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**NEW BORN PROJECT MANAGEMENT PHILOSOPHIES (LEAN & AGILE)
IN CONSTRUCTION INDUSTRY**
Case: Construction company x plumbing renovation projects

Master's Thesis in
Industrial Management

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SYMBOLS AND ABBREVIATIONS

CEO	Chief Executive Officer
CTQ	Critical-to-Quality
DMAIC	Define, Measure, Analyze, Improve and Control
IT	Information Technology
PDCA	Plan-Do-Check-Act
PMBOK	Project Management Body of Knowledge
PM	Project Manager
PMI	Project Management Institute
SCM	Supply Chain Management
TAT	Turnaround time
TPS	Toyota Production System
WBS	Work breakdown structure
WIP	Work in Progress

VAASAN YLIOPISTO

Teknillinen tiedekunta
Tekijä: Tommi Lehtiranta
Tutkielman nimi: Uuden sukupolven projektijohtamisfilosofiat (lean & agile) rakennusalalla. Case: Rakennusalan yritys X put-kiremontti projektit.
Ohjaajan nimi: Jussi Kantola
Tutkinto: Kauppatieteiden maisteri
Ohjelma: Tuotantotalouden tutkinto-ohjelma
Pääaine: Tuotantotalous
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TIIVISTELMÄ:

Projektijohtaminen rakennusalalla on kohdannut tienhaaran. Vanhat perinteiset menetelmät ovat osoittautuneet liian jäykiksi nykypäivän vaatimuksia vastatakseen. Asiakasarvon tuottaminen on noussut keskeiseksi tekijäksi, jota rakennuttajat ovat alkaneet tavoitella projektien kestoa lyhentämällä. Turhuuden poistaminen prosesseista on osoittautunut yrityksille myös kustannustehokkaaksi vaihtoehdoksi.

Tämä tutkimus jakautuu kolmeen osaan. Ensimmäisessä osassa käsitellään aiheen kirjallisuutta, ja etsitään teoriasta menestystekijöitä. Toinen osa käsittelee projektijohtamisesta tehtyjä tutkimuksia, tavoitteena löytää empiirisistä tutkimustuloksista lean ja agile menetelmiä tukevia tuloksia. Kolmannessa osassa käsitellään case muotoisesti Yritys X:n tuottamaa putkiremonttia, putkiremonttia jonka he kykenivät suorittamaan kahdessa viikossa ilman rakennusteknisiä kompromisseja.

Tutkimuskysymyksenä oli löytää rakennusalalle ja putkiremonttien toteuttamiseen projektijohtamisen menestystekijöitä. Tutkimusten kautta pyrin löytämään keskeiset tekijät ja case tutkimuksen kautta nyt vakiintuneita käytäntöjä, sekä omia ehdotuksia siitä, miten tulevaisuudessa tulisi toimia.

UNIVERSITY OF VAASA

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ABSTRACT:

Project Management in the construction industry has reach the turning point. Traditional project management methodologies have proved to be ineffective. Construction companies have started to seek various project management methodologies to be able to create more customer value.

Research is distributed to the several stages. First is theoretical literature review. In a second part the secondary research results has been researched to be able to find relative success factors. The third part constructs from a case study from a Finnish plumbing renovation projects. The main case is the plumbing renovation project made of Company X who were able to reduce project duration significantly.

The object for the research was to find project management a success factors on construction industry and in Finnish plumbing renovation projects. Secondary empirical study opened key factors in construction business and case study how the projects is managed at the moment, and how the project management could be developed in the future.

1. INTRODUCTION

The plumbing renovation project markets in Finland have been blooming for a couple of years now. Markets will reach their peak from 10 to 20 years, when housing completed on upturn from 60's and 70's will start to require a technical renovation projects.

At the moment construction industry is beginning to prepare new project methodologies, to be able to create higher customer value, and to perform in the growing markets. Project duration and project costs is believed to be the biggest contributors in order to succeed in tenders. Construction companies have started to seek new ventures to be able to reach these targets. For a decade's construction industry believed that these targets could be reachable by technical development, but new school business leaders have started to look for answers from better project management methods.

1.1. Research Background

The foundation of this study constructs from my own interests towards the project management and process development. Due to my working experience I have noticed that this sector could be something to work with, and this study's most important object was to strengthen my own knowledge about the project management and new project management philosophies and methodologies.

The theme of the study was selected because it is one of the hottest topics in project management and at the current environment. Construction industry will experience a powerful change in the near future, and this added an interest to investigated what does the papers say at the moment, and how I feel the project management should be developed to ensure the capability to answer to the changing requirements.

1.2.   Research Problem and Scope

The main goal for this study were to define the biggest success factors of the project management in the construction industry. These factors would be the main contributors in order to reach the higher performance, and to be able to fulfil the changing market requirements and to be able to perform in the competition by ensuring higher customer value.

This study focuses to the project management after the project have started. This means that the scope starts when the construction project is handled to the implementer, and the scope ends when the end product is released to the customer. Plumbing renovation projects do have wider scope in the real life, such as the tendering process and a potential maintenance processes. The main focus was to obtain relevant knowledge from project management form the planning and implementing stages.

1.3.   Research Method and Structure

This study includes nine chapters. In the introduction the background, goals and the study methods have been defined. The following four chapters is constructed form the theoretical study. In these factors the main project management philosophies, methods and tools have been introduced.

The empirical part starts from the chapter six, and takes in total of four chapters. Empirical study is mainly constructed from secondary data, by using a scientific research results from various authors and by investigating an interview articles and company's blogs to be able to present a wider picture from the industry development.

The articles and interviews have been focused to investigate the Company X. Which have been the first Finnish construction company to be able to perform a complete plumbing renovation project in similar time frame than the market leaders in the Germany.

2. MANAGEMENT PHILOSOPHIES

In the recent decades the world we are living in has experienced rapid global change which has put traditional methods under the deep consideration. Due to the digitalization the world has become smaller and a much quicker.

Traditional management methods jeopardized as a new generation of management methods has emerged. Lean and agile methodology has risen to be guidelines of today's organizational strategy work and management methods. I started to call these methodologies and their entirety as an operative project management.

The core of operative project management is the methodology of agile project management. To understand the concept of agile project management, it is highly beneficial to take a closer look also to the other methods, which cannot be totally separated from the framework of agile project management. Eventually the combination of these all, will construct the scope of operative project management.

2.1. Lean Overview

Originally lean was production method which was led mainly from Japanese Toyota Production System (TPS). The main ideology was to erase seven problems out from the production or manufacturing. Lean was not a theory; it was an observed attribute which made TPS so successful. (Jones, 2014)

The key question TPS founder Taiichi Ohno tried to outcome was how to fulfill the demand with limited resources. He found out that integrated production system with product variation was more efficient than just fixing the batch size. Ohno succeeded to prove that the supposition of larger batch sizes with high quality and productivity would have been the key to the economic success. (Jones, 2014)

Lean is a systematic chain of methods which is developed to eliminate so called waste from all of those activities from the production which does not add value to the customers. These are: transport, inventory, motion, waiting, overproduction, over processing and defects. (Womack et.al, 2003).

Lean gives different solutions to erase these problems. These solutions include different scheduling programs such as Kanban pull system, continuous development and methodologies to erase errors from production. (Womack et.al, 2003).

Lean is based on five key principles, which are key tools to the successful lean thinking. Value creation is based on customer perspective, know your value chain and erase processes which do not add value, value chain should base to satisfy customer's needs, involve employees to the development and develop processes constantly. (Womack et.al, 1991)

Poppendieck (2003) approaches lean from a bit different direction than Womack et.al. Poppendieck compress the lean for two simply perceivable lists, which describes the central management methods to the lean, and how to erase waste from the process:

Poppendieck's (2003) the principles of lean:

- *Eliminate waste*
- *Amplify learning*
- *Decide as late as possible*
- *Deliver as fast as possible*
- *Empower the team*
- *Build integrity in*
- *See the whole*

The lean management methods ideology is to provide customer with a greater end value. One of the key elements in building on this value is to erase waste from the system. This extra load "waste" is typically produced in various actions like: partially done work, extra processes, extra features, task switching, waiting time, unnecessary motion, defects or in harmful management activities. (Poppendieck, 2003)

2.2. Lean Management Skills

Ohno's findings lead to the work reorganization and over the year's lean philosophy has spread more and more wider than just manufacturing processes. Traditionally humans have seen their work roughly a combination of two different activities, doing their tasks and reacting to the daily crisis. (Gitlow, 2008)

Lean has developed this traditional perspective to the more manufacturing like process. Lean as an managerial method gives input to create work as an process, where planning, scheduling, variation control, continuous improvement, waste elimination and effective communication and knowledge strategies goes hand by hand with satisfying and high performing managerial and working methods. (Gitlow, 2008)

Gitlow highlighted traditional working structure and Ohno encouraged workers and managers to approach their tasks in more scientific perspective and shake-out their old-rooted view from working by giving them Deming's Plan-Do-Chech-Act (PDCA) working tool. (Jones, 2014).

Project management includes often a team management. Jones states that the daily use of PDCA has been proven to develop individuals and also teams work performance. Jones encourages to take lean perspective also in to the other business areas than production, he highlights that project work would be one of those areas where the different applications of PDCA would create a value to the process.

In the real organization life, it may not always be crystal clear how some exact organization creates it value or generate incomes. Another TPS tool value stream mapping is created for this problem to solve organizations value streams form outside of the company and also from cross-functional organizations. (Jones, 2014)

Knowing your value streams is one of the key knowledge for the manager and works, and it should be a guideline of an everyday work. This guideline involves teams much deeper

in to the development process where work routines and future strategies is built in. Value streams also bind organizations to the real customer demand by giving a real pull strategy input. (Jones, 2014)

Lean perspective to the managerial work should be taken account in both way streams. Typical problem for this day's managerial work is that the managers are fulfilled with a lot of internal work to serve the company. This should be seen as waste in the lean methodology and should be something to get a rid of. It is proven that the manager's work input is created if they are closer to the front line because a font line is closer to the value creating activities. (Jones, 2014)

Involving managers to the front line activities managers are much more hands in the daily routines. It is important for the manager to understand their issues, eliminate obstacles and coach his/her colleagues for problem solving, and to outcome the obstacles. Enterprise system can either involve managers to the daily routines or take them off from there by overwhelm them with enterprise activities. (Jones, 2014)

Again PDCA structure with bottom-to-up and up-to-bottom dialogues would be a first step to ensure managerial prowess for successful management. If enterprise is willingness to give right tools for managers, and managers understand their task well enough, this would create a totally different environment where managers and employees would be capable to reach their professional potential. (Jones, 2014)

2.3. The Fundamentals of Agile

Now we have a good outlook on the other management methods related on the theme agile. A big picture always is consisted from a several details. Before we go on the topics of project management, and more precise on agile project management it is important to take a closer look to the fundamentals of agile methodologies.

Agile as a terminological expression has received different meanings over the years. In the different operating environment, it may have a different meaning, and that's why you should be precise to define what kind of agile you are talking about. For example, in the United States or in the information technology (IT) business agile has become a term to signify software development projects which is lead mainly throughout the Scrum methodology. (Cobb, 2015).

