Lean Integrated Design & Production

Master of Science in BIM and Digital Built Environment
Supervised: Dr. Mustapha Munir

By: Solomon Tesfaye
April 2025, Manchester

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Lean application to a Design firm

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(~ 6600 words used)

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What to Expect

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Abbreviations and Acronyms

Abbreviation or acronym	Term
AACLDMB	Addis Ababa City Land Development and Management Bureau
AIR	Asset Information Requirements
BIM	Building Information Modeling
CDE	Common Data Environment
CI	Continuous Improvement
EIR	Exchange Information Requirements
ISO	International Organization for Standardization
KPI	Key Performance Indicator
LT	Lead Time
JIT	Just-In-Time
PDCA	Plan-Do-Check-Act
LC	Lead Time
PFI	Private Finance Intiative
PIR	Project Information Requirements
PM	Project Manager
PT	Processing Time
RFI	Request for Information
TPS	Toyota Production System
VSM	Value Stream Mapping

Table 1. Abbreviations and acronyms

1. Introduction

1.1. Lean Thinking

Lean thinking is a strategic method emphasising on process optimisation, waste reduction, and efficiency maximisation to improve value creation. Originating from the Toyota Production System (TPS), Lean Thinking was developed in the middle of the 20th century by Taiichi Ohno as a means of enhancing manufacturing processes by methodical problem-solving, workflow optimisation, and employee empowerment (Ohno, 1988). Lean has been effectively evolved outside manufacturing since then, finding uses in sectors including healthcare, construction, and professional services, so confirming its general value in enhancing operational performance (Womack & Jones, 2003).

Fundamentally, Lean Thinking is based on the ongoing quest of improvement often referred to as Kaizen which encourages iterative problem-solving to propel small efficiency increases. With seven waste types (overproduction, waiting time, transportation, overprocessing, inventory, motion, and defects), the approach gives eliminating waste (Muda), top priority. Through methodically addressing these inefficiencies, companies can raise production and foster operational excellence (Liker, 2004). Lean Thinking also incorporates Just-in- Time (JIT) ideas to guarantee that resources are given when needed, thereby lowering needless stockpiling and enhancing workflow synchronising. Another basic feature is Jidoka, which stresses the automation of quality control so enabling workers to spot and fix flaws in real-time, so guaranteeing process dependability (Ohno, 1988).

1.2. Lean Principles

Lean Thinking's foundation consists of a set of ideas that direct its application. Lean management across many sectors is based on five fundamental Lean concepts that Womack and Jones (2003) have created. These ideas cover spotting value from the customer's point of view, mapping the value stream to cut non-value-added activities, generating a continuous flow to minimise bottlenecks, building pull systems to control production depending on demand, and aiming for excellence by means of ongoing development. These ideas together provide a methodical approach to process optimisation, making sure that every phase adds to the end value given to the consumer.

Jeffrey K. Liker (2004) expanded on Lean Thinking by stressing the 14 Toyota Way principles grouped into four main themes: philosophy, process, people and partners, and problem-solving. The part on philosophy emphasises the need of sustainability and long-term vision over transient financial success. The process component emphasises on effective workflow design, standardised work methods, and error reduction measures including a method of mistake-proofing called Poka-Yoke, Emphasising respect for individuals, cooperative teamwork, and employee empowerment to take responsibility of problem-solving, the people and partners component focusses Finally, the component on issue-solving encourages the application of systematic problem analysis, data-driven decision-making, and initiatives for constant improvement including Plan-Do-Check-Act (PDCA) cycles.

Womack's five Lean principles and Liker's fourteen Toyota principles taken together offer a complete Lean implementation tool. Although Womack and Jones offer a high-level road map, Liker's ideas provide thorough implementation plans that help companies negotiate the complexity of operational change. These models together guarantee that Lean adoption is both strategic and pragmatic, enabling companies to apply sustained efficiency gains and build an innovative culture by means of Lean adoption.

Emphasising value-driven decision-making, process optimisation, and ongoing development, the five Womack and Jones (2003) principles highlight among them are:

- **Identifying Value:** This means determining what really matters to clients and cutting out events unrelated to those value.
- **Value Stream mapping** is a technique for assessing and enhancing process by separating between value-adding and non-value-adding actions.
- **Establishing Flow** so that work moves without interruptions or bottlenecks.

Pull establishes by matching production with actual demand helps to reduce overgeneration.

- **Perfecting** oneself by means of an ongoing effort to eradicate inefficiencies and maximise performance.

Although these ideas offer a strategic summary of Lean Thinking, they also depend on pragmatic implementation techniques to be successful. Liker's 2004 formulation of the 14 Toyota Principles listed in Table 2 provides such a framework by grouping Lean concepts into four main areas: Philosophy, Process, People & Partners, and Problem-Solving.

Table 2. Summary of the 14 Lean Principles by Liker (2004).

Category	Toyota Lean Principles	Explanation
Philosophy (Long-Term Thinking)	**1**. Base management decisions on a long-term philosophy, even at the expense of short-term financial goals.	Lean organizations prioritize long-term value over short-term gains. This philosophy ensures sustainable growth by fostering a culture of quality and efficiency rather than immediate profit maximization (Liker, 2004).
Process (Eliminate Waste & Ensure Flow)	**2**. Create continuous process flow to surface problems.	A smooth and uninterrupted process flow is essential for efficiency. Bottlenecks and delays often conceal inefficiencies, so identifying and addressing them leads to improved performance (Liker, 2004, Womack & Jones, 2003).
	3. Use "Pull" systems to avoid overproduction.	Overproduction leads to waste in terms of resources and storage. A pull-based system ensures that production is aligned with real-time demand, reducing excess inventory and increasing responsiveness (Liker, 2004, Womack & Jones, 2003).
	4. Level out the workload (Heijunka) .	Workload balancing prevents inefficiencies caused by uneven production scheduling. By standardizing output and avoiding sudden spikes in workload, organizations can ensure stability and efficiency (Liker, 2004).
	5. Build a culture of "Right First Time" (Stop to fix problems).	Quality should be embedded in processes, with an emphasis on preventing defects rather than fixing them after they occur. This aligns with the Jidoka principle, where automated error detection halts production until issues are resolved. (Liker, 2004, Ohno 1988).

Category	Toyota Lean Principles	Explanation
	6. Standardized tasks are the foundation for continuous improvement.	Standardization of work ensures consistency, repeatability, and efficiency. Well-defined processes make it easier to identify areas for improvement and reduce variability (Liker, 2004).
	7. Use visual control so no problems are hidden.	Visual management tools such as Kanban boards, dashboards, and status indicators make inefficiencies visible, allowing teams to identify and resolve issues proactively (Liker, 2004, Womack & Jones, 2003).
	8. Use only reliable, thoroughly tested technology.	Technology should support Lean principles rather than introduce new inefficiencies. New tools should be carefully tested before implementation to ensure they align with the organization's workflow (Liker, 2004, Ohno 1988).
People & Partners (Respect & Teamwork)	**9**. Grow leaders who live the philosophy.	Lean leadership is critical for fostering a culture of continuous improvement. Leaders should not only understand Lean principles but also embody and promote them within the organization (Liker, 2004).
	10. Develop exceptional people and teams who follow the company's philosophy.	Employee development and teamwork are integral to Lean success. Organizations should invest in training programs and encourage collaborative problem-solving (Liker, 2004).
	11. Respect partners and suppliers by challenging them to improve.	Lean organizations work closely with suppliers to ensure quality and efficiency throughout the supply chain. Collaboration and continuous improvement extend beyond internal processes (Liker, 2004).
Problem-Solving (Continuous Improvement & Learning)	**12**. Go and see for yourself to thoroughly understand the situation (Genchi Genbutsu) .	Decision-makers should engage directly with operations to gain firsthand knowledge of challenges. This prevents reliance on second-hand reports and fosters a deeper understanding of issues (Liker, 2004).
	13. Make decisions slowly by consensus, thoroughly considering all options (Nemawashi) .	Lean emphasizes careful, data-driven decision-making. Consensus-building ensures that all stakeholders are considered before implementing significant changes (Liker, 2004, Womack & Jones, 2003).
	14. Become a learning organization through relentless reflection and continuous improvement (Kaizen).	Lean organizations encourage constant learning and adaptation. Regular reflection on past experiences leads to ongoing process refinements and greater efficiency (Liker, 2004, Ohno 1988).

