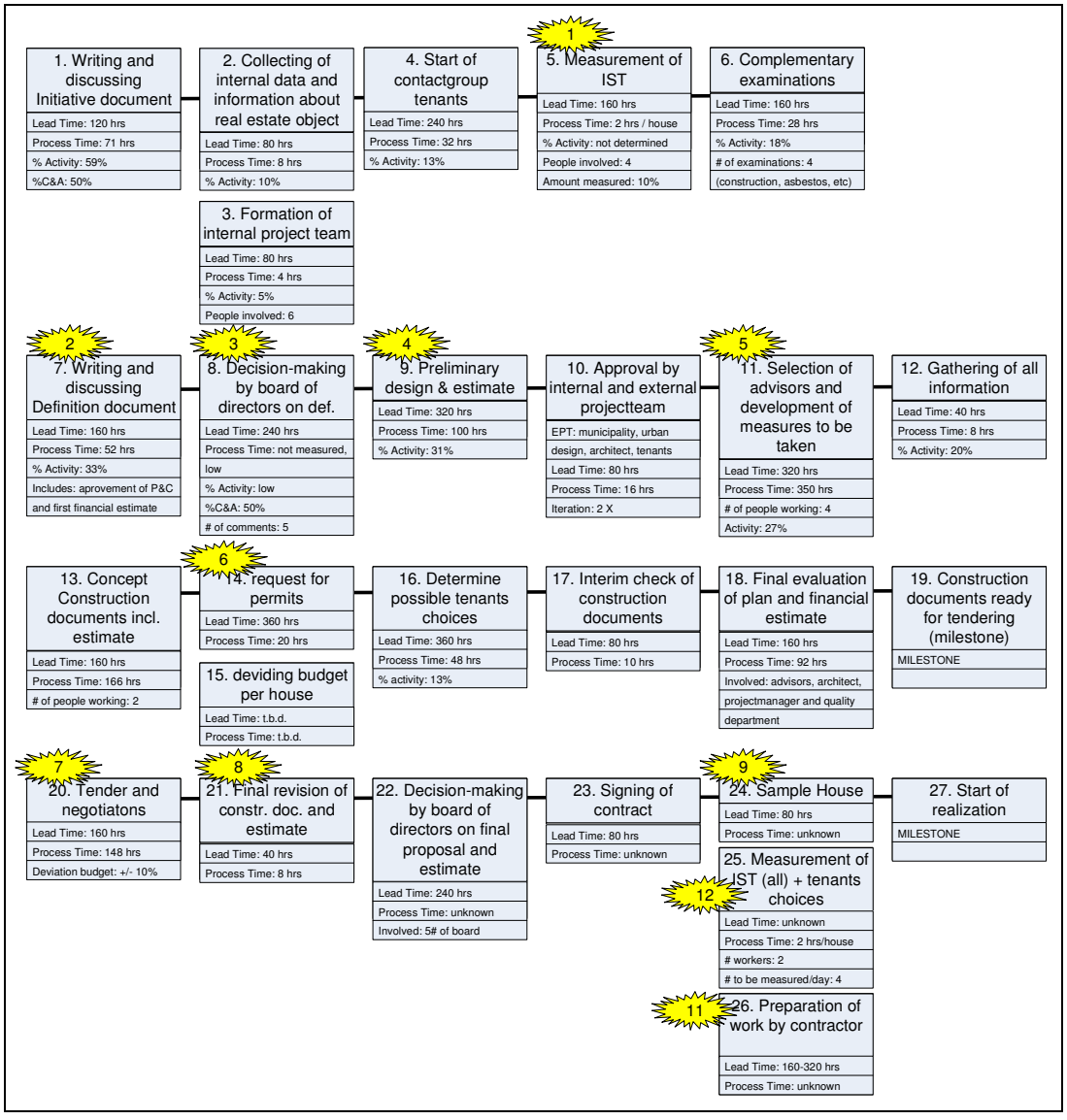

Figure 2: *Current state map of a large maintenance project*

The CS starts with the initiative document in which the projectmanager defines the global goals and targets of the project. With this document the projectmanager acquires a budget for the development of the design en research of the situation. From the initiative document the

global process steps are analysis (measurement IST, examinations), design development, permits, tender and negotiations to start of realization (see figure 2).