By investigating agile terminologies deeper, it is clear that link with scrum has developed just in the recent years. The original description of agile in the Manifesto for Agile Software Development published in 2001, was way wider and deeper than just the link with scrum and software development projects. The Agile Manifesto introduced some proven general principles and values which can be applied in every kind of projects. (Cobb, 2015).

2.4.   The History of Agile Methodology

The Agile Manifesto (2001) was the key contributor on agile management methods development. Agile Manifesto is actually an outcome of software development conference, where 17 of world's leading authors were put together to consider software development methodologies. (Cobb, 2015).

 Agile manifesto was a collective perspective of management methodologies, so it was not invented out of nothing. From the 1980s different authors have been playing around the theme of the complex software development projects. One of the earliest methodologies was called Rapid System Development (1987). It is easy to notice that terms rapid and agile are really close form one other, and these schemes have really been just playing around of each other's. (Cobb, 2015).

Like lean methodology were initiated in the Toyota factories, agile did get it first impetus from software development processes. At the time software developments were going on

a ridiculous frenzy, where the industry's foundation was seeking directions to rollout. Software developing processes were becoming more and more complex and more difficult to manage because of the rapid technologization. This basic need was the input to find out the methodological guidelines on how to succeed in projects and how to arrange its processes. (Cobb, 2015).

The agile manifesto is consisted out from four key values, and from 12 main principles. The basic values of the agile manifesto are: *Individuals and interactions over processes and tools, working software over comprehensive documentation, Customer collaboration over contract negotiation, responding to change over following a plan.* The Agile Manifesto principles are set to serve these values. These principles include merits on how to create customer value, to the internal process development. (The Agile Manifesto Authors, 2001)

The main principles are set to complete the four values. Authors do want to highlight that these principles are not set to be an absolute correct way to produce operations, but they are more like well-known main principles how to succeed in the processes inside the projects. (Cobb, 2015).

1. Our highly priority is to satisfy the customers through early and continuous delivery of valuable software
2. Welcome changing requirements, even late in development. Agile processes harness change for the customer's competitive advantage.
3. Deliver working software frequently, from a couple of weeks to a couple of months, with a preference to the shorter timescale.
4. Business people and developers must work together daily throughout the project.
5. Build projects around motivated individuals. Give them the environment and support they need, and trust them to get the job done.
6. The most efficient and effective method of conveying information to and within a project team is face-to-face conversation.
7. Working software is the primary measure of progress.

8. Agile processes promote sustainable development. The sponsors, developers, and users should be able to maintain a constant pace indefinitely.

9. Continuous attention to technical excellence and good design enhances agility.

10. Simplicity-the art of maximizing the amount of work not done-is essential

11. The best architectures, requirements, and designs emerge from self-organizing teams.

12. At regular intervals, the team reflects on how to become more effective, the tunes and adjusts its behavior accordingly.

The Agile Manifesto, 2001.

Agile management methods emphasis an importance to involve the end customer in to the different project phases. Many traditional plan-driven methods the client is not involved in to the project prior the final stage. This might produce difficulties and a waste of resources if something important must be changed to be able to produce a wanted outcome. (Cobb, 2015).

3. MANAGEMENT METHODOLOGIES

3.1. The Scrum Outlook

Scrum is a project management method, where a group of individuals aims to proceed as a one and to work in a close co-operation. The scrum is one of the most used agile methodology in the world. Like the agile it is mostly used in the software development projects, but it does not be tied just to the software projects, just like agile. (Cobb, 2015)

Scrum is a frame of reference which aims to productive and creative business activities. Authors highlights the importance to handle scrum expressly as a frame of reference, not exact management method. So the scrum is more like a philosophy. Day-to-day project activities is guided by different kind of set of different processes, methods and tools, but the scrum is an umbrella which covers all off these activities. (Schwaber & Sutherland, 2013)

Scrum team is a self-homing complex organ which is in a key responsibility to set the scrum goals and targets, and to estimate is the scrum working how it should. Scrum activities is set on the shape of so called sprints. The name comes from the game rugby, as well as the scrum. In the rugby scrum means the starting pattern of the game, and the sprint the performance before the next scrum. In the scrum business methodology, the scrum team sets the targets and objectives to each sprint, and will evaluate and develop the scrums performance in ongoing process. (Schwaber & Sutherland, 2013)

Scrum management methodologies have two different approaches to the project outcome: solution adaption, and the process adaption. In the solution adaption the basic business need is known, and it reflects as a project input. Other typical characters to the solution adaption is that the project end product, solution or requirements could be fussy, especially in the starting point of the scrum project. (Cobb, 2015)

The process adaption goes tightly hand by hand with the spirt structure. Process adaption is also fully adaptive working structure. The main point is to arrange work in to the individual sprints. Each sprint is a fixed-time working period. After the end of each sprint the scrum is paused, and the project might be re-structured or the requirements or other project objectives may be adapted to serve better the business problem. (Cobb, 2015)

The working processes in the scrum is entangled to the product backlog. The product backlog is a dynamic queue of the job performances, which is set to serve the project outcome. Product backlog management is typically a tasks of a product owner, but in some cases it can be handled by the scrum master or even a business analyst. The timeframe of the ongoing product backlog is typically a couple of sprints, but the larger projects may require longer time period schedule planning. The product backlog is a really similar tool than the work breakdown structure (WBS), just in the different environment. (Cobb, 2015)

3.2.   The Scrum Roles

Scrum ideology is constructed from the different scrum roles. The scrum team is a kind of top organization for these activities. The scrum team is constructed from other project worker's roles. The scrum activities are processed in the co-operation of these roles, and by the guidance of the scrum rules and their transactions. Scrum roles is divided on the roles of the product owner, development team and the scrum master. (Schwaber & Sutherland, 2013)

The product owner is in accountable position to maximize the value of the final product, and the work of the development team. How these objects are achieved, may vary a lot between the different organizations and scrum teams. The project owner individual is an also in a response to coordinate the product backing activities. These management tasks include activities like:

- *Clearly expressing the Product Backlog items;*
- *Ordering the items in the Product Backlog to achieve goals and missions;*
- *Optimizing the value of the work the Development Team Performs;*
- *Ensuring that the Product Backlog is visible, transparent, and clear to all, and shows what the Scrum Team will work on next;*
- *Ensuring the Development Team understands items in the Product Backlog*
  to the level needed

(Schwaber & Sutherland, 2013)

In a typical scrum project there is only one product owner. In the larger scale projects, the product owner may be managed by a corporate level or he/she may be instructed to fulfil the requirements of project sponsors or other decision makers. If this is the case, then the project manager is not the only decision maker of the project, even though he/she is a main responsible for the project progress and outcomes. (Cobb, 2015)

The scrum master is a leader of the scrum team and a kind of supervisor of the actions. He/she is responsible to guide the scrum team so it will stay on the set frame, and will honor the theories, rules and practices set to the scrum team. The scrum master is also a responsible to communicate to the scrum contributors outside the scrum team, so they would understand the needs of the scrum to be able to add value in to it. The scrum master is a responsible to control the interactions, in the name of maximizing the created value in the scrum team. (Cobb, 2015)

The scrum masters working role is to find a solution or to work with several questions in order to serve the different project contributors in the best possible way.

The Scrum Master → The Project Owner

- *Finding techniques for effective Product Backlog management*
- *Helping the Scrum Team understand the need for clear and concise Product Backlog items*
- *Understanding product planning in an empirical environment*
- *Ensuring the Product Owner knows how to arrange the Product Backlog to maximize value*

- *Understanding and practicing agility*
- *Facilitating Scrum events as requested and needed*

(Schwaber & Sutherland, 2013)

The Scrum Master → The Development Team

- *Coaching the Development Team in self-organization and cross-functionality*
- *Helping the Development Team to create high-value products*
- *Removing impediments to the Development Team progress*
- *Facilitating Scrum events as requested or needed*
- *Coaching the Development Team in organizational environments in Which Scrum is not yet fully adopted and understood*

(Schwaber & Sutherland, 2013)

The Scrum Master → The Organization

- *Leading and coaching the organization in its Scrum adoption*
- *Planning Scrum implementation within the organization*
- *Helping employees and stakeholders understand and enact Scrum and empirical product development*
- *Causing change that increases the productivity of the Scrum Team*
- *Working with other Scrum Master to increase the effectiveness of the application of Scrum in the organization.*

(Schwaber & Sutherland, 2013)

The scrum master is a person who is in charge to simplify the tasks of the project team. In agile terminology this position could be point out as a servant leader position. The scrum team should be self-organizing, so the scrum master is not supposed to intervene to the team's processes. What so ever the real life examples are not always so rosy. If the

scrum team is not capable to perform from its objectives, the scrum master may need to take more agile coach like an approach, and help scrum team to reach its potential. (Cobb, 2015)

The development team is constructed from a set of individual professionals with a different skill sets, who's synergy aims to produce a ready end product at the end of each sprint. The scrum framework establishes a several common characters to the development team, which is very similar with the ones in agile project management.

- *They are self-organizing. No on (not even the Scrum Master) tells the Development Team how to turn Product Backlog into increments of potentially releasable functionality*
- *Development Teams are cross-functional, with all of the skills as a team necessary to create a product increment*
- *Scrum recognizes no titles for Development Team members other than Developer, regardless of the work to be addressed like testing or business analysis; there are no exceptions to this rule*
- *Individual Development Team members may have specialized skills and areas of focus but accountability belongs to the Development Team as a whole*

(Schwaber & Sutherland, 2013)

Team building authors success that the teams with different kind of personalities do perform a better outcome, than the teams where the team members all have an absolute same perspective to the reality. Still the ideal is that every development team member could perform any task in the team, but the greater of the level of teamwork is, the deeper in to the specialization team members can dive. (Cobb, 2015)

3.3. Scrum Reflection to the Project Management

The product owner in the scrum project is working in an environment, which is somewhere in between of a traditional conception of a project management and a business analyst. He/she have some responsibilities which occurs strait to the project management, such as; the guidance of project. However, the product owner does set the objectives and outcomes to the project, which is not typical for a traditional project manager. Traditional approach involves the business analyst in to the requirement defining and collection, which are typical tasks for a product owner. (Cobb, 2015)

The role of the scrum master is strictly linked to the scrum environment. The role can be more involved to the project management, or it can be more like the role of a successor. It is important to notice that the scrum master role is not like the traditional project manager role. Scrum project do lack this kind of traditional perspective, even though similarities occurs. There is also something in common. The scrum master should be guiding and supporting the team, which is something the project manager is expected to do as well. (Cobb, 2015)

The communication between the project participants is well known success factor of the team management. The traditional approaches to the project team or scrum team is hard to take, because freedom of action is highly depending on the team and environment. In a sense of traditional project management, the project team member is supposed to plan he's/hers work activities and are responsible to perform an agreed result. This works really similarly in a scrum projects as well. (Cobb, 2015)

