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An Assesment of Lean and Agile Principles in Building Life Cycle Phases

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Abstract

In today's construction world it is no longer enough to just deliver a project, it is also aimed that the project is delivered in the timeliest manner, with the highest quality and with the most feasible budget. In order to do so, people involved in project management have developed new ways such as lean and agile delivery methods. Lean management aims to reduce all waste (defects, over production, waiting, not utilizing talent, etc.) possible, whereas agile management aims to respond problems as quickly as possible. However, it is not easy to introduce these methods into traditional management techniques. In the beginning, they usually cannot be implemented on the whole lifecycle of the project, but on different parts/phases of the project. This study investigates the use of lean and agile tools in project management during each step of the building lifecycle which are categorized as; initiation, design, planning, construction, maintenance, reuse/refurbishment, demolition/recycle. It also categorizes which wastes can be reduced as well as which agile principles can be applied during which lifecycle phase.

Keywords: *Agile, Building life cycle, Lean, Project management.*

Introduction

Currently, the construction industry is trying to find and adapt new methodologies for more efficient building production and human-force utilization. The pressure for higher profit/benefit from the clients and constantly increasing costs of construction forces the industry to leave outdated methods and open new paths to replace traditional processes. Considering the rapidly changing circumstances of building projects, the aim of completing projects within targeted schedule and budget is most likely to fail when only traditional approaches are used (Howell & Ballard, 1998). This creates financial and efficiency pressures on the construction industry which affect every step of the construction life-cycle, from initiation to demolition. Thus, new methodologies are developed and presented for overcoming the ineffective, inefficient, fragmental and wasteful nature of the construction industry. Two of these innovative methodologies are Lean Construction and Agile Construction.

The aim of this paper is to examine whether or not lean and agile principles are applicable for each phase of the building production process, based on a literature review. A study was carried out by compiling the information obtained as a result of the literature research carried out by 7 students enrolled in Istanbul Technical University, Project and Construction Management Doctorate Program, Lean and Agile Management course in the 2019-2020 academic year. In line with the determined goal, 7 students researched whether the principles of lean and agile management are applicable for each phase of the building production process – which are categorized as; initiation, design, planning, construction, maintenance, reuse / refurbishment, demolition / recycle. 312 articles published between 1996 – 2020 were reviewed in total. The literature review then has been categorized in a cross match compatibility of each building phase to lean and agile principles and tools.The results obtained were brought together within the scope of the lesson and may be considered the output of this course.

Use of Lean Principles in Building Life Cycle Phases

The root of lean thinking depending on the Toyota's Production System and used mainly in automotive industry; and the lean concept firstly introduced by Womack et al in 1991 (Picchi et al, 2004). Koskela (1992) defined lean construction as a new production philosophy with various advantages in productivity and quality as well as ability of rapid diffusion into the current system. Howell (1999) explains lean construction as consuming less resources in the way of satisfying the requirements of customer. The lean wastes can be listed as: Defects, Over production, Waiting, Non-Utilized Talent, Transportation, Inventory, Motion, Extra Processing (Mazlum and Pekeriçli, 2016).These wastes, and which can be reduced at each phase of the lifecycle has been summarized in table 1.

In the initiation phase of a project it is possible to reduce defects, overproduction and non-utilized talent by keeping a lean state of mind. According to Picchi et al. (2004) the definition of value in the lean thinking application is also updated from the employer's perspective to the whole enterprise by understanding the main characteristics and properties of the product and employer's benefit. With this perspective, the processes are reviewed and could be improved by reducing waste and increasing the desired results. The improved version allows cost reduction, increase the understanding about project value in the beginning phase of the project, and enables a being team (creating culture) (Picchi et al., 2004). If the project focuses on increasing the value from the first step many wastes can be avoided on the product side (defects, overproduction), as well as non-utilized talent by creating a team.