When looking at the CS waste becomes visible and possible initiatives (see figure 2, bursts) from the view of Chain Collaboration, can be defined:

- The percentage of activity in comparison to lead time on almost every steps is low. A lot of time in the overall process is going to waste as a result of waiting. Waiting for decisions, approval, meetings and documents. For every step further research should be done to minimize, at least, waiting time.
- The percentage complete and accurate (%C&A) for more than one step is 50%. This means one out of two of these steps have to be redone, resulting in extra waiting time and work. Further investigation what causes this low percentage of complete and accurate is needed.
- The decision-making by the board processes in general take a large amount of time (approx. 6 weeks per decision). One major cause for the delay is that project managers have to hand in their project plans 4-6 weeks before the board meeting. The responsibility for taking decisions could also be transferred to the head of the department when the project is still within scope and budget. This could lead to much faster decision-making process.
- The decision by the board, for most projects, are taken for one project at a time, while there are multiple ongoing projects which belong to the same product family. Combining projects can save time.
- There are steps that seem to be double. The measurement of the IST is done in step 6 and step 25. For a traditional design-bid-build project, this is understandable due to the split between design and realization, but within an alliance where client, designers and contractors work together it looks like one step to many.
- The tendering of the projects takes five weeks (step 21 and 22) when all goes well and the tender price is within budget. Step 22 represents a revision of the construction documents as a result of this tendering step. When working in an alliance, developing the design and estimates together, these steps should become obsolete. A process like Target Value Design (*The American Institute of Architects*, 2004), or another Target Costing mechanism, has to be implemented.

The initiatives are presented in the next figure (3, see next page), making a first idea for a future state map.