3.4. Kanban Solutions

Kanban is a part of Toyota Production System (TPS). A lean based pull methodic production system, which can be used in manufacturing or in knowledge work. The word Kanban comes from Japanese language, and it means a kind of signal card. This is also a

base idea in Kanban, which in most predigested description is a visual signal card, which shows a work phases and tasks and the order of the processes. (Turnera et.al., 2012)

In the Kanban system the work phases are divided to every kind of executed tasks just like in work breakdown structure (WBS) solutions. Each task and subtasks is demonstrated by a ticket, which gives a necessarily information about the process. Each task and the ticket is connected to the other tickets, showing the required work phases. The individual task card does not come available to the process, until in advance requires processes have been completed. Kanban were developed to serve a mixed business needs, It's core idea is to connect the work flow to the capacity of the process, control the waste at the work pauses, minimize the inventories, minimize delays, prevent reworks and to ease a process tracking. (Turnera et.al., 2012)

In the manufacturing the components in Kanban could be as small as bits and pieces. Knowledge work varies from a traditional manufacturing and in there the components can be formed from the ideas and information. In the knowledge work the Kanban has converted in to the methodology were the processes have been harmonized by stabilize the work processes with the available resources. It is more centralized on to limit the WIP (work in progress) so that the available resources can be provided to ensure the process flow. (Turnera et.al., 2012)

In knowledge work the Kanban doesn't allow the process to be started before there is available resources allocated to complete it. This is leaded straight out form the Kanban core values in order to maximize the end value. This kind of scheduling system were the queues and resources is visible decreases the invisible scheduling costs, which mainly is built on the unnecessary slack time or due the delays. The visible Kanban sign gives to the project team a good transparency in to the potential bottlenecks, resource limitations or other issues of the process, which helps to limit a potential waste and will build a value in to the project. (Turnera et.al., 2012)

Work in progress (WIP) concept targets the work task which has been started but is not completed. It is well known that the higher WIP rates accumulates a higher cost in to the

process. By controlling the WIP the company can be able to reduce costs and add value for example by finishing the higher value process before the lower value tasks. In some cases, the project worker is working simultaneously with different tasks or available resources does not cover the completion of all ongoing progress. This is why controlling the work tasks and by giving a relevant value to each process will help to control the WIP levels and obtain a higher value for the project outcome. (Turnera et.al., 2012)

In a conceptual WIP control and in order to reduce WIP it is observed that the smaller batch sizes do affect positively to the outcome. Smaller batch sizes do allow the better process flow and builds an efficiency in the process by creating the flexibility in to the scheduling and by providing the project team to response unforeseen problems. In a knowledge work the concept of smaller batch sizes can be harder to understand. Good example for this is to build a to-do-lists to be able to carry out the outcome. (Turnera et.al., 2012)

Natalie Sirina (2016) compresses the Kanban management in to the four core principles.

- *Visualize work to increase communication and collaboration.*
- *Limit work in progress to avoid an endless chain of non-prioritized open tasks.*
- *Measure and optimize the flow, collect metrics, predict future problems.*
- *Aim for continuous improvement as the result of analysis.*

4. MANAGEMENT TOOLS

4.1. Six Sigma

Six sigma is a set of management techniques and tools, which seeks a scientifically proven management methods and activities, which tries to ensure neither closely flawless products nor services to the customer. The core idea of six sigma is to build up higher quality throughout the value creative business processes. (Karjalainen, et.al., 2002)

The gore idea is that the process errors need to be identified and measurable before the process could be developed. Six sigma aims to total quality control, to the processes without errors. The process development activities are reasoned with a specific indicator. These indicators are called sigma. (General Electric, 2016)

Therefore, the sigma is the indicator and as it said, the basic idea includes six of them. High quality is seen the most important attribute to the customer. Another key stone to the company is to deliver, failing to fulfil a customer needs may defect harmfully to the business. Know yourself is good guideline to the company, and the third sigma is to know your process capability and what your system can deliver. Fourth key point concentrates a customer point of view, what customer feels and sees. This is critical knowledge to be able to respond to the market variation. By knowing this the organization may create stable processes which create more value to the customer perspective. The sixth and the final point is that these five previous points needs to be designed to serve the respective customer need and the certain process capability. (General Electric, 2016)

The world is constantly changing and different forces effects to the businesses than in a near history. Business is harder and more complicated now days than it has been ever before. This is why six sigma has been risen to the one of the top topics at our time.

At the bottom line it is a quality control method, but in a top of the line it is a more profound way to organize business and manage your organization. The approach to the six sigma begins always from the customer point of view. From there it tries to navigate its way to the nearly perfect solution by using facts, figures and data as it's guidelines. (Karjalainen, et.al., 2002)

However, Karjalainen notes that the real character of six sigma extends much deeper than just to the data analyzing. Six sigma demands a full focus from top management, customer focus, process development and organizational mind set to be a top of the league player. If the company succeeds to integrate the six sigma thinking with the daily business activities, it manages to develop all of the organization processes to serve market needs in a more beneficial manner.

Six sigma gives answers to the process management and six sigma's results spreads roughly to the four different areas. Firstly, customer focused processes should create better customer satisfaction. By concentrates to the physical processes company should be able to reduce turnaround time (TAT), reduce errors in the process and finally reduce processes which do not create a value to the customer. (Karjalainen et.al., 2002)

Finally, six sigma concentrates to business development solutions, which gives rational cost savings and gives possibilities to the company to grow to the new markets and win new customer relationships. (Karjalainen et.al., 2002).

4.2. Six Sigma Management Skills

Six sigma is a development strategy which is based on employee's knowhow and organization expertize to the continuous development. It is based on human resources such as creativity and innovatively. (Karjalainen et.al., 2002)

Six sigma desires new knowledge's and new performance methods to pursue crater utility. It is also based on processes own learning process, processes should learn by themselves and create a useful data to support its development processes. Finally, the six sigma is based on DMAIC (Define, Measure, Analyze, Improve and Control) system, which is a high performing phased development methodology. (Karjalainen et.al., 2002)

Six sigma is highly usable in different business areas. The usage of six sigma methodologies has spread out for nearly every business processes. Business process development is one of the key points in successful management in every managerial steps and stages. Six sigma is highly recommended approach even if company does not have ready-made master data for it business activities. (Karjalainen et. al., 2002)

Actually the role of the data in six sigma can be seen even unnecessarily highlighted. Six sigma aims to the analytical problem solving, and it tries to develop new ideas, ideas that cannot seen from data. Actually approximately 40% of solutions can be originated from the data, and 60% from analytical solutions which is more innovative, imaginative solutions. So the six sigma should primarily be seen as an analytical tool, and secondarily as a data based problem solving. (Karjalainen et. al., 2002)

Although six sigma is highly used methodology, it still does not mean that it would always be successful approach. Sye (et., al, 2016) proposes that projects tend to fail because they took too long time to be finished. Obviously overrun of schedules is not a reason, it is a consequence.

A suitable management method aims to overtake these problems. Successful approach to six sigma management desires successful planning process. In most cases the project scope is too wide and it leads to the late arrivals. Another problem is obviously data. Data can be outdated; it can be incompetent or it could be also out of reach. (Sye et., al, 2016)

 In every managerial process one of the reasons why tasks fail is obviously the lack of managerial attention. Successful management tends to involve managers in the daily ac-

tivities. In project management the project manager haves a biggest responsibility to proceed in project work. But this is not always the case, there could be agent problem between the project manager and the other manager levels, or the project manager can simply be unmotivated or even incapable to perform his/her tasks. And finally one of the most common reasons why six sigma management projects tends to fail is simply that although six sigma is highly applied methodology, it does not apply in every organizations. (Sye et., al, 2016)

4.3.   Waterfall Model

Waterfall models roots goes into the 1970's, when DR. Winston Royce introduced his process management methods. Royce did not call his model as an "waterfall" and the link between his researches and the waterfall model has been questioned occasionally, but he is still widely considered as a main contributor of a waterfall model development. (Plamquist et.al., 2013)

Royce's model has been seen a risky and error sensitive. Even the man himself did notice in his lifetime that his model works well only to the most straight forward projects. Even now a day's waterfall model has been seen as an outdated method and agile more valuable as present time, Royce do have a big influence for these both. We can debate his influence to the waterfall methodology, but what he did do was notice that the customer should be involved to the development process a way before the testing phase. This was one of he's key findings, and it still is one of the key values in waterfall and agile methodologies. (Plamquist et.al., 2013)

The waterfall model is a simple non-iterative process model which is firmly flowing from the upstream to the downstream, just like the waterfall. The model has been divided on to the steps which do construct from the blocks: conception, initiation, analysis, design, construction, testing, production/implementation and maintenance. These blocks may

vary depending on the business environment, but their core idea still stays the same. (Laplante, et.al., 2004)

The waterfall model works just as any other stage model. After each stage there is evaluation of a work progression, before the project will be able to enter to the next stage. Each stages do have an individual requirements and objectives, which it needs to fulfill. The customer should be involved to each stage of the project, but the most influence the customer do have in a conception stage, when the project requirements will be defined, and in the testing and implementation phases. (Plamquist et.al., 2013)

One of the most significant success factors for the stage models like waterfall is the communication and documentation. These two have ever greater role and the bigger the project is, more important flawless documentation and communication proves to be. It truly is important to highlight these factors within the current project stage, but it is even more important to underline these factors to be able to transmit project successfully to the next stage. So the documentation and communication between the stages should not be compromised at any situation what so ever. (Plamquist et.al., 2013)

Even though the waterfall model is now a days perceived as a software development processes, its roots is in the manufacturing and constructions. Waterfall were created to the environment where unexpected reversals is undesirable and highly costly (Penington, 1983). Later the waterfall was picked up to the developing software business, which did seek a relative project management guideline. In manufacturing and construction industries the risk and time management is the key stones, and actually these two factors were the ones the waterfall model tries to conquer. (Plamquist et.al., 2013)

The waterfall is a management model which tries to eliminate a potential bottlenecks and risks. To be able to succeed in this the requirement identification throughout the stages and notably in planning and budgeting is vital for an outcome. Detailed documentation from the requirements and decision factors is the guideline for the project stage processing. The further the project advance, more important factual early documentation

proves to be. Clear communication between the stakeholders have vital role at risk management. In addition, at the obligation to keep stakeholders on track from the processing, the two-way communication gives also a good platform to uncover the potential obstacles in an early stage. Constant review of the current stage and requirements ensures that the project does not enter to the next stage if the next stage is not capable to serve the process. This eliminates costly re-work. (Plamquist et.al., 2013)

In a synopsis perspective the waterfall and agile methodologies do emphasis several contributors: customer involvement in an early stage, multiple rapidly executed stages or work processes, a defined end product which acts like a spine of the project and an evolutionary approach to the daily activities. So the waterfall does have a certain character and a clear advantage, but it is not a ride in a moonlight. To be able to contribute a successful project, it is important to acknowledge a weaknesses of current management tools and methods. For example, the waterfall expects that the requirements or their sequence or priority does not change. Also each stages do have their potential stumbling block. The first testing arrays late at the project lifecycle and potential re-works and errors are costly to perform. By acknowledging these and by applying strengths and weaknesses to the own business environment, waterfall truly can be a successful managerial tool. (Plamquist et.al., 2013)

4.4. DMAIC Problem Solving

The six sigma have been seen so beneficial management method. Six sigma is based on an analytical analysis and development activities based on this processes. This analyzing process is most often seen in a form of DMAIC problem solution process. DMAIC is close relative of PDCA (Plan-Do-Check-Act) model. Actually it can be seen as a PDCA but pumped with steroids; it is bigger and stronger but may not be so simple and agile. DMAIC originally were based on five steps Define-Measure-Analyze-Improve-Control (Karjalainen et.al., 2002).