1.3. Lean construction

Lean Thinking's use in the building sector has resulted in Lean Construction, a field aimed at raising project efficiency, lowering costs, and strengthening stakeholder cooperation by means of its principles. Conventions in construction often suffer from inefficiencies like material waste, poor communication, scheduling problems, and rework. Lean Construction optimises processes and reduces waste by including Lean concepts into design, planning, and construction phases, therefore addressing these problems (Koskela, 2000).

Value Stream Mapping (VSM), one of Lean Construction's fundamental approaches, entails a whole construction process analysis to find inefficiencies and streamline processes. Through the mapping out of value-adding and non-value-adding activities, building companies can reduce waste and enhance resource allocation. Just-in-Time (JIT) delivery is another important idea since it guarantees that labour and supplies arrive exactly when needed, therefore lowering inventory costs and site traffic congestion (Aziz & Hafez, 2013). Integrated Project Delivery (IPD) also encourages cooperation among architects, engineers, and contractors starting the project, therefore avoiding expensive rework and schedule problems (Ballard & Howell, 2003).

By allowing real-time coordination and clash detection, the introduction of digital technology including Building Information Modelling (BIM) has improved Lean Construction even more. By use of a shared digital model, BIM helps interdisciplinary teams to cooperate, therefore assuring that design differences are found and corrected before building starts. This integration increases project execution accuracy and greatly lowers request for information (RFIs). Lean Construction ideas such Last Planner System (LPS) also improve project scheduling by encouraging proactive planning and team responsibility, thereby lowering delays and raising efficiency (Hamzeh, Ballard, & Tommelein, 2009).

Lean Construction helps companies to achieve better sustainability, reduced project costs, and increased production. Lean ideas used methodically in construction not only increases operational efficiency but also promotes a culture of ongoing improvement, therefore guaranteeing long-term competitiveness in an ever more complex and dynamic sector.

1.4. Benefits of Lean

Adoption of Lean principles in several sectors has brought about notable advantages including improved quality, cost reductions, and more efficiency. Lean's capacity to eliminate waste in processes helps one of its main benefits: it maximises resource use and lowers running costs by so optimising the use of resources. Simplifying processes and removing pointless procedures helps companies to reach higher production with less resources, hence increasing profitability.

Lean also improves process effectiveness and adaptability, enabling companies to minimally disrupt their adaptation to changing market needs (Womack & Jones, 2013). Just-in- Time concepts guarantee that resources and commodities are exactly available when needed, therefore lowering waste and excess inventory and enhancing supply chain coordination by means of precise availability. Lean also promotes Kaizen, a culture of ongoing development that helps staff members find inefficiencies and help processes to be optimised (Liker, 2004).

Better quality of goods and services is another main advantage of Lean. Lean guarantees that mistakes are found and corrected at the source by including quality control systems into processes (Jidoka), therefore lowering rework and faults. This emphasis on quality not only raises consumer happiness but also helps to lower long-term expenses related to inferior products.

Especially in diverse fields like design and construction, lean also fosters cooperation and teamwork. Lean lessens misalignment and improves project results by supporting cross-func-

tional collaboration and group decision-making. Lean approaches such Integrated Project Delivery (IPD) help to better coordinate stakeholders in building, for instance, thereby reducing design conflicts and enhancing project schedules (Ballard & Howell, 2003).

1.5. Challenges in Implementing Lean construction

Implementing Lean Construction faces significant challenges, including a lack of industry knowledge leading to inappropriate applications (Vernikos et al., 2014; Nguyen et al., 2020). Traditional contracts, rigid deadlines, and varying legal constraints across states further hinder its adoption (Bygballe et al., 2018; Daramsis et al., 2018). Cultural resistance rooted in traditional norms exacerbates these difficulties, necessitating strong leadership and collaborative efforts (Monyane et al., 2018). Fragmented teams, communication barriers, and space constraints in complex projects disrupt workflows and limit Lean efficiency (Daniel et al., 2016; Wondimu et al., 2017).

1.6. Purpose of the Report

Fasil Giorghis Consult, a multidisciplinary design firm specializing in architecture, heritage conservation, and engineering services, is facing operational inefficiencies that threaten its reputation and financial stability. Once known for its inventiveness, the company today faces problems including inadequate time for design, bad scheduling, expensive changes brought on by design conflicts, unequal task distribution, and poor knowledge transfer. These difficulties point to major waste and need the application of Lean Thinking to simplify processes, increase cooperation, and maximise resource use. Lean tools such Value Stream Mapping, Just-in- Time scheduling, and Kaizen help the company to critically assess its design process. It suggests a Lean-based process model fit for the company's requirements and points up the underlying reasons of inefficiencies. To guarantee sustainability, the paper also offers a continues improvement framework and a methodical implementation approach. The ultimate aim is to enable leadership to increase output and bring back the firm's excellence in engineering and multidisciplinary design.

2. Critical evaluation of the current process

2.1. Contextual Overview

Long acknowledged as a leader in multidisciplinary design, Fasil Giorghis Consult is renowned for its innovative, context-sensitive architectural concepts. The firm's portfolio shows a dedication to mix technical correctness with creative expression across architecture, historical preservation, structural engineering, electrical systems, and plumbing design.

But in recent years, systematic operational inefficiencies have caused the company to see a drop in creative production and profitability. A move towards design-build and Private Finance Initiative (PFI) projects, where outside contractors often control schedules and congesting of processes is aggravating this difficulty. These conditions have hampered design innovation, slowed outputs, and hampered teamwork.

Notwithstanding these difficulties, Fasil Giorghis Consult is committed long term to protect architectural heritage, promote multidisciplinary cooperation, and provide design and technical excellence. The company respects cultural awareness, staff professional growth, and continual execution of excellent, significant solutions to clients. This guiding concept can help to put long-term value creation, structured improvement, and lean thinking's emphasis on purpose-driven decision-making first over transient benefits that will be discussed in the next sections. Currently, the firm is structured as follows:

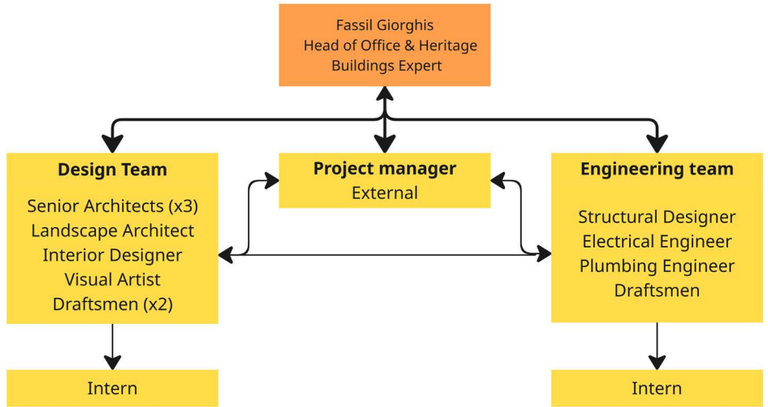


Figure 1. Company structure at Fasil Giorghis Consult.