Table 1: Use of Lean Principles in Building Life Cycle Phases

LEAN WASTES	Init.	Design	Plan.	Const.	Maint.	Reuse Refurb.	Demol. Recycle
Defects	x	x	x	x	x		x
Overproduction	x	x	x	x		x	
Waiting			x		x		x
Not utilized talent	x		x	x			
Transportation			x		x	x	
Inventory			x	x		x	x
Motion			x		x		x
Extra processing		x		x		x	

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According to the literature review on lean design management, there are four important factors related to reducing waste and increasing the value: " interaction, Value and value stream mapping, Lean culture and assembling the team, Information flow" (Reifi & Emmitt, 2013). According to Mazlum and Pekeriçli (2016), considerable effects of the architectural design process that progresses with lean thinking on the construction process are mostly neglected. It is very important to increase the level of lean thinking efficiency in design processes in order to increase the efficiency in the construction process. To increase the efficiency of the entire construction process, it is necessary to identify waste items that cause inefficiencies in the design process (Mazlum and Pekeriçli, 2016). By using lean principles at the design phase defects, overproduction and extra processing can be avoided from an early on stage. This will also improve the efficiency of the whole building life cycle.

In the planning phase, defects and overproduction is reduced by last planner with integrated control mechanisms, Blockchain with automated digitalization (incorrect knowledge), BIM with clash detection and digitalization. Waiting and motion are reduced by Blockchain with erasing intermediaries in supply chain, BIM with digitalization and implementation of supporting tools like UAV, AR, and VR. Inventory waste is reduced by eliminating paperwork in BIM and Blockchain. Non-utilized talent waste is reduced by last planner with great collaboration with field personnel and subcontractors. Transportation waste is reduced by Blockchain.

The most basic principle of Lean Construction is to reduce non value adding activities which can also be defined as wastes. According to the study of Bossink and Brouwers (1996) on waste in Dutch construction industry, 9% in weight of total materials are wasted on site and from 1% to 10% of each construction material leaves the construction site as solid waste, while up to 30% of purchased materials end up as waste in Brazilian construction industry. Maturana et al. (2003) argue that a 30% reduction in the number of work-force is possible to obtain throughout the schedule when multi-skilled workers are used. Project-based employment of labor, simultaneous implementation of different tasks and high training costs create a barrier for this application in the construction phase of building projects.

Building maintenance is the longest phase in the building life cycle. Total productive maintenance method is usually used to support lean manufacturing. However, it can also be used in lean building maintenance. Defects and management variations can be eliminated at source (Ahmed et al., 2004). Similarly, various wastes such as waiting, transporting, processing, inventory can be reduced by satellite workshops / stores, lineside trays etc, decentralized lineside maintenance, escalation capping, (i.e., capability guidelines), first in - first out spare parts, respectively (Davies and Greenough, 2010). One should aim for the continuous improvement which in the long run would decrease wastes and improve efficiency (Bicheno, 2000).

In the reuse / refurbishment phase, several wastes can be reduced using lean methodologies. For example, Horman et al., (2003) examined the usage of buffers in the production system of the Pentagon renovation project. Short interval production scheduling (SIPS) was used to plan activities of the interior construction. The planning method is applied in the project segmented into small work zones to improve production workflow. Mitropoulos & Howell, (2002) studied on the investigation of the problems of an office renovation project during the design process and proposed approaches in order to mitigate design duration and rework. The acceleration of the discovery of existing conditions, the identification of the project constraints as well as improvement of the iterative design process with a team-based involvement identified as approaches to deal with design duration and rework. Agyekum et al., (2013) stated that recycling of materials which causes the waste on site and reusing of surplus materials are appropriate to prevent and reduce wastes in construction. Also, they stress the critical role of proper storage and handling of building materials in eliminating waste in construction.

Finally in the demolution / recycle phase, present activities and patterns in the disposal of construction materials are based on the whole building life cycle and the idea of reincarnation. Strategies on this subject involve integrated recycling, zero waste, international approaches, resource optimization, reuse of materials, waste reduction and deconstruction (Kralj and Marki, 2008). Reuse and recycle strategies seem strongly match with lean understanding and principles. For reuse, it is encouraging to include subcontractors and other stakeholders as a shareholder for time and cost benefits. Moreover, some green building certification processes have also positive effect on back to back principle in terms of recycle. If the main contractors follow the requirements of certificate, they could force the related subcontractors and suppliers, i.e. to use materials with higher recycle percentages.