As theory developed it has been boosted also with additional steps with different authors. For example, replicate and thank the teams and with additional steps. Team management stage has seen as cross functional organizational human resource management, while additional step is set to be a company or business area originated focus area. (Webber et.al., 2007).
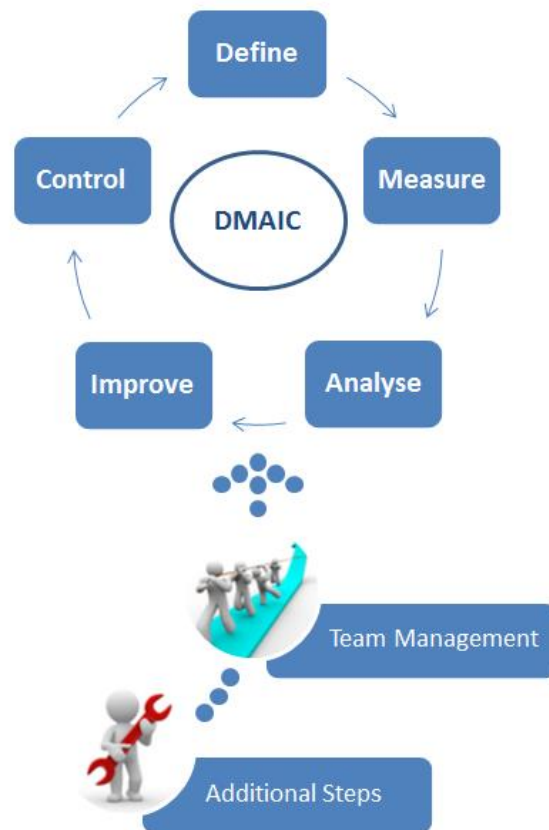

Figure 1 DMAIC - And additional two steps

DMAIC has been around for a while, but as we know the problem solving methods has concerned our minds even longer. De Mast (2012) has lined together DMAIC phases with Smith's (1988) heuristic problem solving methodology.

Definition starts with a problem selection and identification (de Mast et.al., 2012). Definition needs to be a complete one for trough out the development progress. This means that it is important to set goals and targets for the process in the definition phase. Goals needs to be relevant for the process measurable. It is also important to define a desired success rate, so that the process workers would be on the map as soon as process starts, and as long as it will last. (Smith, 1988).

A measure phase begins with converting the problem and the current situation in the measurable shape. In a measuring it is important to successfully analyze and name Critical-to-Quality (QTY) factors for the guidelines of the process. (de Mast et.al., 2012). This starts by describing a current case and by researching the needed data to develop in the process. The findings of describing and research processes should be linked to the goals which were typed in the definition phase, and formulated suitable if needed. (Smith, 1988)

In analyze step the measured data is analyzed. It is vital to notice that data may not be completed and the full answer is hard to lead throughout from the gathered data. So the analyze can be both quantitative and/or qualitative analyzing methods. However, it is urgent to find the real influence factors to the key problem, and how these factors affect to the QTY definitions. (de Mast et.al., 2012). Smith (1988) highlights the significance of diagnosis methods in analyze phase. The base expectation in analyze phase is that the current situation and even future goals is well-known. Diagnosis means that it is vital to analyze why the situation is what it is and why things are in the way they are.

Improve phase is the real developing phase in DMAIC. In this phase all the previous phases are set together and based on these the developing activities is set to be done. The process improvements can be as complete as it needs to be, concerning for example pro-

cess design, performance or implementations. These process developing activities is concentrated to enhance the accomplishments of the CTQ factors (de Mast et.al., 2012). Process design is a critical interface on how to perform and succeed the desired goal of the process (Smith, 1988). He states that the design construct from three different functions: alternative generation, prediction of effectiveness and from evaluation of alternatives.

In the control stage the company is controlling and further developing the solutions it subscribed in the previous phase. It is assumed to control and adjust the management methods and process systems it identified earlier. This is vital phase to the DMAIC process to achieve the goals it has been given. Process needs to be steered to the right way and adjusted after the feedback has been received. (de Mast et.al., 2012). Smith (1988) comments that some kind of control system needs to be implemented to the DMAIN process, to be able to receive successful improvement alternatives for the process.

5. PROJECT MANAGEMENT

Now days more and more business activities and processes have been shaped to serve project like organization or processes. Business language talks constantly about projects, and even if the organization is in different shape, or processes handled differently. It is even more likely that an employee will phase an individual or team project work in he's/her career. This is why it is impossible to highlight enough the importance of project and project work knowledge.

5.1. Project Definition

The project is a temporary structure which is constructed from different business processes, which is set to serve a defined need or a task. Project has always a pre-agreed outcome, the reason why the project is set to be working. Characterized to the projects are also other predefined conditions, starting and ending point and project task is to solve some classified problem. (Artto K., Martinsuo M., Kujala J., 2006)

The project definition is not always so simple. Obviously different authors do have a different definitions or different sorts of touch to their perspective. All together most authors agree some core conditions for the projects. Like Crawford et al. (2006) states the first condition for the project is to reach a definition for the work. This can be seen as a starting point of the project. It is important to notice that this phase might be informal or more formal. Even though authors haves a different perspective to the project definitions, three conditions have become most well-known. These are individuality of each project, project is set to fulfill a defined purpose and defined deadline. (Mantel et al., 2005)

5.2.   Project Organization

Project organization haves two separate meanings. Firstly, the business organization which arranges its activities in a project manner can be called a project organization. (Dingle 1997). However, in this case we are more interested about that other definition.

Project organization is a temporary organization working inside mother organization. Project organization is constructed to serve a specific meaning, the project. It is constructed from employees, managers, supervisors and tasks, just like every other organization. Project organization may include also assistants, experts and supports staff who may be vital for the project success, but who may not be a project owner. (Dingle, 1997)

Project organizations can be roughly divided to the two different definitions, pure project organization and functional project organization. (Mantel. et al. (2005). Pure project organization is a permanent state. The organization is organized in a way that there basically are no permanent structures. Functional project organization is organized to serve a specific task, a project. And it will be obliterated after a project has produced a desired outcome. (Ruuska, 2005)

Project organizations and their definitions divide authors to the separate groups. For example, Dingle (1997) introduces terminology of overall project organization and project team organization. Hoe ever, even though the terminology changes authors are still basically talking about the same things, about the same sort of organization structures.

Dingle (1997) highlights that these organization structures do not have any given structures or management methods. These are taking shape on each time and environment and can be different between the organizations or projects. In different organizations the values, responsibilities and task may vary and for the management team it is important to shape project organization to suit in the mother organization and business area.

The project organization is an umbrella for every project. It main task is to find a organizational structure which helps project to succeed, and to offer the right tools for the project to maintain its efficiency. (PM4DEV, 2007)

Each project has an individual objects and characteristics. Each project organizations needs to be unique as well. In the project organization perspective, the first stage of the project needs to be a clarification of organization chart and define the basic needs of the project, to be able to constitute an environment where project managers, project teams and project workers can be successful. (PM4DEV, 2007)

Transparent organization chart is a first step to build an efficient project. It gives a good outlook to the persons involved in to the project and their working relations to each other's. This helps communication inside the project when the responsibilities and roles is well known throughout the project organization. (PM4DEV, 2007)

There are two key questions to be solved in the order to construct an efficient project organization. The project manager needs to be aware what kind of specialization the project needs, and how project activities should be coordinated. (PM4DEV, 2007)

Specialization defines what kind of knowledge needs to be integrated in the different parts of project organization. This can be creativity to the innovation sector, or negotiation skills to the procurement. In the project individuals with different specializations and tasks is working towards the same goal. At the same time most of the project tasks is organized by work breakdown structure (WBS), where parts from the entirety is divided to the individuals. The organization needs to be coordinated so the different components will serve the same goal. (PM4DEV, 2007)

5.3. Project Team

Project team is a set of professionals who main job is to get the things done. Project team works inside of the project organization and is most times put together by the project manager, who is in a main responsible for the project management. (Boddy, 2002)

A separate project team may not be necessary in every cases. The role of a project team does rise if the project is the bigger scale project, or it is more complex or if the project outcome is higher prior for the parent organization. (Boddy, 2002)

The main idea of a project team is that it should be more efficient than the outcome of individuals work efficiency separately. Effective project team would be build up by professionals with different kind of attributes and characteristics. It is a key task for the project manager to construct the group who will reinforce individual's attributes, not cannibalize them. (Dingle, 1997)

Even though it is important to build up a crew with different strengths, it is important to notice that all the project activities are not carry out inside the project team. Project team is working inside the project organization, and the project organization offers a support functions for the project team. For example, law technical know-how is now more important than never, but is it still beneficial to tie up a law professional inside the project team, or would it be more agile just to point out a professional from the organization for the use of the project team. (Dingle, 1997)

Project team should be more efficient than the individual project workers. This means that project manager should not sacrifice the team efficiency just to get some specific individual to the team. Researches shows that the attitude and suitability to the project team is the most important selection criteria, even more important than the know-how concerned on project matter. (Meier, 2008)

5.4.   Project Worker

Organizations have always different structures. Project organizations have parent organizations and project teams working inside the parent organization, but it is always individual project workers who works on daily project routines.

Project worker is an individual who works directly on the scheme of ongoing project. Researchers have found a few key attributes for the efficient project worker, such as: strong reporting skills, data management skills, capability to embrace the best practices, quality management skills, and capability to support the project outside his/her own role. (Garvey, 2014)

The project work is often quite chaotic working method. At the project there is constantly a lot going on, a lot to take care of, and many project owners to satisfy. This creates a basic need for the project worker to be capable of working changing environment and to be able to handle a multiple task simultaneously. For the project manager it is vital to stay aware of what everyone is doing and where the project is going. So strong analytical and communicational skills is required from the project worker, to be able to fulfil a management needs, to create a relevant analysis and to communicate those to the management echelons.   (Garvey, 2014)

Obviously good communication trough out the project organization and between the project workers is vital to ensure project individuals capabilities to maintain the whole picture from the project. To understand the whole picture is vital for the individuals to be able to succeed on project tasks. To be able to understand the best working practices, as well as to be able to manage the working quality and to be able to notice the need of support and to give a helping hand to solve it. (Garvey, 2014)

6. PROJECT RESOURCE DEVELOPMENT

In the project environment the project infectors are called as the project resources. There are two kinds of resources, immaterial and material. The resource can be immaterial such the project workers or the organizational workers which have been named as a resource of a project. Some projects can be consisted only from immaterial resources, but there can be also material resources involved. A material resource is something visible, like logs for the log house.