2.2. Firm's Current Process

2.2.1 Overview of Operational Inefficiencies

Fasil Giorghis is Once known for its creative design solutions, Consult is now dealing with a variety of operational inefficiencies affecting project execution and general effectiveness. These include too much time spent on troubleshooting, unstructured scheduling resulting in inconsistent deadlines, design interferences resulting in expensive changes, poor task distribution generating workload imbalances, and little knowledge transfer between experienced and junior workers. These problems mirror major Lean wastes like underutilisation of talent (Muda), overprocessing, unevenness (Mura), flaws, and overburden (Muri). Dealing with them calls for Lean ideas applied to improve interdisciplinary cooperation, streamline processes, and maximise resource allocation.

2.2.2 Impact of Timeline Misalignment and Rework

Common misalignments between team coordination and project schedules have caused significant disruptions. Last-minute contractor-led revisions by senior architects often force draughtsmen to recreate drawings an example of defect waste (Muda), since it uses time without contributing value. Structural, electrical, and plumbing teams left waiting for revised plans show waiting waste (Muda) resulting from idle resources when these delays trickle into adjacent fields.

2.2.3 Downstream Effects on Engineering Disciplines

Regular incomplete or outdated designs from the structural designer force constant revisions in computations. This not only shows defect waste (Muda) but also helps to overprocess since developers spend time fixing preventable

problems. Similar challenges exist for electrical engineers; designing based on unstable floor plans results in redesigns once more reflecting both flaws and overprocessing.

2.2.4 Revisions and Overburden in Plumbing Design

Shifting layouts and fixture placements demands continual adjustments under strict timelines, which sometimes overburdens plumbing engineers (Muri). Muri in Lean systems defines stress, inefficiencies, and increased risk of errors resulting from this repetitive last-minute activity.

2.2.5 Effects on Construction Phase and Supporting Designers

The inefficiencies reach construction, where differences in design documents cause project managers to get too high RFIs. Usually working in later stages, landscape and interior designers suffer from limited time, which compromises their capacity to provide excellent products. This illustrates Mura (unevenness), whereby unequal planning causes some roles to be underused while others become overburdened.

2.2.6 Underutilization of Junior Staff and Mentorship Breakdown

Unclear job delegation leaves junior designers and interns without assignments, which causes underutilisation of human potential. Senior staff members, meantime, are overburdened with critical changes (Muri). This disparity compromises internal capacity-building by upsetting mentoring and restricting knowledge-transfer possibilities.

2.2.7 Strategic Shifts and Process Misalignment

Although financially advantageous, the firm's strategic move towards design-build contracts has heightened internal inefficiencies by giving external deadlines first priority at the expense of internal process flow. Lean concepts like pull-based systems and workflow synchronisation (Ohno, 1988) show a mismatch between operational capacity and strategic direction.

2.2.8 Current State Mapping

To find ongoing inefficiencies in a typical residential project overseen by Fasil Giorghis Consult in Addis Ababa, a current-state value stream map was created. The process starts with a client acquiring a land ownership certificate from the Addis Ababa City Land Bureau and turning in a vague design brief. The project manager (PM) assigns a top architect who re-orders the certificate and does site and regulatory investigation. Usually taking 60 days, the PM files the certificate and asks the sub-city land office for land survey and regulation data due to delays. After then, the architect creates a conceptual design and starts a feasibility study that the PM sends to utility offices with a 30-day response period. Once inputs are acquired, the team discusses the preliminary, landscape, and interior designs with the engineering team.

Engineers start their design with the basic package, survey, and feasibility information. The PM manages building regulations and procurement at the same time, therefore assisting the last design phase. The senior architect compiles the final designs, sent to the construction permit office, by combining all inputs. Because of constant changes, this phase can last up to ninety days. Delays include informal communication, overabundance of coordination for top staff, and underutilisation of juniors including draughtsmen and interns. With only 60 days of actual processing and a 264-day lead time, the process shows Muda (waste), Mura (unevenness), and Muri (overburden), therefore stressing the need of reform as described in Section 3.

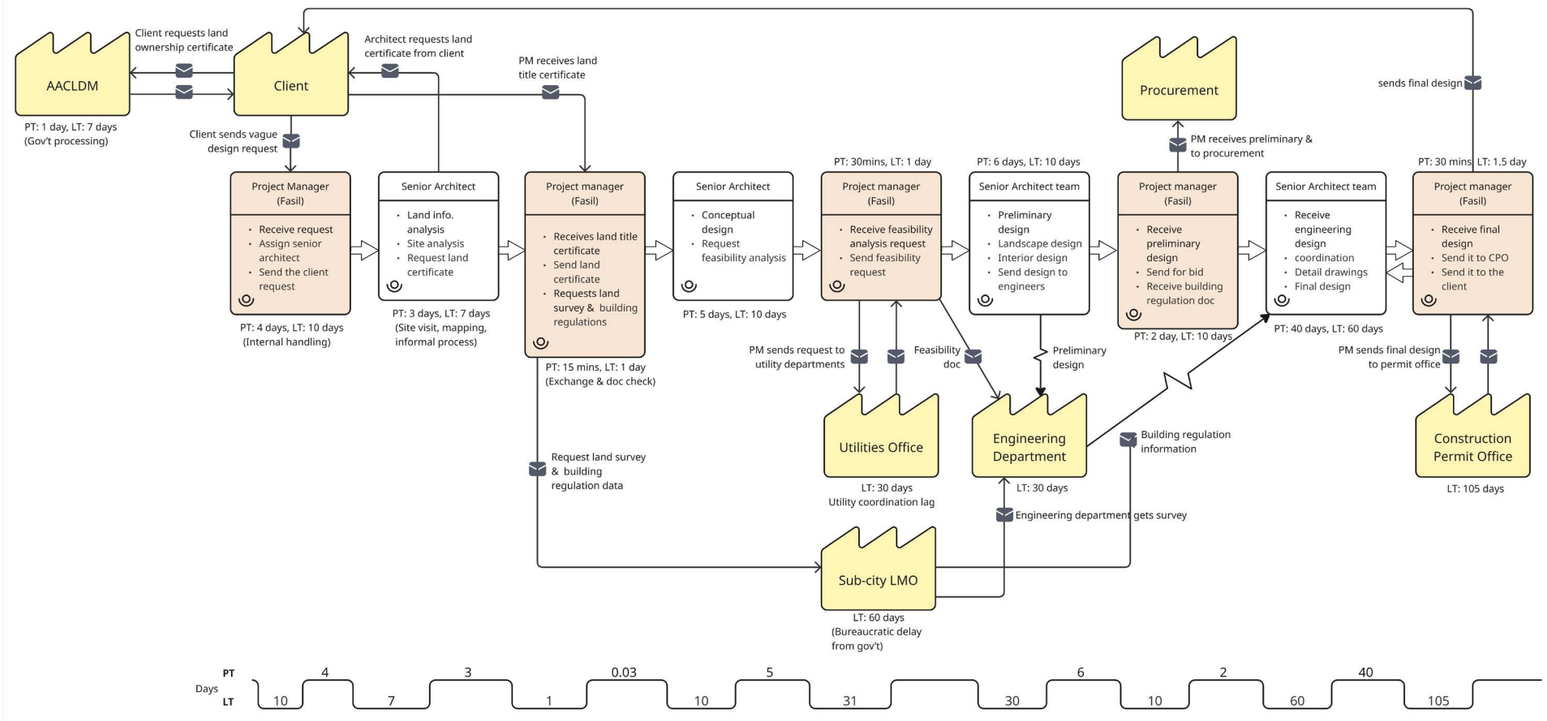


Figure 2. Current Value Stream Map of the firm.