Use of Agile Principles in Building Life Cycle Phases

Agile management was born in the software industry to increase flexibility; then, many other industries, including the construction industry, have also adapted the agile approach. Koskela et al. (2006) defined lean as a collection of repeatable and focused responses to a constrained and competitive environment with limited resources; while agile is a strategic and proactive response for continuous change and unpredictable situations. According to Sohi et al (2015), agile methodology includes objectives in planning, quality, risks, changing requirement and value. Instead of upfront planning, incremental planning should be selected to choose most current available information. Quality standards ought to be up fronted and also technical risks should be addressed in the process as early as possible to reduce the effect of changing requirements. Additionally, in order to give power and trust to the staff, increase the involvement of the client and communication between project team and working environment the value of the business should be continuous and frequent.These principles and their effect in project lifecycle phases can be seen in table 2.

Table 2: Use of Agile Principles in Building Life Cycle Phases

AGILE PRINCIPLES	Init.	Design	Plan.	Const.	Maint.	Reuse Refurb.	Demol. Recycle
individuals & interactions over processes and tools	x		x	x	x		x
working software over comprehensive documents		x	x	x			x
customer collaboration over contract negotiation	x					x	
responding to change over following a plan		x	x	x	x	x	

As an example of how individuals come before processes in an agile management environment in the initiation phase of a project, Rascanis et al (2015) studied adaptation of agile project management methodology for project team in terms of people's emotional status. Motivation of personnel of an IT firm, which started to use Agile Scrum in their last project, is investigated by means of a questionnaire which has questions grouped depending on the hierarchy of human needs in Maslow's pyramid. Study results shows that group members have high regard for the working in a team with group members; while, they are disappointed in terms of reward (like social guarantee, remuneration). The firm could improve project team by improving reward mechanism to achieve higher level motivation (Rascanis et al, 2015). The same idology can also be applied to clients/customers as agile repetitively mentions how people's involvement is the cornerstone of agile mentality.

Agile management can also have a positive effect on the design phaseas well. Bellomo et al. (2014) highlight two main consept for agile architecure:

- Flexible, all-purpose, easy to improve and replace system or software that will not be affected by several changes,
- Agile way uses an iterative lifecycle to define an architecture and also to figure out the problem and restrictions that allows the architectural design strategically improve over time.

Agile architecture is not only a process of dividing architectural work into iterations, but also recurrently and often concurrently elaborate development proceeds as the requirements, architecture, and design/implementation. (Bellomo et al., 2014). It could be understtod that by using agile in design working system that is open to change can be established.

In planning phase, since the greater collaboration and interactions is established between individuals, responding to change will be quicker in Last Planner system. Also, in Blockchain and BIM, change is noticed with vivid, and updated system, thus it leads fast response. Moreover, BIM and Blockchain suit agile's working software principle.

In the construction phase, Krishna et al. (2020) conducted a data analysis research on implementation of Agile Construction on different infrastructure projects and provided results for the effects of agile management in construction industry. In order to overcome t delay causatives, several agile enablers were applied to the cases: kick-off meetings, scrum development, sprint meetings, backlogs, fixed time, short cycle planning, flexibility, communication, integration, iteration, technology and continuous learning. After theoretical application of these agile enablers, it was concluded that they may reduce delay for about 70% to 80% percent per case if adopted and implemented properly. Koskela et al. (2006) analyzed the potential of Agile management for the pre-design, design and construction phases based on several criteria and concluded that "implementation of Agile management in the construction phase is expected to be harder because the consequences of changes may cause big impacts on the project objectives."

In the maintenance phase, preventive maintenance could be carried out even before a failure arose which is a great example of the agile principle of responding to change over when following a plan. The maintenance strategy aims to reduce the probability of a failure or increase the functionality of an item (Fouladgar et al., 2012). In this strategy, fixed operating time interval and the number of output units are the main basis of the maintenance activities which are performed without the consideration of the current condition of the investigated item. Also, in this strategy, performance and/or monitoring parameters such as corrosion and electric current monitoring, lubricant and vibration analysis, leak and crack detection, and ultrasonic testing could be another base for the maintenance activities to be performed (Mostafa et al., 2015).