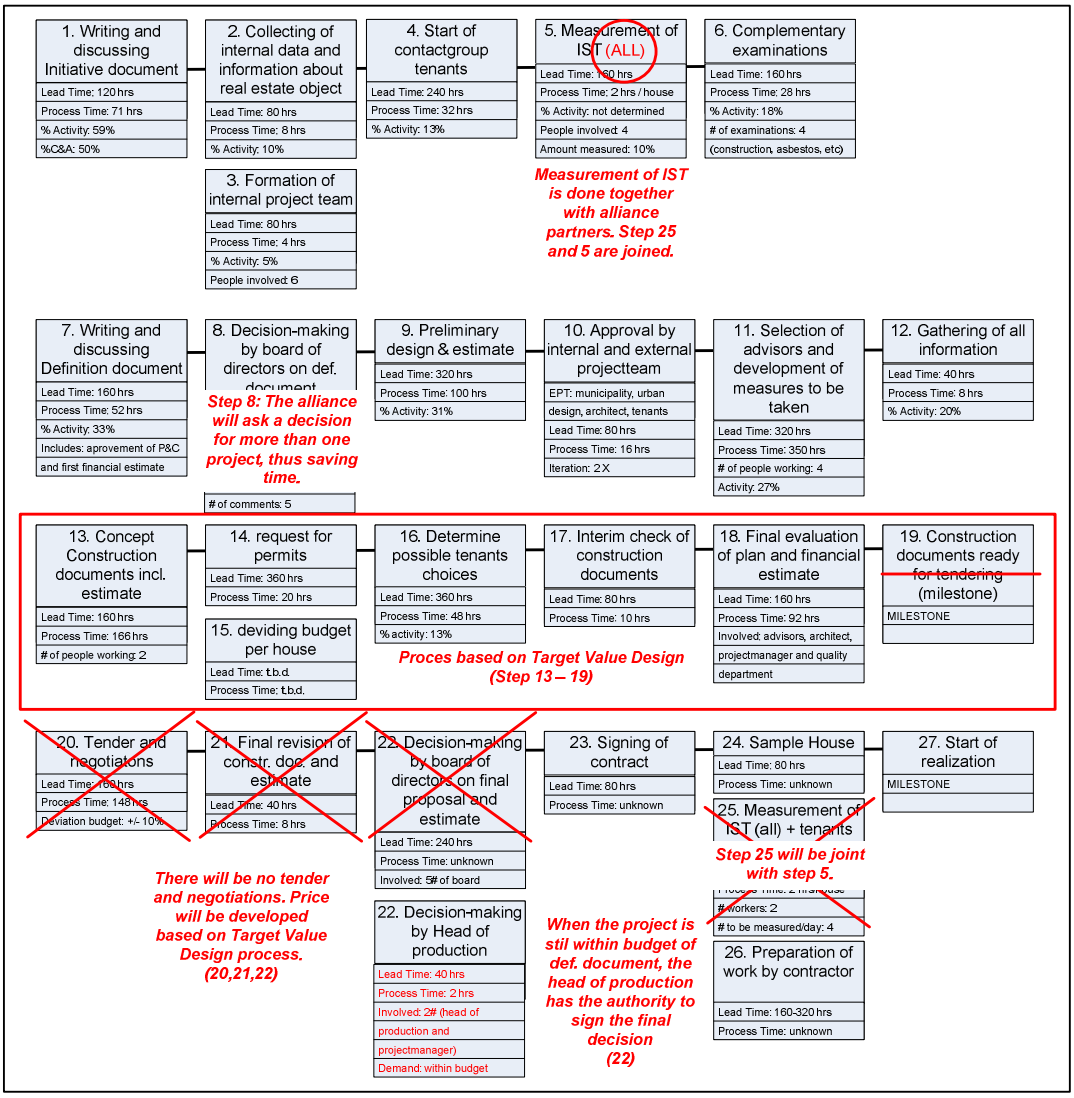

Figure 3: *First idea for the future state map of a large maintenance project*

5.2 Case 2: Upgrading of existing apartments

Using VSM the current state (CS) of the definition and design phase of the upgrading of existing apartments was drawn (see figure 4, next page). At the time of writing this article, the metrics for this project where not fully developed yet, therefore they are not presented.

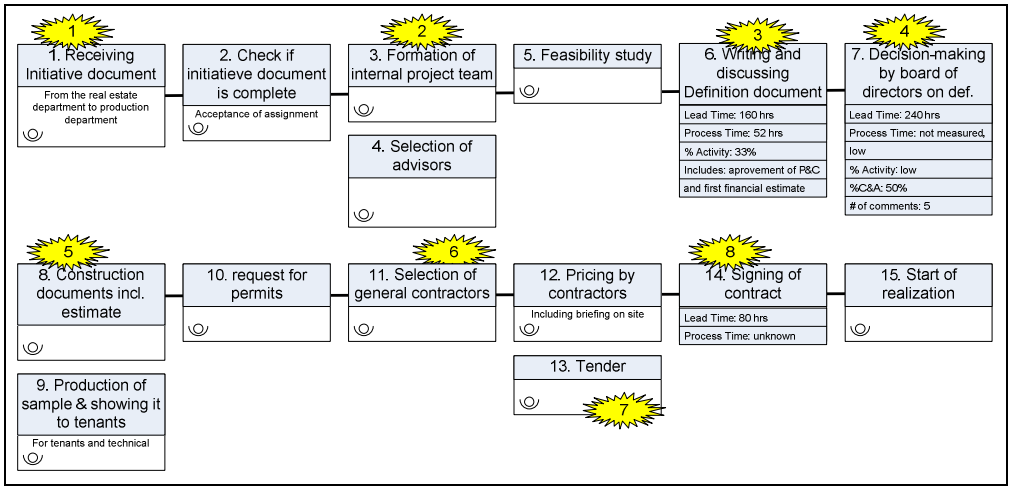

Figure 4: *Current state map of an upgrading of existing apartments project*

The CS map of the upgrading projects is shorter than the CS op a large maintenance project. This is due to the lower level of complexity of these projects.

The CS starts with the initiative document in which the projectmanager defines the global goals and targets of the project. The initiatieve document forms the assignment for the projectleader of the production department. This projectleader checks if the document is complete. When the project is accepted the projectleader sets up an internal team and selects advisors for a feasibility study. Based on the feasibility study the projectleader writes definition document on which the board decides. When the board approves the construction documents are produced and a sample is produced for testing. When the permits are requested, possible contractors are selected. These contractors can start pricing the project. After the tender one contractor is awarded the project and the project start.