2.3. Fishbone analysis

Fishbone (Ishikawa) diagrams were created to methodically identify the main causes of reoccurring inefficiencies at Fasil Giorghis Consult. Six domains; People, Process, Technology, Management, Client/External Factors, and Resources which allow this visual tool (Figure 3) to classify many reasons into a whole picture of systemic failures influencing operational efficiency and creative output. These inefficiencies also fulfil the Three Ms of Lean: Muda (waste), Mura (unevenness), and Muri (overburden), therefore showing how non-value-added operations lower profitability and restrict innovation.

· People

The workforce of the company suffers with ambiguous roles, which results in overlapping jobs or important responsibilities missing through gaps. Junior designers often lack structured mentorship, which limits their professional growth and results in lost potential, a clear case of underutilization waste (Muda). Senior staff, on the other hand, are overburdened with project oversight and troubleshooting, leaving little room for strategic or high-value design work, which contributes to overburden (Muri). This imbalance stifles collaboration, as experienced designers are unable to allocate time for training, ultimately weakening the transfer of knowledge and skills within the firm.

· Process

Workflows at Fasil Giorghis Consult are reactive rather than structured, leading to inefficiencies and delays. The absence of standardized protocols forces designers to make frequent last-minute adjustments to accommodate client changes or delayed inputs from other disciplines. For example, structural engineers often revise their plans multiple times due to incomplete or outdated architectural schematics, resulting in rework and wasted resources (Muda - defect waste). Additionally, teams frequently work with outdated information due to the lack of a formal input management system, leading to waiting waste (Muda). Uneven task distribution (Mura) aggravates inefficiencies since certain departments stay underused while others show too much demand.

· Technology

The company greatly reduces efficiency by depending so much on antiquated design technologies as email-based coordination and 2D CAD software. The absence of Building Information Modeling (BIM) for integrated design collaboration leads to undetected clashes between architectural, structural, and MEP designs, increasing the number of design conflicts that require costly revisions (Muda - defect waste). Informal communication channels further delay updates, requiring designers to spend unnecessary time tracking project changes across disjointed platforms, creating additional waiting waste (Muda). Moreover, repetitive manual tasks such as redrawing elements that could be automatedcontribute to overburden (Muri) by increasing the workload of technical staff unnecessarily.

· Management

Leadership practices within the firm prioritize external deadlines set by contractors, rather than internal workflow optimization. This issue is particularly evident in PFI projects, where project timelines are often accepted without negotiation, leading to unrealistic deadlines that strain internal teams (Mura - unevenness). The lack of proactive leadership results in an absence of accountability for process improvements, leaving inefficient workflows unaddressed and reinforcing operational waste (Muda). Additionally, the failure to monitor workloads effectively results in an imbalanced distribution of tasks, with some staff being overwhelmed while others remain idle, further contributing to unevenness (Mura).

· Client/External Factors

Clients frequently submit unstable briefs with vague requirements, leading to frequent revisions and inefficiencies throughout the design process. Late-stage decisions, such as material substitutions or layout changes, disrupt established workflows and force unnecessary rework (Muda - over-processing waste). In design-build projects, contractors dictate project schedules without consulting the firm, reducing designers' control over their own timelines and increasing operational unpredictability (Mura - unevenness). These external factors further exacerbate the firm's internal inefficiencies by forcing teams to accommodate unpredictable shifts in project scope and execution.

· Resources

Critical project inputs, such as site surveys and client specifications, are frequently incomplete or missing at the project kickoff stage, leading designers to rely on assumptions. This results in significant rework when assumptions prove incorrect, adding to defect waste (Muda). Additionally, the firm lacks a structured system for reusing knowledge from past projects, meaning that designers often need to solve problems that have already been addressed in previous work. This redundancy leads to over-processing waste (Muda) and reduces overall efficiency. Furthermore, the absence of task-tracking tools prevents managers from monitoring workloads and redistributing tasks efficiently, leading to inefficient resource utilization (Mura).

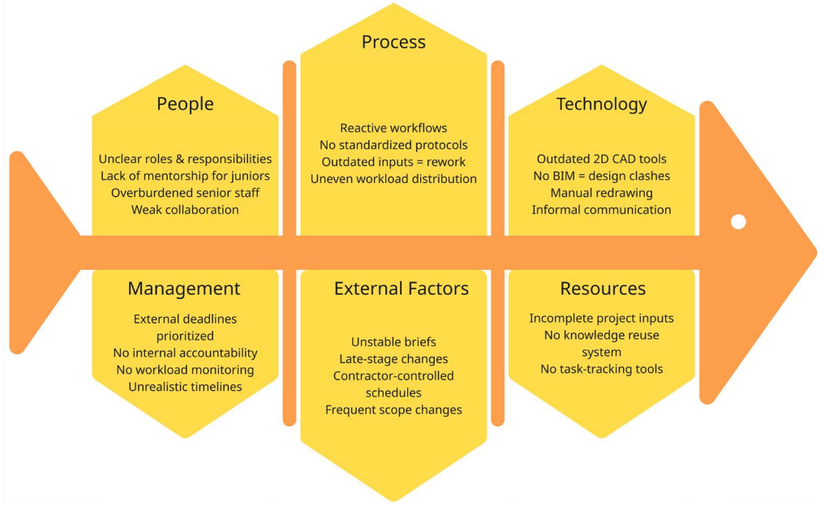


Figure 3. Ishikawa Diagram for the problems analyzed.

2.4. In-depth Root Cause Analysis through 5 Whys

While the Fishbone Diagram in the previous section offers a whole classification of the inefficiencies influencing the company, the following section employs the 5 Whys technique to investigate the underlying causes of particular, highly impactful problems in more depth shown in table 3 below.

Table 3. Five Whys Summary Table. Note: **>** represents the word "Why".

Problem	5 Whys Summary	Root Cause
No time for creative design tasks	Waiting/troubleshooting **>** Delayed/incomplete inputs **>** No structured input process **>** Ad-hoc communication **>** Management prioritizes deadlines	Lack of standardized workflows and over-focus on external deadlines
No responsibility for design schedule	No responsibility **>** Unclear roles **>** No accountability defined **>** Contractors expected to schedule **>** No internal project management capacity	Lack of project management training and role development
Constant client changes & delays	Frequent changes **>** Unclear briefs **>** Unstructured engagement **>** No client workshops **>** Speed prioritized over planning	Rushed project starts without thorough client engagement
Design starts by chasing inputs or assuming	Inputs missing **>** No input schedule **>** No mapped dependencies **>** No process documentation **>** No continuous improvement	Lack of process mapping/documentation causing reactive workflows
Drawing clashes & RFIs	Interference **>** Siloed work **>** No collaborative review **>** No BIM use **>** Resistance due to no training/resources	No investment in BIM/collaborative tools or supporting training
Ineffective task allocation	Poor allocation **>** No workload monitoring **>** No tracking system **>** Informal methods **>** Management underestimates the issue	No task management system or tool in place
Poor knowledge transfer	No mentorship **>** No time **>** Tight schedules **>** Over-commitment **>** Revenue prioritized over capacity building	Short-term revenue focus at the expense of mentoring

3. Development of a Target Process

· The Central Role of Standardized Workflows

The comprehensive 5 Whys study carried out in Section 2.4 exposed that a great range of operational inefficiencies at Fasil Giorghis Consult converge on one basic problem: the lack of standardised workflows and structured process management. This underlying cause drives a series of problems compromising the firm's capacity to provide original, excellent design solutions quickly.