Agile management is mainly about responding to the needs quickly in line with the changing needs of occupants and to provide satisfaction to occupants. Similarly, the term refurbishment is mainly about responding to the needs of existing buildings which loss of their function. Notably, rather than demolishing and new build, refurbishment is a rapid approach to respond to the needs of existing buildings as well as their occupants. For instance, the NewTrend project based on the integrated retrofit design methodology (IDM) aims to guide all involved stakeholders in the retrofitting projects (Khoja et al., 2017). This study considers the required communication and participation mechanisms between all involved stakeholders in all phases. The early involvement of occupants is critical to understand the occupants' needs and problems to retrofitting that can eliminate the possible rework and distributions in retrofitting (Khoja et al., 2017). In terms of agile thinking, this study covers the involvement of all project participants, communication, and collaboration among all stakeholders which play a substantial role in construction, management as well as decision-making to all phases of refurbishment projects. Also, rather than purchasing new materials, reusing existing building material is a rapid solution to respond to the needs of the projects. The responsiveness of reusable materials is supportive in terms of agile methodology.

Similar studies have not been encountered in the literature regarding the full assessment of the building demolition phase within the scope of agile principles. However, as a result of executing the building deconstruction process through the developed 5-dimensional BIM model, coordination between all stakeholders is ensured with a single model. In this context, the planning phase is created with high accuracy and it is ensured that the workers in charge at each stage of the demolition respond quickly to changes and an efficient interaction emerges. Besides, the collection of all projects and programs on a single model minimizes the number of documents created.

Use of Lean and Agile Tools in Building Life Cycle Phases

In order to apply lean and agile management principeles into the phases of building life cycle various tools have been used. In this section an array of these tools will be investigated according to the appropriate building phase they have been used as can be seen in table 3. Each tool is beneficial for a different purpose at a different phase. While researching these tools, it was recognized that some projects would use tools that would make their projects more lean or agile without even realizing it.

Table 3: Use of Lean and Agile Tools in Building Life Cycle Phases.

TOOLS	Init.	Design	Plan.	Const.	Maint.	Reuse Refurb.	Demol. Recycle
BIM		x	x	x	x	x	x
Pull (JIT) production				x	x	x	x
Last planner system		x	x	x		x	
Scrum				x			
Blockchain			x				
Digitalization	x			x	x		
Standardization	x			x	x		x
5 Whys	x						
Value Stream Mapping		x					
Set based design		x					
Cross functional charts				x			
Hejijunka Box						x	
Kanban Cards						x	

Building Information Modeling (BIM): A very common tool that can be used in many phases of the building lifecycle is BIM. The use of BIM and lean design management not only increases the value realization of the customer, but also allows the visualization of the content of the

design work and the detection and removal of non-value design tasks (Tauriainen et al., 2016). According to Eastman (2008), effective use of BIM in projects can improve design, improve buildability and establish faster project completion, and can save time and money for both the business owner and the project team. In addition, studies prove that the use of BIM results in increased construction efficiency, greater employee involvement in the project and reduced unexpected situations (Azhar et al., 2008).

It can be argued that, if implemented properly, even the most basic BIM applications may favour the lean construction purposes (Sacks et al., 2010). Even though this application is generally classified under design phase in the literature, the continuous and simultaneous nature of BIM models and processes serves the continuous flow process aspect of lean construction. Proper and dedicated implementation of BIM can carry the project from beginning to demolition phase with lower cost, reduced project duration and higher quality of application which leads to an unintentional lean construction in BIM projects.

Implementation of the lean thinking in the process of maintenance might be a complex approach. Integrating the BIM with the lean thinking might provide a better understanding for this complex approach. The lean thinking and the implementation of the BIM in the maintenance process can create a virtual environment that allows for a comprehensive analysis of the entire facility. It will allow to the business to be managed in much more detail. Integration of the BIM with the lean thinking enable to focus on completion of the process, increament on the process transparency and decrase on the number of non-value adding activities (Shou et al., 2014).

BIM is especially useful during the demolition process. It provides a systematic and sustainable model on the planning of demolition process and building inventory, and how the demolition process will be planned in the most efficient way. At this stage, given the developing scanning technology and 3D design possibilities,BIM applications can make a significant contribution to solving the problem (Marzouk et al. 2019). When BIM applications are considered together with interactive visualization techniques, managers can visualize which materials are placed where; determine deconstruction sites that need to pay heed or special implementations. Also, safety precautions and waste amount can be estimated. In this context, the principles required for the demolition process can be detailed and a new process for building deconstruction and waste management can be described (Ge et al. 2017).