6.1. Project Leadership Skills

Project management is like a birthday cake, there is no one and only way to assemble it, but typically it has been put together with different kind of layers and elements. In a large project there can be numerous project managers who do have individual responsibilities and different managerial positions. In addition, projects may be effected by organizational managers and decision makers outside the actual project organization. So the position of managers is central in order on succeed in the project. Managerial activities roughly include two directions, organizational work and leadership. Effective leadership requires good leadership skills.

Project Management Institute (PMI – PMBOK, 2013) defines leadership as: *Developing a vision and strategy, and motivating people towards achieving that vision and strategy.* PMBOK's definition is simple and clear, but it may include a risk of excessive simplification? Traditional organizational approach may comprise a manager of a manager of defined area like human resources, financing or site management. In these sections the managerial activities are easier to define. However, the project environment is an extensive and rapidly changing area of business activities. The project leader is typically in charge of several areas and ideologies. Technical, entrepreneurial and managerial skills are often required to be able to scope through the project terrain, which creates a constant change to the work of project leader. (Burke et el., 2014)

The role of the project leader can be complex, but similarly it is a key role for the project success. The project manager's leadership skills are vital to ensure the progress of the project. He/she needs to work towards several directions, collect he process inputs from the project stakeholders and communicate these successfully to the project workers. The organizations strategy and vision is a guideline in this work, but the manager needs to be able to communicate project expectations to the project participants and also empower and inspire them to create a higher value to the project output. (Burke et el., 2014)

Only rarely the project leaders have the comfort to have his/her own project organization totally separated from the parent organization. Parent organization may affect for the project work even if it does not have any authority towards the project. For example, if the parent organization works in matrix shape and the project workers are gathered from different parts of the parent organization, the project leader may not have a complete authority and control from the project workers. In this case the project leader needs to have effective negotiation skills to be able to influence to the other parent organization managers to be able to ensure the project resources involvement to the project. (Burke et el., 2014)

The project manager task is to build a potential team, and lead it to the success. It is not a simple task, and project managers is required to have several leadership attributes at a good level. A good project leader needs to have a good eye to the team selection, influence to the team building and good coaching and mentoring skills. The project leader cannot be participating in every project activity, so delegating and communicating skills is highly needed. To be able to ensure a continuous development the project manager needs to be able to monitor the performance, evaluate it with an accurate practice, and be able to solve potential problems. These attributes provide the project leader with a good platform to be able to succeed his/her responsibilities. However, it is vital to remember that the motivation may be the most important leadership skill, because it is a source of quality working activities, and the motivation of the leader does have a tendency to expand to the project organization and workers. (Burke et el., 2014)

6.2. Project Worker Development

The project teams are always constructed from individual project workers. When the purpose is to develop the project team's overall performance, the individual project workers is the grass-roots of that process. Even though the team spirit has been proved to be key factor to the success, much needed specialization occurs in the individual level.

The development of individual always starts from the growth of motivation. The motivation developing is a complex matter, which is affected by several inputs. These are for example the individual evolution, experienced fairness, the work objectivity and the job security. These factors build workers dedication to the project, and by then the project success. (Dwivedula, et al, 2010)

Project worker is often working in a blurry environment. Most of the occasions there is many overlapping processes going on at the same time, and it might be hard to keep a good overlook from the project while the ongoing hassle. In the project worker development progress should point out the worker's flexibility, skills to work in uncertainty, innovativity, creativity, skills to produce intelligent analysis and obviously the communication skills. (Dwivedula, et al, 2010)

Authors claims that the work motivation is the main contributor in order to obtain greater value out form the individuals working processes. In the project work the motivation factories may wary form other kind of work areas, but the motivation is well-thought-of even more important factor in the project environment. The main factor in motivation building process is the individuals and the organizations objectives, employees inclusion in the decision making process, challenges and formal and informal communication between the different parties. (Dwivedula, et al, 2010)

6.3.   Project Team Development

As we have learned each project is an individual event. It is important to notice that even though each project is temporary pattern, the project team might not be. The more project requires specialization, it is more common the project team works together longer periods, just changing projects. This is common for example in shipbuilding, or in ocean liners maintenance work.

The project team is a dynamic environment where individuals work together with a same objective. Dynamic environment creates a dynamic development progress, which is not complete on the hands of the project leader. From the dynamic development progress can be found several common stages, which the leader needs to notice to be able to guide development towards the desired direction. (Burke et el., 2014)

Bruce Tuckman has featured a classic team development model, which is consisted from: forming, storming, norming and performing. Burke et el., (2014) have reinforced this model by additional attributes of maturing and declining. In an early stage of a project the development scope is highly centered to the individual level, but in the storming and norming phases the team and task management takes a bigger role. In the late stages of the project, the team development should be centered to the task management and to the team management and individual level starts to decline. (Burke et el., 2014)

When the project team enters to the maturing stage, the project manager should consider some kind of change in to the team. The human nature starts to get more stable in the comfort area. This may affect harmfully to the business if the individual project workers start to avoid new ideas and a growth of business to be able to ensure a comfortable work-ing environment. Maturing phase can be momentarily avoided or escaped, but eventually the declining is inevitable when a cash flows dries and the project team is incapable to obtain new investments. (Burke et el., 2014)

The main key to the project team development is communication. The force of words should not be underestimated, as long as the jobs get done it is impossible to over communicate. The quality of communication and its quantity is one of the biggest thing in project team management, which needs to be consciously maintained in order of project team development, and to develop human relationships inside the project team. (Meier, 2008)

Project managers main task is to ensure a profitable working environment to the project team. To succeed in this, project manager needs to be able to erase performance prejudice factors. These factors might concern even personal, organizational or other external factors. The team spirit has been noticed to be the biggest success factor on the project team management, and the manager should cherish this with soft hand. In some cases, this might mean also harder approach, if some internal person proves to be poisonous to the team spirit or in overall project perspective. (Meier, 2008)

Hackman (1990) states that the project team development should concentrate to the three different schemes: achievements, capabilities and how the team succeed from given tasks. The individuals work motivation is one of the biggest contributors in this besides on the team spirit. Innovative environment with suitable incentives is the main tools for the project management. After all the investments to the project team development should be concentrated in a similar way than every other investment, only the profitable ones should be proceeded. (Boddy, 2002)

6.4. Project Procurement Management

Project procurement considers material and immaterial resource acquisition for the needs of the project. Typical procurement is centered to fulfil the projects material need, but as good as it may be an acquisition of external knowledge. As a side product of procurement, there will be some kind of inventories in some point of a supply chain. Effective procure-

ment aims to reduction or even elimination of the inventories inside the parent organization. This would be called as a JIT (just-in-time), which aims to the situation where the procured commodities go straight to the production.

The PMBOK introduces the definition of the project procurement management: *Project Procurement Management includes the processes necessary to purchase or acquire products, services or results, needed from outside the project team. The organization can be either the buyer or seller of the products, services, or results of a project.*

The most important factor of project procurement management is to ensure that the needed resources would be on site when needed and like needed. Agile project management gives two different procurement approaches to fulfil theses needs. Typical plan-driven approach excepts that the basic requirements and specifications of needed resources is well-known. This enables highly interactive relationship with the customer and the vendor within a clearly defined contract. Typical adaptive approach is more flexible approach where the customer and a vendor is seen more like a partners. Adaptive approach gives some latitude in the details, providing vendor with a bigger role in specification. (Cobb, 2015)

The responsibility from the procurement may change within the organization. In an agile world the product owner would be responsible in most cases, assisted by the project manager. In the real world the centralized organizational buyers do occur. In a project management the environment is so variable that the procurer should be the individual who is clearly knowledgeable form the project definition, requirements and the stage of the project. In a highly material centralized business some kind of inventories may be necessarily. Tight schedules build even more pressure to the inventory management when it is highly important that the needed resource is available when needed. (Cobb, 2015)

7. AGILE & LEAN AS AN SUCCES FACTORS

In the professional world, the fuzz around the agile and lean management philosophies is palpable. Is it all about nothing, or is there really evidence from a systematic correlation between these philosophies and with a successful value creative project management? To be able to create a create picture, let's take a look to the other researches from the scheme.

7.1. Differences Between the Agile and Traditional Methods

Lightweight project management approaches like agile has become to challenge traditional project management methods like waterfall. The benefit in the agile methodologies is the customer interaction and that it is capable to react to possible modifications in the project requirements and specifications. Traditional approaches require that the design and specifications would be secured in the early stages of the project. Agile methodologies seek possibilities to avoid these factors, and sees them as a stubborn way to manage the business processes. (Sarrador et.al., 2015)

Traditional project management methodologies do have them reasoning. It would be fantastic to be able to determine every single detail of the project before the start of it, right? That would be an ideal, but is it rational? Probably not. Traditional methods did work in traditional world. But now a day the world is in a constant change, and to be honest I think there is no possibilities to organize work just in the way that Fredric Taylor did. Time has changed and methodologies needs to change with it. Regrettably traditional methods produce a great risk of twisters in a late stages of the project. These twisters may produce a massive re-works, lack of flexibility, customer dissatisfaction and worst of all, the possibility that the completed project would be a complete failure and would not serve any need what so ever. (Sarrador et.al., 2015)

Collyer et al., (2010) found out that there are three common factors, which tends to change in a dynamic project environment. First of all, the goals use to change throughout the

project. Customer needs may change, or something else unsuspected comes in the way. Secondary the materials or resources may change. This may affect to the used tools and techniques, and may require an adaption in the other fields as well. Lastly every project is someway related to the other projects, services or products. For example, it is useless to produce some product, which would be outdated due the change of the services on the markets.

	Traditional Development	Agile Development
Fundamental assumption	Systems are fully specifiable, predictable, and are built through meticulous and extensive planning	High-quality adaptive software is developed by small teams using the principles of continuous design improvement and testing based on rapid feedback and Change
Management style	Command and control	Leadership and collaboration
Knowledge management	Explicit	Tacit
Communication	Formal	Informal
Development model	Life-cycle model	The evolutionary-delivery model
Desired organizational form/structure	Mechanistic (bureaucratic with high formalization), aimed at large organizations	Organic (flexible and participative encouraging cooperative social action), aimed at small and medium sized Organizations
Quality control	Heavy planning and strict control. Late, heavy testing	Continuous control of requirements, design and solutions. Continous testing

Figure 2 Main differences between traditional development and Agile development.

(Dybå & Dingsøyr. 2008)

It is notable that even though the traditional methods have been criticized from a lot of front end planning, the agile methodologies do require it as well. Some researches even success that the agile requires even more planning work than traditional approaches, it

just is spread all over the project lifecycle. Traditional methods require a lot of front end planning, because the change or additional requirements and specifications is nearly impossible at the later stages of the project. This might lead to the point where something is processed just because the plan said so, this predisposes to the risk of rework and delays. (Coram et.al., 2005)

It is important to notice that an individual project often needs characters from different management methods. There are project factors like safety requirements, project size and well-known requirements, which do require more up-front planning. More turbulent environments give more pressure to the agile methodologies and the front-end planning does not take so large role of the project (Sarrador et.al., 2015). Sarrador et.al., 2013 find out on their research that too much planning can be as harmful and costly as too narrow planning. They found out what they call U –turn as a cost effectiveness, where too extensive planning and too minor planning had similar effects on the project success.