In the case of "No Time for Creative Design Tasks," for instance, the 5 Whys study found that designers routinely waste time waiting for, or debugging, inadequate or inconsistent inputs. This path of inefficiency results from a deformed system for management and input scheduling. Without a consistent workflow, communication falls to ad hoc interactions, which causes delays, rework, and less capacity for creative inquiry.

Likewise, the problem of "No Ownership of Design Scheduling" surfaced from ambiguous roles and responsibility, stemming mostly from the absence of well-defined processes. This gap allows outside vendors especially designers in design-build projects to enforce strict timetables, therefore driving the internal team into reactive forms of functioning. Strategic planning and creativity are thereby subordinated to crisis response.

From delayed decisions and job repetitions to poor cross-disciplinary cooperation, this common theme runs across many problem areas. In every scenario, the absence of process standardising functions as the shared denominator. The company suffers to attain flow a basic Lean principle and incurs significant loss in time, effort, and opportunity without well defined, recorded processes.

From a Lean standpoint, this immediately runs counter to Liker's principle #6, which stresses the requirement of standardised activities as the foundation for improvement and empowerment and breaches the notion of producing value by continuous process flow (Womack & Jones, 2003). Apart from hindering operational efficiency, the lack of consistency in the present system limits learning, development, and creativity on all spheres of the company.

Thus, reinforced by additional Lean concepts from Liker's framework to fill certain operational gaps, the goal system suggested in this section is organised around standardised processes as the main catalyst for transformation. Grounded in this methodology, the following matrix (Table 4) offers a set of problem-solution pairs.

Problem	Root Cause	Lean Principle Applied	Proposed Target Process
No time for creative design tasks	Lack of standardized workflows and over-focus on external deadlines	Principle #6 – Standardized Tasks	Develop and enforce structured input workflows, including stage gates, input readiness checklists, and synchronized timelines to ensure early clarity and reduce troubleshooting mid-process.
No responsibility for design schedule	Lack of project management training and role development	Principle #9 – Grow Leaders Who Understand the Work	Introduce internal project management roles with clear scheduling responsibilities. Train mid-level staff in Lean-based coordination, schedule tracking, and communication.
Constant client changes & delays	Sacrificing thorough client engagement for quick starts to meet deadlines	Principle #11 – Respect Your Extended Network of Partners	Institutionalize pre-design client engagement workshops. Implement signed-off design briefs and a formal change request log to manage scope fluctuations.

Table 4. Problem-Solution Matrix with respective Lean principles.

Problem	Root Cause	Lean Principle Applied	Proposed Target Process
Design starts by chasing inputs or assuming	Lack of process mapping/documentation causing reactive workflows	Principle #2 – Create Continuous Process Flow	Map all input dependencies at project initiation. Introduce visual input schedules and enforce minimum viable inputs before starting design. Use Kanban to manage flow.
Drawing clashes & RFIs	No investment in BIM/ collaborative tools or supporting training	Principle #8 – Use Technology to Support People	Adopt BIM as a standard coordination tool. Provide training for multidisciplinary teams and schedule clash-detection reviews before key milestones.
Ineffective task allocation	No task management system or tool in place	Principle #6 – Standardized Tasks	Deploy a role-based task management platform (e.g., Trello, Jira). Define task ownership with WBS elements, and track progress weekly in stand-ups.
Poor knowledge transfer	Focus on short-term revenue, neglecting mentorship/capacity building	Principle #14 – Become a Learning Organization	Develop a digital knowledge repository with templates, lessons learned, and process guides. Schedule regular knowledge-sharing reviews and mentoring cycles.

3.1. Standardized Target Process

A Standardised Target Process integrating three fundamental components (Figure 4) People, Procedure, and Tools, anchors the suggested improvement. The People dimension stresses clearly defined roles like the Lean Lead and promotes mentoring and leadership development, which are absolutely essential for encouraging ownership and maintaining knowledge flow over the team. Procedure is the arrangement of work comprising the application of a formal customer engagement strategy, a consistent workflow implementation, and a continuous improvement (CI) framework. This guarantees that every chore is arranged correctly, that duties are unambiguous, and that quality is maintained throughout along the project life. To enable real-time collaboration, lower communication lags, and guarantee data accessibility, the Tools aspect brings BIM, Kanban, and digital repositories among other enabling technologies. These three elements taken together support a repeatable process flow rooted in Lean concepts.

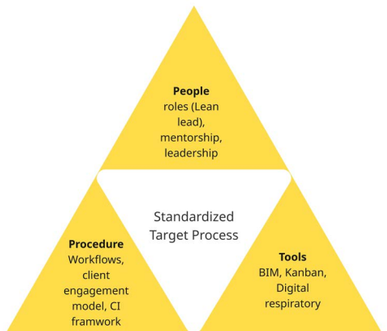


Figure 4. Standardized Target process that involves People, Procedure, and Tools.

3.2. Integrated Digital Collaboration and Input Management

The inadequate coordination of inputs amongst disciplines has been another main cause of inefficiency. Often the absence of an input management system leads to late-stage design clashes, too many changes, and missed deadlines. The goal process presents integrated digital collaboration tools that impose a just-in- time (JIT) approach, lower handoff delays, and enable real-time data sharing to help to solve this.

Building Information Modelling (BIM) offers a shared digital space where cross-disciplinary cooperation is improved, and design discrepancies can be found and fixed early on. Concurrently, a Kanban-based input tracking system helps teams control input readiness and view workflow status, therefore guaranteeing that activities are begun only when absolutely necessary. These instruments, together with stage-specific input checks, produce a structured, pull-based system that aligns work with availability, lowers friction, and improves predictability all around the value stream.

3.3. Clearly Defined Roles and Accountability

The uncertainty about project role ownership adds still another factor to inefficiencies. Unorganised task distribution, unequal workloads, and reactive decision-making resulting from unclear duties have resulted. The target process addresses this by including well defined roles ingrained in the workflow.

Every team member is allocated a certain role and responsibility framework inside the process. Enforcing deadlines and making sure interdependent tasks are coordinated fall to project managers. Senior architects coordinate across several disciplines to guarantee harmonious architectural, structural, and MEP() features. For every phase, technical staff members including draughtsmen, engineers, and interns have well specified deliverables. A new position, the Lean Lead, is also assigned to monitor project progress and guarantee adherence to uniform policies.

Principle 9 of Liker's framework; "Grow Leaders Who Thoroughly Understand the Work, Live the Philosophy, and Teach It to Others" is supported by this disciplined division of labour. It also embodies Lean's respect-for- persons attitude by arming people with clarity and responsibility and so reducing overburden (muri) and unequal task distribution (mura).

3.4. Structured Client Engagement

Another crucial area of inefficiencies has been client contacts. Regular late-stage modifications and inadequately defined project scopes have caused scope creep, mismatched expectations, and major rework. These interruptions compromise the team's capacity to keep a steady flow in addition to timing.

This is addressed with a three-stage organised customer engagement model. Clients participate in official seminars in the pre-design stage to co-develop and record a common vision and design brief. Any asked changes are followed a formalised change management process throughout the design stage to guarantee that their cost and timing effects are evaluated before permission. At last, customers participate in milestone reviews and receive an open project road plan to guarantee alignment all through the process.

This method supports Lean's definition of value as seen from the customer's point of view. The company guarantees that value is always produced and waste from pointless changes is reduced by setting common expectations from the beginning and methodically managing change.