Just-In-Time (JIT): During the construction phase, Lean Assembly includes fabrication & logistics that overlaps with Lean Supply, installation and commissioning. The coordination of fabrication & logistic between Lean Supply and Lean Assembly leads to Just-In-Time (JIT) management which is back-and-forth between Lean Project Delivery System stages. JIT in Execution Phase require the Lean Supply to meet the need of Lean Assembly “just-in-time” which is only possible if Lean Design can feedforward and Lean Assembly feedback Lean Supply “just-in-time”. Ballard (2000a) promotes multiskilling in shops and site installation, changing the front-line supervisor’s role to coaching and managing improvement from giving orders, in-process inspection in shops and on site and incorporation of First Run Studies into site assembly.

In order to make ethe demolition phase more lean, traditional “Demolition” methods shall be abandoned and “Deconstruction” method, which allow the selection, separation, reuse and recycling of the material, should be preferred in the sector. For this purpose, the "Make-To-Order" approach could be apllied to deliver recyclable and usable materials to enduser. “Make-

To-Order" is a pull system similar to JIT. "Make-To-Order" method is the most suitable method for building deconstruction projects actually means that using the Pull-planning principle in building deconstruction projects would yield highly efficient results, since the inventory is minimum. (Marzouk et al. 2019)

Last Planner System: One of the tools that are commonly used in lean and agile management is the Last Planner System. LPS is the most known tool of lean management in planning and design phase of construction. LPS is a method that aims to succeed the lean goals like decreasing waste and obscure parts of construction, and increasing productivity. The goal of LPS is that succeeding these aims with making plans and collabrative excution by responsible individuals for final assignmet of work (Ballard et al. 2009). LPS, is the making of promises—or commitments—by individuals to do something within a specified amount of time LPS is a method that simply formalizes the coordination process in a planning context to help focus the attention of individuals involved in work, regarding what the project aims are and how best to succeed it through teamwork and collaboration (Tilley, 2005).In the construction phase, traditional planning systems schedule the project with a push-driven approach. Executions of the activities are decided without taking into account what else can be done. On the other hand, LPS distinguishes activities that will be performed from the activities that should be performed (Ballard, 2000b). In a study conducted by Heinonen & Seppänen (2016), Last Planner System is implemented for a refurbishment project. The results show that productivity increased to 380% of baseline, quality defect reduction of 99%, as well as the project lead time reduction of 73% (Heinonen & Seppänen, 2016).

5 Whys: During the initiation phase, Tsao et al (2000) studied to improve the installation of metal door frames at a prison project by considering lean and agile perspective. In the study, they try to understand how to eliminate the time consuming process on future projects. In order to solve this case, they tried to use 5 WHYs, which is a practical technique to determine root causes. By reviewing and trying to improve the system, the method statement of an installation could be improved and it could be embedded to the process in the beginning for future projects. Also by implanting a solution to a method in the beginning of the project is directly affects the design, manufacturing and construction phases as well.

Standardization: According to Picchi et al (2004) , standardization is also an important tool while applying lean and agile methodologies. The quality standards includes Quality Management Plan, Check Lists, Quality Check Forms and Method of Statements; including their format, procedure and period, too. Method of Statement is a crucial document to define the process in the construction phase one by one and should be prepared for the first rank contract works in the beginning. Moreover, it is a good tool to perform continuous improvement by establishing systematic and improved procedure.

Value stream mapping: In the design phase, waiting for information at the stage of detailing the projects and the disruption of the work of the designers due to external variables causes the waiting time to increase. For this reason, creating a visual and accessible database allows designers to provide the necessary information when needed (Leite, Neto, 2016). Value stream mapping is a lean management tool based on visualizing the steps required from the creation of the product to the delivery to the customer. This tool helps to understand the process analysis and process improvement. According to Leite and Neto (2016) by decreasing costs and the lead time Value Stream Mapping is a beneficial method to envision how the the design is improves in the company, to indentify the several acitivties and recognize the wastes.

Set Based Design: According to, (Singer et al., 2009), Set Based Design is an application that keeps design options as much as possible during the design development process. It proceeds over not a single design solution as in the point based design, eliminating weaker options over time, identifying multiple options and researching them simultaneously (Figure 5). After considering the options, the most optimum solution is achieved by continuing with more effective solutions.