7.2. Agile & Lean in a Project Environment

Sarrador et.al., (2015) produced a quantitative study about the impact of agile and lean in the project constraint. Their goal was to find is there an empirical relationship between the usage of agile philosophy and the project success. They found out that the agile methodologies really do improve time and budget management, and it does merit on the stakeholder satisfaction. They found out that there really is a positive correlation between the agile management and project success. They state that by their research the agile methodology does increase the project efficiency, stakeholder satisfaction and also the wider business goals.

Sarrador et.al., (2015) gathered a data from 1002 projects which were not restricted by the industrial or geological restrictions. The success of agile methodologies has been researched in a IT projects, but they really were the one to produce a large scale empirical

study in another environment. Their main interest was to test project success in two dimensions, by the overall satisfaction of the stakeholders and by the efficiency of the project. Their other interest was to find variables, which were correlative to the positive project outcome. They found out that the quality goals and visions were the most important success factor, even bigger than the experience of the project team or the complexity of the project.

J. Koskela et.al., (2004) found that the customer's mayor involvement in planning is vital to ensure a high customer satisfaction and an effective planning. In their research they state that in the agile project 42.8% the time that customer put in to the project, is allocated to the planning stage. The customer's involvement is obviously related to the character of the project. In some projects the specifications are easier to change, than for example in the construction industries it may be highly costly for example to change the specifications of the installed floor.

7.3.   The Success Factors

First, it is necessary to notice that even the researchers do not agree a universal measure for a project success. Is it a desired outcome, is it more important to stay on schedule and budget, or would it be even something else? Munns and Bjeirmi (1996) stated that the researchers too often define that the project and so on the project management ends when the product have been handed to the customer, instead of taking account a larger scope. For example, in a bumbling renovation project the customer surely requires that the desired outcome would last for at least several decades.

So it has been debated what the success is? Can a project be a success if the customer in unsatisfied but it has had a great positive impact to the organization, and another way around. Serrador et.al., (2015) have valued many descriptions to the project success, and they came in to the conclusion that the project success is measured by two different dimensions. The project efficiency defines the level that the project has been able to meet

its time and cost requirements and the scope of goals. The second dimension considers the stakeholders' success. It requires a consideration of the satisfaction of the project stakeholders. They state that the stakeholders are the best authority to define the project overall success.

Serrador et.al., (2015) have found that the level of agile methodology planning is a key predictor on the success of the project. The predictor is influenced by three different moderators, which are: quality of the vision/goals, project complexity and the experience of the project team. The goals are a guideline of the project, the complexity adds a variation in to the project and then the agile methodologies do have its advantage. Researchers state that the experience of the project team is correlative to the quality of the work they produce. These are the key factors to the successful project, which are clarified in the next figure.
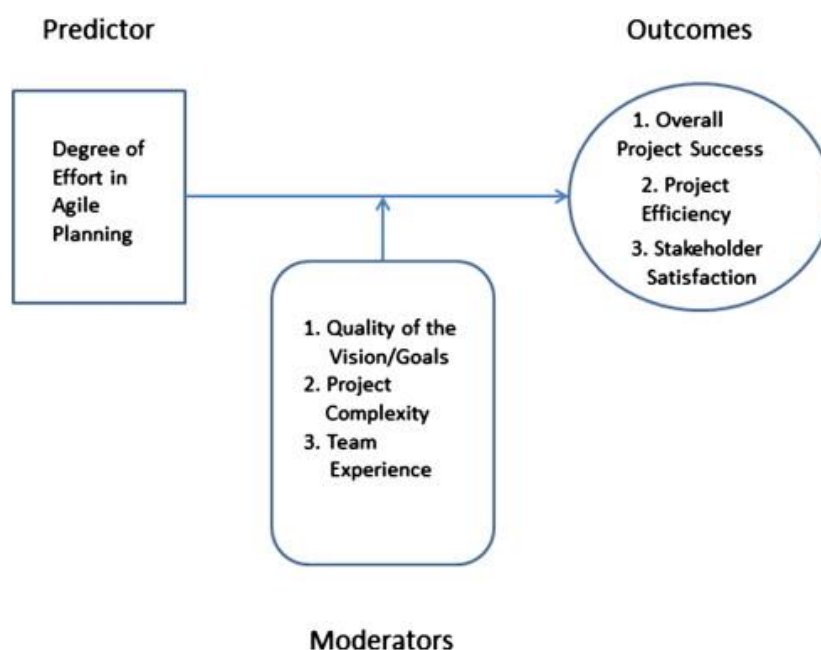

Figure 3 Agile Methods Success Factors

Serrador et.al., (2015)

Research found that the agile methodology interaction was positively correlative to the project success. Researchers states, that event the positive impact of agile methodologies to the project success is rather small it still is significant by these three named positive outcomes. project success factors: overall project success, project efficiency and stakeholder satisfaction. The most interesting finding is that according the study the amount of upfront planning was in a same range apart on the involvement of agile methodologies. This finding would denote that the agile methodologies actually would demand more planning, because the planning would be done also in later stages of the project. (Serrador et.al., 2015)

Methodology type means with ANOVA analysis: how much of the project was done using agile or iterative techniques.

Percentage agile/iterative	Means and ANOVA				
	Upfront planning effort index	Agile planning effort index	Efficiency factor	Stakeholder success factor	Valid N
80–100%	0.161	0.149	4.821	3.638	80
60–79%	0.147	0.138	4.664	3.567	152
40–59%	0.164	0.132	4.793	3.544	347
20–39%	0.135	0.101	4.638	3.414	162
1–19%	0.150	0.091	4.460	3.179	194
0%	0.154	0.048	4.582	3.208	451
All Groups	0.153	0.105	4.647	3.376	1386
F	1.492	18.370	1.93	7.73	
p(F)	0.173	0.000	0.087	0.000	

Figure 4 The Effect of Agile to the Project Success

Serrador et.al., (2015)

7.4.   Agile and Lean in Construction Industry

Serrador et.al., (2015) found out that the agile methodologies are a quite slightly use in the construction industries. They found out in total of 23 projects, which were examined

for the study. They found this interesting, because the agile methodologies were first introduced in the construction and manufacturing industries (Dybå and Dingsøyr, 2008).

In their research Serrador et.al., (2015) was unable to find a proven record that in the construction industry the agile methodology would straightly correlate to the positive outcomes. They found out that the regression between the project success were to significant that the direct reasoned the ultimate outcome was too hard to be proven. Or at least the study does not show a significant statistical relationship between the agile management and project success in the construction industry.

One of the main findings of the research was that the experienced staff does not play too important role of the project success. And actually in the agile methodology project this factor is less important than in the traditional project management. This might be outcome of the ongoing planning process, where the staff members are more involved in the planning process, and the needs of individual worker might be easier to be discovered. Reworks also follows form the unsuccessful planning or unsuccessful working activities. It might be that the agile methodology is more receivable of these dilemmas. This is good news for the construction industry. In Finnish constructions, it is typical that the turnover rate of the workers is high. (Serrador et.al., 2015)

In the construction project, the schedule and budget management is vital. In this field it is not uncommon that the project management is unable to scope through the project complexity, in order to succeed on these factors. It is also important to notice that even if the project is not overrun by schedule, it still might last too long. Good example on this is plumbing renovation projects in Finland, which tends to last up to three months or even more. Unnecessary time in the project does not create value or customer satisfaction.

As a result of general development the project management have get more complex specifications and standards. The researchers clearly see that the pure project management methods like the traditional project management are not effective enough anymore (Priemus et.al., 2013). Lean has been seen as a successful general managerial management philosophy while the agile has been seen as too light philosophy to scope projects

that are more complex. Agile still clearly have's benefits on dynamic environments, and these are the reasons why the combination of agile and lean just might be the breakthrough in construction projects, to be able to deal with the complexity and uncertainty. (Sohi et.al., 2016)

The project complexity has been named as the biggest steps stone in the construction projects. Complexity and disorganization has become a main factor on time overruns and project failures (Kaming, et.al., 1997). Meng (2012) has divided poor performance factors to the two separate groups: internal and external. Internal factors are factors that the project team can scope even indirectly. This kind of poor performance may be the result of action from the: customer, the contractor, subcontractor, the designer, consultant or supplier. External factors are the factors that the project team may not be able to influence. These factors might be weather, unforeseen conditions, market fluctuation or regularly changes.

Project complexity may not be a new problem, but it has become more vital to deal with to be able to succeed in the project. In the construction industry, the change is inevitable. Large numbers of contractors, subcontractors and other stakeholders is working towards the common goal. Prieamus et.al., (2013) states that the stakeholders need to learn to incorporate change in to the project, instead of constantly fight against the change. Koppenjan et al. (2011) named this as a prepare and commit approach, where the extended project commitment is required from every participant. They state that the new age project management should be lead in to this direction, without forgetting a conventional project management as a part of the project management. Lean philosophy can be seen as a conventional project management, and agile as philosophy that is more dynamic.

Sohi et.al., (2016) researched the question of lean and agile in construction industries. They gathered information from 67 respondents and they found out eight significant statistical correlations between the agile and lean and the project success factors in the construction industry.

	Complexity 1 (technical complexity)	Complexity 2 (uncertainty)	Complexity 3 (organizational complexity)	Complexity 4 (stakeholder)	Complexity 5 (external complexity)
Lean & Agile 1 (structure & integration)	0.443**	0.205	0.594**	0.175	0.521**
Lean & Agile 2 (coordination)	0.079	0.092	0.173	0.157	0.261*
Lean & Agile 3 (planning)	0.249*	0.278*	0.325**	-0.093	0.112
Lean & Agile 4 (resource allocation)	0.147	0.195	0.196	-0.080	0.180
Lean & Agile 5 (communication)	0.226	0.120	0.431**	-0.173	0.198

**. Correlation is significant at the 0.01 level
*. Correlation is significant at the 0.05 level

Figure 5 Correlation matrix between complexity and lean & agile factors

Sohi et.al., (2016)

Their research shows that the combination of lean and agile gives a competitive advantage on every other criterion than in the stakeholder complexity. This might be consequence of a typical construction project, which do involve several stakeholders with different project objects. So lean and agile may request more time from the stakeholders, which may show itself as a negative in one perspective, but positive on other criteria's. In succeeding on large construction project with lean and agile, the collaboration between the stakeholders may be at the level they haven't used to before. This may cause some growing pains amongst the stakeholders.