3.5. Continuous Improvement Framework and Knowledge Transfer

The new process design integrates a continuous improvement mechanism to guarantee that the Lean transformation stays sustainable and flexible. Any initial gains run the danger of being lost over time without organised means of adaptation and feedback. The target process presents a structure that supports ongoing education and memory of knowledge.

Weekly Kaizen meetings give team members a forum to go over previous work, pinpoint areas of process difficulty, and suggest small enhancements. A digital knowledge repository records lessons gained and best practices, therefore facilitating organisational learning and helping to minimise the loss of institutional memory. Trackable performance indicators such RFI frequency, input readiness, and turnaround time help to direct evidence-based process improvements.

Under Liker's paradigm, this system promotes Principle 14: "Become a Learning Organisation Through Relentless Reflection and Continuous Improvement." Through Kaizen integration into daily tasks, the company promotes growth, experimentation, and introspection.

3.6. Proposed State Mapping

Building on the inefficiencies found in Section 2.2.8, a future-state value (Figure 5) stream was intended to simplify the apartment project delivery process at Fasil Giorghis Consult. Under this better paradigm, the client's design request is recorded using a consistent format based on ISO 19650 Part 2 criteria (such as the AIR, PIR, and EIR), therefore guaranteeing clarity and alignment from the start. The Project Manager appoints a Senior Architect, and a Lean Lead is brought in to handle document exchanges with stakeholders including the sub-city land office, utility departments, and construction permit authority. For instance, whilst the sub-city land survey and regulation request, previously delayed by 60 days, is streamlined to 20 days due to proactive coordination, the land information and site analysis stage is now finished in five days, down from seven. To help the architect with early-stage chores, an intern is hired.

Kaizen Champions help engineers and architects create reusable content libraries and templates thereby enabling quick access of design standards and hence less repetition. Design development (preliminary, landscape, interior) is finished in 9 days (LT), for example, engineering work is finished in 20 days with better inputs and less revisions. Integration of BIM with a Common Data Environment (CDE) improves cooperation even more and helps to clear communication obstacles. Thanks to better standardising, the once up to 105-day permit process is now expected to last 40 days. Reflecting notable increases in efficiency, coordination, and flow, the lead time is lowered from 264 to 181 days overall while total processing time reduced from 60 to 53 days.

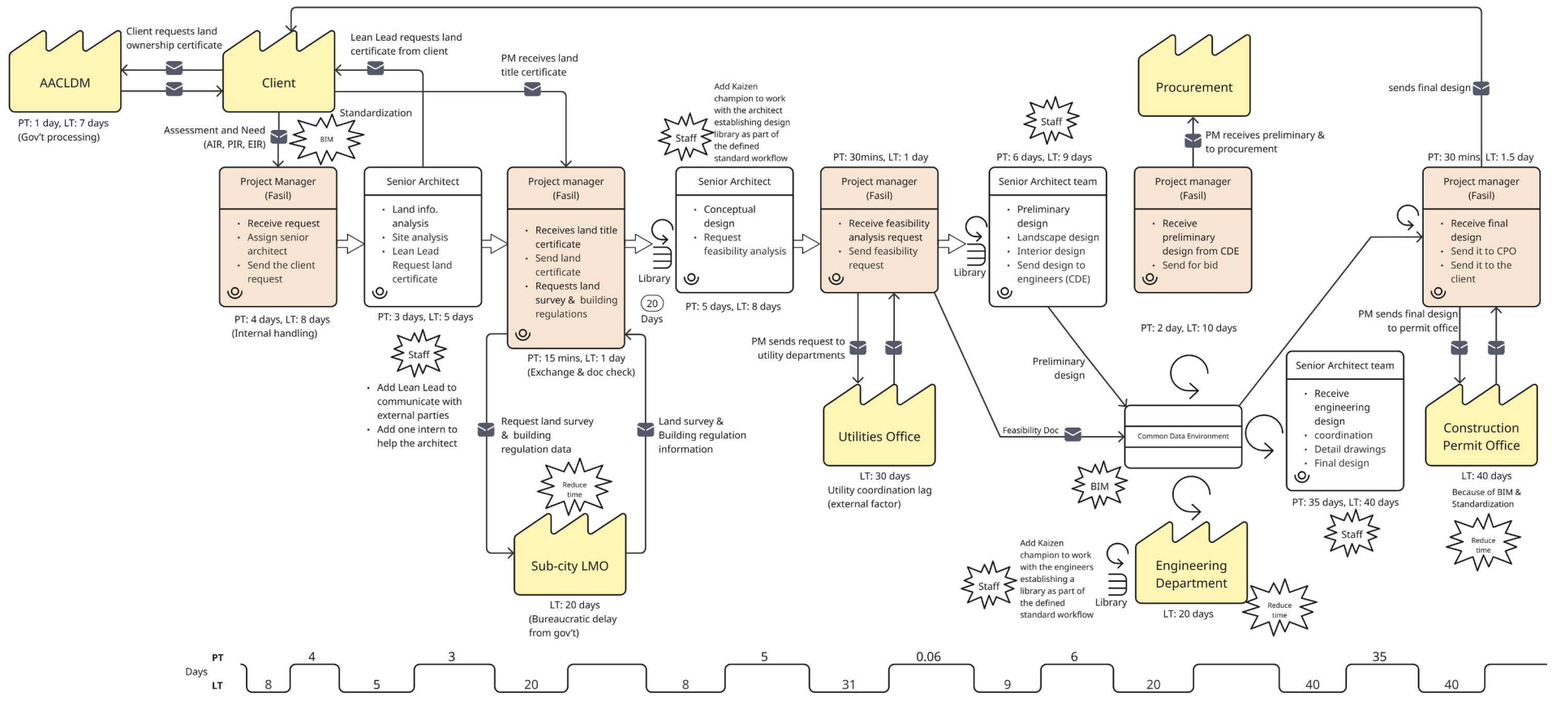


Figure 5. Proposed Value Stream Map of the firm.

4. Implementation Plans

Lean at Fasil Giorghis Consult will be implemented successfully holistically and with cultural sensitivity in line with the values, operational rhythms, and multidisciplinary design practice of the company which is more than just the introduction of process technologies. Lean may solve ingrained workflow inefficiencies such as scattered communication, poor input preparedness, and reactive scheduling without sacrificing the creative spirit of the studio as discussed in Sections 2 and 3. Inspired by Liker's (2004) Lean transformation ideas, this section offers a phased implementation road map tailored especially for the structure, dynamics, and project profile of Fasil Giorghis Consult.

This method engages leadership in creating high-level strategic alignment while acknowledging the bottom-up, deep learning needs of a design consultancy. Starting from inside projects instead of trying a surface-wide implementation, it reflects the Narrow and Deep approach suggested by Arbulu and Zabelle (2006). Moreover, it strikes a balance between the technical and cultural elements of Lean (Liker Tip 1), therefore guaranteeing that development is not only contextually suitable and sustainable but also technically efficient.

4.1. Phased Implementation Roadmap

Over the course of twelve months, the implementation plan is broken up into three successive phases. This stepwise approach supports Liker's (2004) claim that Lean adoption must "start with technical action and follow with cultural change" (Tip 1), and that real-world experimentation rather than abstract theorising starts meaningful transformation.

- **Phase 1 (Months 1–3): Pilot-Based Learning and Workflow Prototyping**

Implementation starts with a carefully chosen pilot project ideally a mid-scale, multi-consultant historic restoration or adaptive reuse project reflecting the firm's core portfolio. This project will operate as a "living lab" testing Lean concepts in a low-risk but high-learning setting, therefore allowing the team to experiment with actual workflow difficulties instead of hypothetical training scenarios (Liker Tip 2).