Scrum: This is a method applied in the management of complex and software projects open to change. Scrum does not explicitly state the steps to be followed during a project. Instead, it offers a flexible management style with its own rules. The most important feature of Scrum is that it aims to reveal the failing points in the process by introducing a transparent production process. In this way, it provides continuous improvement by solving the problems. It can be beneficial in the design phase, but there are various problems in using Scrum at the design stage of construction projects such as; indetifying the owner, various deliveries of work packages, unclear tasks on a scrum board, hard to usewith team of more than 20 people, teams working remotely cannot meat for a daily sprinting (Demir & Theis, 2016).

Digitalization: This is a very helpful tool in the most phases of the building lifecycle. For example, in the maintenance phase, the maintenance processes are measured, managed and analyzed by using the Computerized Maintenance Management System (CMMS). This includes the task planning and scheduling, inventory control and management, labor and material cost accounting, and historical data of the asset (Mostafa et al., 2015). The maintenance tasks are efficiently planned and executed with the usage of related softwares by CMMS to ensure the maximum uptime for the critical equipment to maintain the operations of the company (Aniki & Akinlabi, 2013). In the demolution phase, Liu and Pun (2004) brought up the idea of creating a web-based catalog where products likely to salvaged from building deconstruction were presented to the endcustomer and through that the demand can be determined comfortably, while also contributing to the planning of the demolition process.

Blockchain: Blockchain is a new developing technology that has great potential to synchronize and accelerate other industries with a lot of advantages to companies, industries, clients, and society (Nawari & Ravindran, 2019). Blockchain has a distributed network that allows us to share, recreate, and synchronize data without any geographical border. The distinctive basic feature of blockchain technology is that no center or centralized data storage exists (Perera et al., 2020). Core technologies behind blockchain are peer to peer, hashing algorithm, key cryptology, and consensus algorithm. The implementation of Blockchain technologies in the planning phase could increase effectiveness of distinctive industries, also use of several supporting tools would cause efficiencies, cultivate business manner, and promote modern technologies (Mathews, et al., 2017).

Cross Functional Process Charts: This is a tool utilized in lean construction that is used for defining implementation steps and processes. This chart includes the responsible parties on the where each responsible party fall under a "row" while two or more "columns" define the project phase (Tuholski et al., 2009) These charts may help identifying unnecessary and non-value adding steps along with complex connections between steps which can be simplified and may pass onto future works in forms of documentation and improve waste reduction with less effort which is another lean thinking aspect.

Visual Tools (heijunka box, kanban cards): Various visual tools can be used to make building lifecycle phases more lean and agile. In the casestudy conducted by Bryde & Schulmeister

(2012), to implement lean thinking in this refurbishment project selected lean approaches were applied including: minimizing stock held on site: JIT delivery of materials, pull-driven scheduling: heijunka box, levelling of workload: process mapping and analysis of performance indicators, visual management: floor plans as well as kanban cards, team work: weekly meetings . The implementation of visual management strategies such as visual zoning of the site with using the heijunka box, performance charts as well as kanban cards and conducting of structured weekly meetings were found as successful to refurbishment project in terms of collaborative teamwork as well as empowerment of workers especially (Bryde & Schulmeister, 2012). The considerations of cultural, project-related as well as human-related issues play a critical role to accomplish lean targets during the application of lean thinking in refurbishment projects.

Conclusion and Discussion

After reviewing 312 articles on lean and agile management systems, it could be concluded that using lean and agile definitely affects the building production in a positive manner. However, use of these methodologies is very primitive and not at all at full capacity. In summary the points below could be made for this study:

1. Lean management is more commonly used than agile management in the industry and therefore there is more research on the benefits of lean management.
2. Amongst the tools of lean and agile management BIM is the most commonly used system followed by LPS, JIT and standardization. The reason BIM is most commonly used is that it allows a holistic project management system.
3. BIM is not directly an agile or lean tool. It has been used way before these management styles were integrated into construction. Since BIM optimizes the building process it aurtomatically serves some aspects of lean and agile management.
4. Tools vary according to the phase they are used in. Organizational tools and visual tools are mostly used in the begiingng phases such as initiation, planning design etc. whereas tools to make the production / assembly easier are used in the construction, maintenance, reuse and demolition phases.
5. Most businesses incorporate some sort of lean and agile management into their project without even realizing that those methods are lean / agile.

It should not be forgotten that lean and agile management are fairly new concepts and there are new research and tools conducted everyday. This study is just a review of what has been established so far and not what could be done in the future. As the use of lean and agile becomes more common, the approach towars these management styles would also change.

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