The structure and integration reflects to the technical complexity in several ways. It has been seen that the collaboration and working more in project team instead of individual professionals has increased a success rate of the project. Experienced project manager has had similar effects, and he/she has been more likely to keep project in hands. The clarification of project objectives and goals would be vital to keep in mind throughout the project. Project teams and experienced project manager has been seen to increase this subject. They also believe that the use of standardizations would lead to the higher experience rate amongst the project workers. Also Sohi et.al., states that the usage of smaller batch sizes would help construction projects to reach it goals. Smaller batch sizes mean that the work inside the main project would be divided to the smaller mini projects, which would construct the main project. Smaller project is easier to control, and easier to understand. They also state that the mini projects would automatically increase the experience

of the project managers. If one manager manages the large project, he/she may not be experienced with every detail. But if the project is constructed by mini projects which is led by the experienced professional, the total experience rate would automatically be increased.

Another positive correlative factor with structure and integration elements of agile and lean is organizational complexity. This factor is straightly contributive with technical elements. Organizational complexity is constructed by the collaboration of contractors, subcontractors and other resources, and the interaction between them. Successful project management requires high stakeholder's collaboration, which is one of agile main objects. Mini projects would serve also this factor. Organizing work to the project teams, project teams would be constructed by several workers which should be seen as a resources, instead of individual resources would work by themselves. This would increase an availability of the resources, and also ease the communication between the resources and throughout the project.

Also external complexity management has been seen to have a positive correlation of the structure and integration elements of lean and agile. The main factor in order to succeed on external complexity is communication. With a high quality communication, the project controls risk by controlling failures in communication chain. Miscommunication may lead to re-works and schedule failures, if wanted resources is not available at the time they are needed. Team work and project teams is a key player in here as well, as team work tends to improve the communication.

The coordination elements are highly beneficial to manage the external complexity. Coordination is constructed by meetings, information chains and the performance reviews. To be able to fulfil the requirements of high quality coordination the information would need to be transparent and understandable and available at any given time, so that the project workers would work under the umbrella of correct information.

The planning elements of lean and agile have served positive outcomes in several ways. It have's positive correlation with technical complexity, uncertainty and with the organizational complexity. By involving team members and stakeholders in to the planning process the project manager creates a good platform to succeed in all of these factors. Involving team members and stakeholders in to the decision making process the project managers highlights the importance of resources experience and communication. Mutually agreed planning processes gives to project manager better outlook to the expert's opinions, and provides every stakeholder to be included in to the communication chain.

The last chapter of figure 5 shows that the agile and lean communication elements reflects positively to the organizational complexity. Construction project is including potentially a huge number of individual workers with different task, from different employers and from different background. The efficient communication is required to keep all the actions in hands, and ensuring as fluent project work as possible. Fluent communication ensures that the individual workers should know what he/she should be doing. It also ensures that every individual resources should know what the others is doing. These aspects increase communication and decreases a potential risk through the miscommunication or misunderstandings.

element	Statement	reduces complexity	manages complexity	unsure
Lean 1	all specialists work together in the project, instead of the project being divided into parts and merging all the parts at the end of the process	X	X	
Lean 2	all relevant alternatives are considered and worked out		X	
	the decision making process related to the alternatives is delayed as much as possible		X	
Lean 3	the constructability of the project is taken into consideration	X	X	
Lean 4	much information, like problems and corresponding action plan and the project's performance, is visualised and insightful to me at any given moment	X		
Lean 5	standardization is used in this project	X		
Agile 6	I have selected the tasks I am performing myself		X	
Agile 7	performance is tracked on a daily basis			X
Agile 8	the team or sub-team meets on a daily basis			X
	amongst the team everyone is aware of who is doing what, since we often align this	X	X	
Agile 9	the work is divided in smaller batches, which after completion are delivered to the customer so he/she can provide feedback	X		
Merged 10	I was involved in the planning process	X	X	
Merged 11	a detailed planning was not made at the beginning of the process, but a one week/month planning is made on a weekly/monthly basis		X	
	in the planning only tasks with high priority (according to the customer) and for which all prerequisites are met are included			X
Merged 12	Problems, even the smaller ones, are reported when they occur and made insightful to all team members			X

Figure 6 Summary of correlation matrix

Sohi et.al., (2016)

8. PLUMBING RENOVATION PROJECTS CASE COMPANY X

Plumbing renovations have been one of the hot topics in Finland for recent years. Finland experienced unprecedented construction boom after the world wars. The boom was at its top during the 50's until the 70's. Buildings that were built during that period is reaching an age were massive renovations is required to ensure safe accommodation. The biggest renovations concern the facade and the plumbing of the buildings. Here I focus to the plumbing renovation projects.

The plumbing renovation projects has become one of the biggest fears of the people who live in a block of flats. These projects tend to be very costly, roughly 600-900 euros per room square. Even bigger harm for a project customer have been the duration of the renovation project. At the moment the traditional renovation project will be expected to last anywhere from 29 months up to staggering 80 months. Planning processes can tie up even 58 months, while the residential detriment can be as much as 3 months. (talokeskus.fi, 2016)

8.1.   The Renovation of the Plumbing Renovation Projects

Potentially the ground breaking news were heard in the fall 2016 when the Company X's Chief Executive Officer (CEO) told that their aim is to produce a complete plumbing renovation project in just one week without any sleight of hands what so ever. Over two years ago the CEO X told in Kauppalehti (2014) interview that Finnish construction industry had lagged behind of the development. He stated that Finnish construction industry is full of the "technology religious" persons, who suspects that the development comes due to the technology-based development. He highlighted that his study tours to Germany where the plumbing renovation projects is done in just one week, have shown that the new innovations surely may increase the efficiency of the project by 10 present, but the rest 90 present of the efficiency is constructer by the management and from the working culture.

The CEO X told that the biggest project outcomes differences in Finland and the Germany is the duration of the project, the cost of the project and the level of planning. In Germany, the renovation project is planned to the level of every half an hour, in Finland the scheduling is done typically in a weekly basis. In addition, the costs are a totally in a different scale. The CEO X told that a typical German renovation project cost roughly a half from the value of Finnish renovation project.

The CEO X started a development project where he tried to find reasoning for the long lasting projects in Finland. He installed game cameras to the construction sites, and found out that the bathrooms where the biggest renovation is completed stay empty from the worker up to 80 present time of the ongoing renovation project. Most of the worker's time goes in to the general wonderment, moving the renovation articles or to sort out the unexpected change. (Kauppalehti, 2016)

The CEO X also calms down the buzz around their pilots. In the fall 2016 they finished one of their pilot projects, and succeeded to complete the physical construction renovations in just two weeks. However, he states that this should not be expected in every project. Each renovation project should deal as individuals because they have individual specifications and requirements. He states that by their renovation model they expect to be able to finish any renovation project so that the residential detriment would stay between of 6 to 8 weeks, instead of a typical 12 weeks or 3 months. He also plays down the speculation of the cost efficiency of their model, by noticing that their model may reduce cost from 10 to 20 percentages. (Kauppalehti, 2016)

The CEO X clears that the main role as in successful project is preliminary planning and the collaboration between the project stakeholders. He states that to be able to produce a renovation project with just two weeks of residential detriment, their company needs to be in a planning process from the beginning. (Kauppalehti, 2016)

8.2.   Company X's Alliance Model & Project Management Contract

Alliance model has firstly introduced in Australia, from where it has spread all over the world. First alliance model construction project was implemented in Finland in the years 2010-2011. Alliance model is not purely a project management method; it is more a project form. In the alliance, model the project stakeholders: subscriber (customer), the key players of designing and production agrees a mutual term to complete the project. In the alliance model, the sanctions and profits have divided evenly with the parties. In a basic form alliance model the implementer has been brought in to the project in its first planning stages. (Kanervo, 2012)

The Company X (2016) call their new-born project management method as a project management contract, which is guided by the alliance model, where the subscriber and the implementer is committed to work together in order to produce the best possible outcome. This can be seen as a partial implementation of agile philosophy, where the end customer is involved to the planning processes throughout the project. In the construction industry, one project often includes on contractor and numerous subcontractors, who also needs to commit to the project in more precise manner.

The Company X (2016) has noticed that the project design realization should be incorporated to the project management contract, which would be assigned to the one chosen construction company. In traditional plumbing renovation project the designer, and main contractor may have been even a different party, which have increased friction inside the project work. By concentrating a project management task to one stakeholder, the subscriber ensures better communication flow through the communication chain, and make sure that their voice is hear also by the ears of implementer. If the project design and management is in one hands, it is also easier to lock the solutions for the problems when the requirements and specifications is in clear. The re-modification of the specifications and requirements comes also easier, because the communication and command chains are a lot shorter and more efficient.

In a project management contract the main responsibility of the directing of the technical designers belongs to the project implementer. The Company X alliance method utilizes so-called Big Room methodology, which gathers every individual designer under the same roof to design the project. This increases the overall experience of the project team, when the professionals with different strengths works together to be able to reach the common objects and goals. The Company X believes that the broad expertise ensures versatile solutions and the compatibility of the different components. They also state that the rational overall design reduces costs, and it may reduce the project duration.

The project management contract and alliance model increases the flexibility and the control of the project. It makes the interlace of the designing and implementation possible, when the control of these processes is in same hands. This makes cost and time reductions possible, because the re-modification is more possible and it may reduce a risk of re-work. In the construction industry one of the biggest causes of the re-work and wasted time is that the construction drawings and the realization tends to differ. In the traditional plumbing renovation project the designs and planning processes have completed before the project work steps in to the implementation phase. The project management contract makes possible that some demolition work has completed before the designs have been locked. This gives more moving space to the designer and ensures that the potential pitfalls can be detected before it would require re-designs and re-works.

8.3.   The Progress of Company X Plumbing Renovation Project

The plumbing renovation project takes typically several years, depending on the definition of the starting point. The demand to renovate the plumbing system is typically well-known factor at least several years before the implementation. The actual steps start from the project planning. In the project planning stage, the project objectives, the method of allotment and the extent of remodeling will be defined. The customer has been involved in the project planning stage, to ensure knowledge of customer needs and the repairing needs of the apartment complex. In the project, planning phase also the basic information

and project data has been gathered to serve a decision-making in the later stages of the project.

The Company X (2016) highlights the importance of the involvement of the project implementer in the early stages in the planning process. In a traditional plumbing renovation project the project planning and design has been given to the designing company, and implementation to the constructer. They state that the involvement of the implementer provides project to be realistic, expedient and unique to serve the real needs of the customer.

The project planning stage is followed by plumbing renovation planning stage, where the details, requirements and specifications of the renovation project will be set. The project planning stage plays a big role in this stage, because it defines which measures needs to be defined in the plumbing renovation-planning phase, and which ones can be defined in the later stage of the project. In the plumbing renovation, planning stages, the technical designs and solutions has been reconciling to match the requirements set in the project planning stage. The outcome of the renovation planning stage is the implementation plans and drawings, which is required to be able to enter next stage, the implementation stage.

The Company X uses so-called plumbing renovation workshop, to gather all the project stakeholders in the same room. There the project customers can interact with designers and constructers. This kind of interaction has been seen vital to ensure fluent communication with the project participants and to ensure that the vital knowledge does not disappear to the process. When an experienced project worker from different areas is set together with the customers, the visualization of the project has been made possible, and there still is someone who knows is all the proposals feasible. These workshops are set to be held in the both planning stages, in the project planning and in the renovation planning stages.