Beginning with value stream mapping to see and diagnose inefficiencies across the lifetime of the project, from initial concept design to final submission, including consultant collaboration, design changes, and client approvals and the pilot will visualise and diagnose (Tip 4). Co-created with the project team, this mapping will guide the development of a future state process based in both Lean logic and practical constraints.

Designed Kaizen seminars will be offered to hasten learning and create early successes. These will centre on reoccurring problems such last-minute technical design modifications (Tip 5), late input validation, and vague customer briefs. These seminars will be co-creative venues where team members tackle real bottlenecks, not top-down training courses.

The BIM coordination process will use lean principles including input checklists and Kanban boards for job visualisation. The pilot avoids disruptive technology changes by timing these Lean tools with current Revit processes, therefore promoting openness, job flow, and early issue discovery. This phase supports "learning by doing" and encourages team members' ownership, so creating the technical foundation for more general acceptance (Tips 1, 3, 5).

- **Phase 2 (Months 4–7): Scaling and Organisational Realignment**

Lean practices will be spread among several project teams after the pilot. Significantly, this suggests a contextual modification of the pilot's successes rather than a wholesale application. Lessons discovered will be first presented gradually to future projects and then codified as internal guidelines covering input readiness protocols, drawing coordination efforts, and time allocation for design-review cycles.

From siloed functional workflows (e.g., architect-only task flows) the company will start using value stream-oriented team structures where architectural, technical, and engineering collaboration is arranged around the delivery of end-to-end value (Tip 6). This change redefines how teams work, share knowledge, and track development even if the company is not completely restructured.

From the pilot team, training will grow naturally outward under the direction of internal champions. Drawn from the first phase, these people will lead hands-on onboarding and offer feedback loops, so embed Lean more successfully than external training by itself (Tips 2, 13). Training continues to be problem-oriented, anchored on actual project settings rather than theoretical seminars.

The performance measuring system of the company will also change at this stage. Lean-oriented indicators such as input availability rate, job rework levels, and client reaction lead time will balance traditional measurements including drawing counts or submission deadlines (Tip 10). These KPIs will help decisions be made, encourage lifelong learning, and highlight system-wide waste.

These days, standardising will become a pillar. Unlike bureaucracy, standardised procedures will be seen as creative enhancers that release design time and lower noise from process confusion (Tip 7). Specifically around client onboarding, consultant coordination, and weekly review cycles, the emphasis is on building flexible but consistent baselines.

Visibility of leaders has to be still robust. Not only will project leads and directors authorise Lean interventions, but they will actively participate in reviews, learning cycles, and showcases. This phase also entails matching Lean efforts with strategic corporate goals, such delivering timely, resource-efficient architecture on budget and with cultural grounding based on tips 1, 11.

- **Phase 3 (Months 8–12): Embedding Lean Culture and Leadership**

Lean joins the organisational fabric in the last step. Formalising roles like Kaizen facilitators, staff members who arrange retrospectives, keep Lean dashboards, and address cross-team inefficiencies helps to These facilitators serve more as enablers than managers; they help teams to keep always improving (Tip 12).

Weekly retrospectives and project post-mortems will become regular practices to create institutional memory. These provide teams regular venues to reflect, go over mistakes securely, and record ideas, therefore serving both learning and motivating factors. Lean showcases will be presented quarterly, when teams highlight advancements in process and design delivery, so honouring and disseminating success.

At this level, growth of leadership is underlined. Lean aptitude mid-level staff members will undergo organised coaching to equip for future strategic responsibilities, therefore transforming Lean aptitude from a one-off endeavour into a succession-ready competency (Tip 12).

The transformation narrative will stress Fasil Giorghis Consult's legacy as a disciplined, intelligent, and culturally anchored design practice so Lean is not seen as an imported business tool but rather as an extension of the architectural identity of the firm. Lean will be positioned as a modern amplification of rather than a substitute for that history (Tip 11).

The company will remain opportunistic throughout, concentrating Lean adoption on initiatives that provide visibility, complexity, or strategic valuesuch as competitor entrance or culturally sensitive commissions. These high-impact scenarios will highlight Lean's ability to increase coordination under actual stresses, lower rework, and raise design quality (Tip 9).

Table 5. Summery of anticipated challenges and response strategies.

4.2. Key Enablers of Implementation

The implementation strategy is underpinned by several enabling conditions that are essential for success:

- **Visible and Aligned Leadership**

Senior leaders have to actively support the Lean project, so highlighting its strategic relevance and taking part in early seminars. Their roles comprise those of resource distribution, conflict settlement, and cultural formation.

- **Structured Time for Improvement Activities**

Lack of time for reflective practice and ongoing improvement is a typical Lean implementation mistake. Non-billable hours at Fasil Giorghis Consult will be dedicated especially for Kaizen events, process audits, and team retrospectives. This shows a dedication to include development within the work, not to treat it as a side chore.

- **Iterative and Adaptive Change Management**

Rather having a set course, the implementation process will be seen as an adaptive trip. Every phase will include feedback systems so that the strategy changes in reaction to new ideas and contextual changes. This guarantees adaptability to the special dynamics of a creative design environment and resilience.

4.3. Anticipated Challenges and Response Strategies

Challenge	Response Strategy
Cultural resistance and skepticism	Communicate Lean not as a constraint but as an enabler of creative work. Use pilot results and peer testimonials to build credibility (Liker, Tip 8).
Low process literacy and change fatigue	Adopt a just-in-time learning approach. Avoid overwhelming staff with abstract models. Allow teams to discover Lean through real problems (Tip 2).
Metric misalignment	Transition toward outcome- and flow-based indicators. Provide clear definitions and involve teams in metric development to ensure buy-in (Tip 10).
Leadership disengagement	Formalise leadership roles in the implementation structure. Offer executive coaching on Lean thinking and sponsor regular reflection meetings.
Scaling inconsistencies	Ensure that pilot learnings are codified before wider rollout. Use internal case studies and go-and-see visits to share insights across teams.

4.4. Visual Implementation Timeline

Figure 6, a 12-month Lean implementation road map, shows Fasil Giorghis Consult's tiered strategy. Phase 1 is a pilot setup and process diagnostics; Phase 2 is Kaizen seminars, training, and structural adjustment. Phase 3, the last phase, will be implementing Lean through internal presentations and leadership development. To guarantee long-term sustainability, the road plan combines process standardising, ongoing improvement with training and cultural reinforcement.

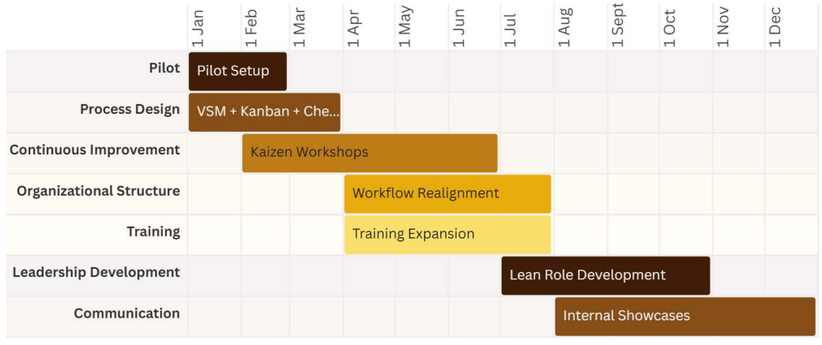


Figure 6. Timeline of the Lean implementation road map.