When looking at the CS waste becomes visible and possible initiatives (see figure 4, bursts) from the view of Chain Collaboration, can be defined:

- Every projects starts with an initiative document (step 1). Part of this document is a program (an analysis of current situation and possible actions plus estimates). The program is drawn up for every single project. This initiative (burst 1) contains the development of a standard program document. Based on this program, all projects (25) can be analyzed and roughly estimated. This will be done by the advisors, general contractor and subcontractors which are part of the Chain Collaboration. By using this standardized program and the knowledge of the Chain Collaboration partners the speed and accuracy of the analysis will become much higher than current practice.
- The steps 3 and 4, formation of an internal project team and the selection of advisors (and possible contractors), will be eliminated due to Chain Collaboration.
- The writing of a definition document can be shortened using the standardized program (step 6).
- The decision-making by the board (step 7) can be shortened and multiple projects can be decided on instead of one which is current practice.
- The construction documents (step 8) can be simplified, only defining the information that is needed.

- Due to Chain Collaboration the general contractor is already selected. The selection step (11) can be deleted from the current map.
- There will be no tender (step 13).
- The signing of the contract will be replaced by a final check on the price and documents. The boards will sign a standard project agreement.

The initiatives are presented in the next figure (5), making a first idea for a future state map.

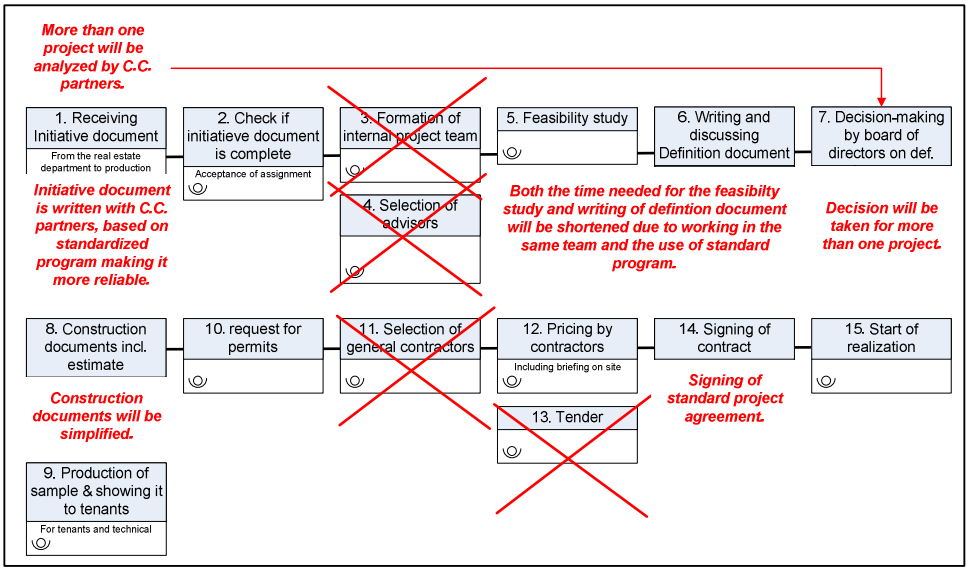

Figure 5: *First idea for the future state map of of an upgrading of existing apartments project*

6. CONCLUSIONS AND FINAL REMARKS

It seems that the combination of strategies, applied by the HC under the umbrella concept of Chain Collaboration, makes it possible not only to filter out waste from the traditional (design-bid-built) way of working by the use of lean principles, but also to alter the complete development and design phase. The reason for this is mainly the formation of a strategic alliance. The strategic alliance makes it possible to:

- research and develop (invest) a more efficient way of working;
- work as one integrated supply chain based on one joined process;
- utilize contractor's knowledge on design, construction and costs in the early stages of design, this making the whole process more predictable;
- filter out non-value adding steps (tender, negotiations, revisions of documents);
- join steps because the justification for two separate steps has disappeared;
- make steps simpler and less time consuming.

This first step in this Chain Collaboration effort looks very promising, but it's also clear that the future will tell us if the several initiatives can be implemented and what their effect will be. Only then can the actual performance be measured.

Parallel to this development are many other aspects that have to be tackled which have not been part of this paper. Personal issues, issues between team members, another way of working, mixing cultures, etc can all become bumps along the way. Next to this, the 'pattern

of payoff' and 'the shadow of the future' (Axelrod et al., 1985) will pay an important role in keeping the alliance working.

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