In the plumbing renovations implementation stage the project control is the key attributor to be able to stay in the schedule and cost plans. Constant observation and control enables the possibility to manage the potential risks and failures as soon as they occur, and by

managing these factors the potential re-modeling and re-work is set to the lowest possible level, which enables the possibility to stay on schedule. The Company X ensures the constant communication flow by naming a responsible individual to communicate with the project participants. For example, the customer does know whom to contact if something derogating occurs, or he/she simply wants to get information from the project development.

The Company X tries to standardize their production by serving a standard solutions and packages to the customer. They also serve a total serving concept, where all the customers' needs and requirements have been implemented. The Company X also puts extra resources to ensure an effective communication flow through the participants. The customers get timely information of the project progress even with text messages, if they desire this kind of service.

A traditional plumbing renovation is implemented with a one sift operation. The Company X puts more resources in to the project, to be able to finish it in a shorter period. This requires two sift operations, and this have a major different to the project customer. The Company X does not recommend a living in a department when the renovation is implemented. This ensures more liberty to the project workers to complete their tasks and stay on schedule.

The Company X have launched their new service "Ketterä" renovation solution, the name refers straight to the agile philosophy. The Company X's method clearly have's certain characters of agile methods, for example the customers' involvement to the decision process and designers project teams. The competition in the construction business, especially in plumbing renovations is harsh, so the company does not want to give accurate details on their success factors at this time. After all, their target is to abbreviate the flow time, and intensify the system stream by controlling slack.

8.4.   Working Method Adolescence in Plumbing Renovations

The Company X is not the only constructor who seeks the better methods to fulfill the customer needs. Construction market is competitive, and even in a small country like Finland is, you can make your order from numerous constructors. Even the number of so-called big market players is could easily reach a dozen. To this number could be added regional big players, also the smaller ones and finally some players abroad. So the markets are broad and hard to survive in. Now the companies have started to seek competitive advantage from the required duration of the renovation project.

The Company Z is a large scale construction company and a major market player. They have expertise from various construction processes, and they as well have come to the markets with the promise of shortened renovation time. The company CEO Z (Helsingin Sanomat, 2016) states, that the Company Z leans forward to the lean methodology to be able to shorten the process time. The CEO Z says that their renovation project implementation stage typically takes around 4 weeks to be completed. They have been able to intensify the process flow by more detailed planning and by using building elements to the construction. The CEO Z states that by better scheduling, material management, human resource management, and operational planning they have been able to cut down the process time. The Company Z clearly leans more strictly to the lean methodologies, than the Company X to the Agile philosophy, this both aspects should be combined.

One of the Roihuvuori's pilot plumbing renovation project manager (PM) was PM Y from the consulting company, Company Y. He highlights that detailed advance planning were the key success factor on the project, alongside the alliance model. PM Y (2016) states that even the planning process could be completed way before the deadline. In this pilot project, the planning stage took only 1 month, in typical plumbing renovation project it takes on average 4 to 5 months. He acknowledges that the renovation was prepared a couple of months in the common areas, before the renovation of residential apartments. By this way, they were able to cut down the residential detriment time, and intensify their processes. PM Y states that the biggest success factor is the organization of the work.

Unnecessary downtime and re-working should be avoided, and every project participant should be committed to the scheduling, so the process flow would be efficient.

In a short time period, everything needs to go on plans. First of all, the plans need to be accurate so that there is also preparedness for surprises. Also the task of project workers and project managers needs more commitment for the common goals. The Company X CEO noted that in their Roihuvuori constructions worked around 100 workers during the 2-week period. That kind of relatively small construction area with numerous workers needs clear instructions to ensure process flow and low risk rates.

9. CONCLUSION

The object for this study were try to find evidence on agile and lean philosophies as a construction industry success factors, and a potential new wave managerial methods. Studies from example from the Sohi el.al., (2016) have strengthened the perception that the traditional project management methods in construction industry should soon be buried, and replaced more on date managerial philosophies and methodologies.

The future research questions should drill more deeply to the operational management. Now it is almost an occult science, what happens in the construction sites. Maybe in the future, this is more open and the operational working methods could be researched more detailed.

According to this study, the future researches may handle the problems of supply chain management (SCM) in construction business, or how to reduce bottlenecks from the processes. Agile philosophies builds pressure to the supply chain management. The question would be how the construction industry companies could prevent their projects form potential errors in SCM. Technical and legal restrictions make bottlenecks in to the plumbing renovation projects. R&D projects should be required to investigate some possibilities to decrease technical bottlenecks.

9.1. Project Management Mix Suggestion for the Construction Industry

It has been seen that the lean philosophy is too rigid to take project complexity in account, the complexity that is typical for construction industry. Therefore, it should be strengthened with agile methodologies, which would ensure the project agility to take complexity and variation into account. Agile philosophy also includes customer deeply in the planning and decision making processes, which have been seen a vital success factors for project outcome and customer satisfaction.

Finnish construction companies have acknowledged the market change, and have brought a set of different management methodologies to fulfil the customers need from shortened plumbing renovation projects. The Company Z trust mainly to lean as the Company X to the agile methodologies. Finnish companies are still lacking the phase of their German colleagues. According to findings of studies, the combination of lean and agile could be the answer to do renovations even quicker, by managing and reducing the complexity of the project and the processes under the project umbrella.

In the new generation plumbing renovation projects the key stones should be, co-operation between the stakeholders, preliminary planning and preparations, and the customer's involvement in planning, designing and decision making processes. These are typical lean and agile characters, but it also needs to be noticed that the operational management and logistic should be in control in this scale project.

The Company X uses designer's co-operation, which rises the expertise of the project. Project teams such as scrum teams should also be used in the operational management, to increase an experience of team and shrink the time that is tie up in certain process. The Company X stated that the operational schedule planning has done on hourly basis. To be able to ensure process flow Kanban solutions may increase the phase of completing the task and transit to the next on.

The proponents of the new generation plumbing renovation projects have stated that the most important thing is to erase waste time from the processes. Six sigma management methods tackle to this problem by giving tools to conquer potential threads. However, the six sigma solutions should be implemented on individual concerns to serve the needs of individual projects.

In the new environment, the learning curve should be taken serious to be able to stay in market competition. DMAIC problem solving gives keys to analyze the company's projects, and a reason to seek a potential improvement to be able to generate the future projects even more fluently and more efficient.

9.2. The Markets of the Plumbing Renovation Projects

It is clear that the markets of the plumbing renovation projects have reached the turning point. New managerial methodologies have decreases the cost and duration significantly. One of the main concerns can be the companies' readiness or even willingness to do renovation projects even in a shorter time period. The Company X have announced already that the demand of their service exceeds supply of the service. The Company X should be able to increase their capacity, but it does not happen over a one night.

In this point it should be clear that the company which can supply new generation plumbing renovation project, and scale it to fulfil the market demand, will be the big winner of the market transition. However, the traditional plumbing renovation services stayed in the markets way too long, and there still might be a fundamental risk that the construction companies do not want to challenge themselves more than is required.

9.3. Development Suggestion for Plumbing Renovation Projects

In this research the plumbing renovation project management development successions is divided in three different sectors. Paraphrasing the structure of the study, the development successions is divided to ones which have mainly either lean or agile characteristics. And lastly to those which haves' clearly characters from the both managerial philosophies.

By using standardization and by visualizing information the project managers would be able to reduce project complexity. These methods are leaded from lean philosophies. The standardization would build up the project workers experience levels. By using standard resources and methodologies the workers would be performing in familiar tasks, which would increase the quality of processes and decrease the time tied up in to it. By visualizing the information, the basic knowledge is created more insightful. Standardization can

be for example the building blocks like the Company Z uses, or standard working methods and culture.

By managing the complexity, the company needs to be able to create alternative solutions to the different dilemmas. Creating alternative solution options the project managers keeps possibilities to do changes to the implementation plans. This method also is based on lean philosophies and it gives a possibility to delay the decision making process as late as possible. This prevents form the unnecessary work stages and from re-works. Creating alternative solutions but not locking the implementation plans is vital to ensure the process flow. Alternative solutions are especially important before the real construction requirements and specifications is factually known.

Lean philosophies gives methods which reduces and manages the project complexity. Using project teams like the scrum teams gives possibility for the specialists to work together. This increases the experience of the project teams, and it is easier to take account different factors from different work areas. Every construction project should also be taken as an individual. Constructability creates separate requirements for example to the logistics. Plumbing renovation projects could gather scrum team likeable teams, which would construct from professionals from different professions. They may be able to complete the renovation more fluently. At the moment the Company X uses project teams to manage the designing activities, but this kind of thinking should be spread more wider to the construction processes.

Agile philosophy brings on a bit more human resource management likeable management tools. In construction industry the processes should be divided in the smaller projects, so called mini projects. In plumbing renovation project this would mean that every single bathroom or a job site would have individual project planning. This would increase expertise levels and decrease time tied in the process. More important it would reduce project complexity, because every project worker would have fewer issues to worry about.

The importance of communication should not be underestimated. It simply is impossible to highlight the importance of it. Agile philosophy requires that everyone is on table what

he/she should be doing, and everyone should know also at least what other project team members would be working on. This matter would reduce and manage the complexity. Too many meetings have been seen as a time waste. So here the suggestion is clear Kanban system, what is happening and what should be happening. This ensures that if the individual worker would drop out of information flow or simply forget things, it would be easy to check out all the necessary information.

Planning stage do have a characters of both agile and lean philosophies. It clearly is significant to notice that the professionals themselves should be included in to the planning processes to be able to reduce and manage the project complexity. The Company X did include designers to the planning processes, but if it is possible that the designer does not have enough competence from to ensure the knowledge that the implementation would go without problems. It is also important that the detailed plans are not locked in the beginning of the project, but those decisions should be delayed as late as possible. This gives much pressure to the logistics. The key point of the logistics is to provide needed resources at the time they are needed. The problems in logistics could be prevented by ensuring enough resources to respond to the sudden changes.

9.4. Plumbing Renovations Market Forecast

It always is risky to forecast how markets will change, and in which direction. At this point one thing should be clear. The markets probably begin to require even shorter project durations. At the moment the company would be capable to compete in the markets if it can provide plumbing renovation project with 2 to 4 weeks' duration. The Company X cannot respond to the market needs, so there clearly is unfulfilled marker demand. Probably in the future the project durations will get even shorter. Two weeks sounds now really short compared on 3 months, but if some company could provide full renovation with only one weed residential detriment, then two weeks would sound ancient. So the companies would need to try to solve problems so they would be able to complete the plumbing renovation project even shorter than the Company X do at the moment.

It is hard to see, that any company could gain a competitive advantage any other way than with shorter project duration. Obviously price is always a competitive factor, but it is hard to see that the companies would be proactive to lower the prices if they have to put more resources in to the project and process management. Probably when the markets have reached their new the equilibrium point. When the two weeks' duration has become a standard, then new competitive factors will come and those probably will be even shorter project duration, prices and the customers change to influent to the project outcome.

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