4.5. Risk Register

Risk	Impact	Mitigation Strategy
Staff burnout or overcommitment	High	Protect time for improvement. Limit concurrent change initiatives.
Technology integration failure	Medium	Involve IT early. Pilot test digital tools before full rollout.
Consultant dependency	Medium	Prioritise internal capability building. Use external experts only in advisory roles.
Inconsistent adoption across teams	High	Use internal champions, clear templates, and cross-team retrospectives.
Leadership turnover	Medium	Institutionalise Lean roles and document lessons to preserve momentum through transitions.

Table 6. Summary table for risk register and mitigation strategy.

5. Plans for Continuous Improvement

A defining feature of sustainable Lean transformation is the institutionalisation of continuous improvement as an embedded operational and cultural norm. For Fasil Giorghis Consult, a design consultancy operating within a complex and dynamic construction environment, continuous improvement (CI) must transcend episodic initiatives and become part of everyday practice. This requires not only methodological structure but also appropriate leadership, accountability systems, and evaluative metrics. Drawing on Kaizen principles, Lean thinking, and Jeffrey Liker's (2004) implementation guidance, this section presents a tailored, practicable plan for integrating CI into the firm's design and management systems.

5.1. Embedding Lean Through Roles and Responsibility

Fasil Giorghis Consult will use a simplified governance structure including a Lean Lead and Kaizen Champion if it is to maintain Lean transformation. Drawn from internal workers, the Lean Lead will be in charge of organising consistent processes, maintaining the digital knowledge library, and using PDCA (Plan-Do-Check-Act) cycles to propel ongoing development. Moreover, Selected internally, Kaizen Champions will help to support this job by planning reflection sessions, supporting improvement initiatives, and mentoring colleagues to include Lean techniques into daily operations.

By writing phase-based reflection reports following every milestone, Project Leads from design and engineering teams will also add operational knowledge. These studies will flow into the knowledge base, therefore guaranteeing the capture and application of learning. Combining strategic oversight (Lean Lead), operational input (Project Leads), and facilitation (Kaizen Champions), this tripartite method portrays CI as a systematic, team-driven process incorporated into the corporate culture and maintained outside of individual projects.

5.2. Improving Structure Around PDCA Cycles

Originally developed from Deming's quality movement and extensively embraced in Lean implementations, the Plan-Do-Check-Act (PDCA) cycle is central to the CI architecture (Womack & Jones, 2003). Using this cycle, Fasil Giorghis Consult will arrange bi-weekly team-based improvement sessions, each aimed at resolving real-time workflow inefficiencies.

Teams will examine process data including measures of coordinated rework incidence or client change request frequency during the Plan stage in order to find waste or friction areas. They will test particular countermeasures, such updated client briefing forms or improved BIM coordination techniques, in the Do phase. The Check phase will consist in the comparison of outcomes with predetermined key performance indicators (KPIs), such a planned decrease in Request for Information (RFI) entries or enhancement of input ready rates. At last, successful interventions will be standardised and codified for cross-project application during the Act phase, therefore ensuring that learning is kept and scaled.

By incorporating learning into operational practice and guaranteeing that progress is evidence-based rather than anecdotal, this disciplined, cyclical methodology shown in Figure 7 supports Kaizen.

Figure 7. Plan-Do-Check-Act (PDCA) cycle for continues improvment in the firm.

5.3. Kaizen Champion Training

Fasil Giorghis Consult will launch a Kaizen Champions Training Program to operationalise the facilitation of CI activities. This will be developed internally and presented in a workshop style every three months alongside matching peer mentorship between departments. Technical and soft skills will be in equal measure in the course.

Technical courses will include Lean diagnostics, value stream mapping, Bim-based collision detection for coordination accuracy, and PDCA facilitation. Essential for facilitating introspective conversation, complementary modules will include facilitation skills, conflict management, and constructive feedback delivery. By arming a core group of champions with these competencies, the company guarantees that ongoing development is driven from inside by capable facilitators who grasp the processes and cultural background of the company rather than depending on outside consultants or sporadic efforts.

5.4. Making Progress Measurable

For Lean to truly take root at Fasil Giorghis Consult, it's essential to track what's working and where improvement is needed. To do this, the firm will use a set of practical Key Performance Indicators (KPIs) that align with core Lean ideas. These metrics won't just measure efficiency they'll also reflect how well Lean values are being embraced across teams.

- **Operational Indicators: Tracking Process Performance**

Input Readiness Rate (Target: 95%)
This shows whether design inputs arrive complete and on time. High scores mean teams can work without delay, a key part of the Just-in-Time approach that helps avoid waiting waste.
Coordination Rework Incidence
Pulled from BIM audit logs, this tracks how often changes are made due to design clashes. Fewer reworks suggest better quality and alignment across disciplines, an outcome tied to Jidoka, or building quality into the process.
Client Change Request Frequency
By monitoring how often clients request changes mid-project, the firm can see how well early engagement is working. Clearer expectations from the start should lead to fewer last-minute shifts supporting the Lean principle of defining value from the customer's point of view.

- **Cultural Indicators: Tracking Team Engagement**

Kaizen Participation Rate (Target: 90%+)
This reflects how many team members actively take part in improvement sessions. High participation shows Lean is becoming part of everyday practice, not just a top-down initiative.
CI Initiative Completion Rate
This metric shows whether improvement ideas are actually followed through. It ensures good ideas don't get lost or stall out before making an impact.
Knowledge Reuse Rate
This tracks how often documented lessons or templates are reused in new projects. A strong rate indicates a learning culture where past experience informs future success.

5.5. Structuring and Visualizing the CI Process

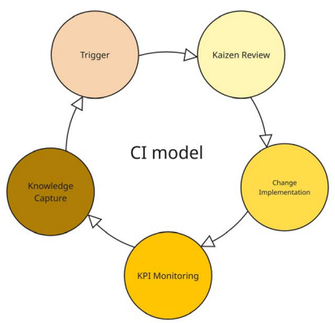
Using a formal visual process model, termed the Continuous Improvement Loop (Figure 8), the company will institutionalise CI as a regular practice. Designed as such, this loop catches the whole lifetime of an improvement project:

Using a consistent CI Reflection Template, every improvement event will be recorded with regard to problem description, root cause analysis, suggested countermeasure, implementation action, and measured result. To allow cross-project learning, these templates will be kept in the Digital Knowledge Repository under topic and project type indexing.

Internal training manuals, team dashboards, and onboarding documentation will all have

Figure 8. Continuous improvment model.

graphic depiction of this cycle. The CI process is meant to be demystified and team-level ownership of improvement initiatives encouraged.



5.6. Sustaining Improvement Through Cultural Reinforcement

Including CI into the corporate culture calls for it to become a visible, valued, and often used activity. Three key channels will be used to do this: first, by dedicating non-billable time each month for Kaizen sessions, therefore avoiding staff members from having to pick between project work and improvement initiatives. Second, by organising a monthly "CI Showcase," in which teams show to peers and leaders the results of their work on improvement, hence fostering momentum and friendly rivalry. Thirdly, by appreciating consistent involvement and creativity via performance reviews and internal communications.

Fasil Giorghis Consult positions itself to sustain Lean transformation over the long run by combining structured methodology, robust governance, focused training, and performance-linked metrics. Constant improvement becomes rather natural for the company to learn, adapt, and produce value rather than a temporary project.

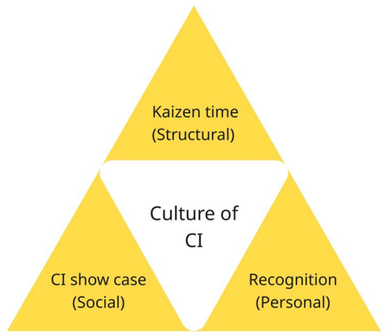


Figure 9. Three pillars (Structural, Social, Personal) to sustain the culture of continuous improvment.

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