MANUFACTURING OF A QUALITY PRODUCT PROCESSES: A JOURNEY FROM GOOD TO GREAT

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Executive Summary

This report presents a comprehensive analysis of Custom-Built Kit Homes' (CBKH) manufacturing processes, identifies inefficiencies, and offers strategic recommendations for improvement. Our goal is to enhance CBKH's operational efficiency, reduce costs, and elevate customer satisfaction.

Summary of Findings

Process Waste Identification: Using qualitative and quantitative analysis techniques, we revealed several sources of process waste, including transportation inefficiencies, lengthy waiting times, and a substantial number of defects in the manufacturing process.

Pareto Analysis: A Pareto analysis indicated that addressing waste in the quality assurance and procurement processes should be a top priority, as they account for a significant portion of identified inefficiencies.

Recommendations

Real-Time Communication: To eliminate delays caused by outdated communication methods, we recommend implementing a real-time communication system. This initiative will facilitate immediate information exchange among employees, suppliers, and customers, fostering collaboration and efficiency gains..

Preferred Supplier Program (PSP): We propose the establishment of a Preferred Supplier Program to optimize the supply chain. This initiative will lead to cost savings, reduced lead times, and enhanced relationships with suppliers in both the building approval and procurement processes.

Dynamic Inventory Management: Implementing a dynamic inventory management system will enable CBKH to adapt inventory levels to changing customer requirements. This approach will minimize stock-related delays and enhance inventory efficiency.

Six Sigma with DMAIC: Embrace the Six Sigma methodology, specifically the DMAIC (Define, Measure, Analyse, Improve, Control) approach, to enhance product quality and reduce costs. By fostering a culture of continuous improvement, CBKH can reduce defects, enhance workmanship, and drive operational excellence.

By implementing these recommendations, CBKH can streamline its manufacturing processes, resulting in significant savings in both time and money. These solutions aim to improve customer satisfaction, supplier relationships, and operational efficiency, ultimately positioning CBKH for immediate and long-term success.

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Introduction

The purpose of this report is to execute and apply the Process Analysis, and subsequent Process Redesign phases of the Business Process Lifecycle (Dumas et al., 2019). We aim to deliver improvement recommendations to Custom-Built Kit Homes (CKH) management based on a review the existing processes and identification of key improvement opportunities. Using numerous qualitative and quantitative techniques, we aim to achieve this by:

· Analysing the current "As-Is" processes for instances of process waste

· Identifying the root causes of process waste and other inefficiencies

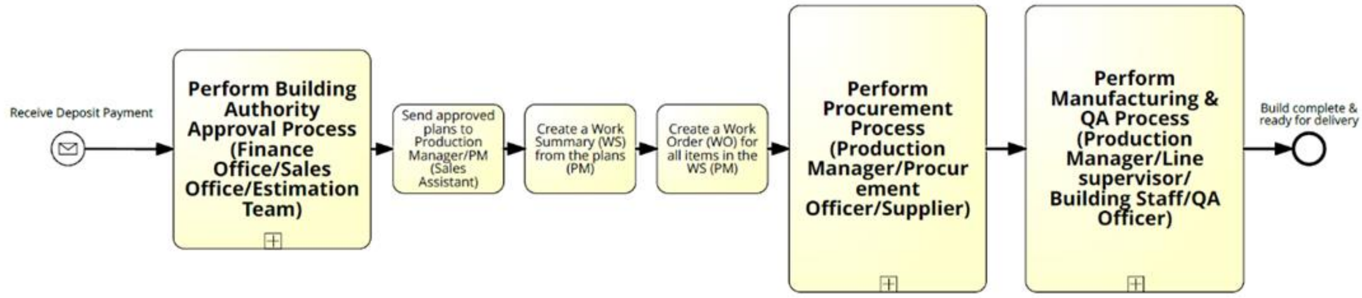
· Developing a comprehensive Issues Register from the findings of our analysis and the information provided directly from CKH

· Using heuristic process redesign and systemic ideation to present a variety of impactful improvement solutions

· Providing a roadmap and feasibility analysis of both short-term and long-term improvement initiatives

Scope of Analysis

In this report, we predominantly focus our analysis and subsequent transformation proposals on CKH's Production processes. Our approach, geared towards delivering a comprehensive business strategy for substantial systemic enhancement, entails a deliberate concentration on this specific aspect of the business model, as opposed to a broader analysis of the entire organization. At its essence, CKH operates as a manufacturer, so we have applied an operational-perspective encompassing the external approval, procurement, manufacturing, and quality assurance processes within the CKH Production systems. Below we have used Business Process Model and Notation (BPMN) to display a high-level view of the relationship between the processes we will be addressing within the report:



Our previous report on CKH, focused on the Process Discovery phase of the BPM Lifecycle to establish the "As-Is" processes currently operating. With slight variation, we have used the same classification system of hierarchal relationships to categorise the Production Process as a Level 2 operation within the overall CKH business activities. As such, the current order and relationship between the contributing granular processes work as below:

Level 2 – Production Process

Level 3 – Building Authority Approval Process

Level 3 – Procurement Process

Level 3 – Manufacturing Process

Level 4 – Quality Assurance Process

Process Waste Analysis

To identify sources of waste we perform a close of review of existing process activities and determine process waste. First we will perform qualitative analysis of “As-Is” processes to identify instances of process waste, as defined by Taiichi Ohno’s eight categories of waste (Shou et al., 2019). Subsequently, we will review each process using a variety of Flow Analysis methods to provide a quantitative analysis perspective to this report (Dumas et al., 2019, pp. 255-272). For each process, we calculate the Cycle Time (CT), Total Cycle Time (TCT) and Cycle Time Efficiency (CTE) as metrics to analyse and optimise processes, identify bottlenecks, reduce inefficiencies, and improve overall process performance. Further to this, we conduct a cost-per-instance-process for each with an emphasis on labour & resource costs. Our subsequent findings will contribute to building a comprehensive Issues Register.

Root Cause Analysis and Process Enhancement

The next phase involves identification of improvement opportunities using root analysis of the operational weaknesses identified in the Issues Register. This step is crucial for understanding the underlying reasons behind process weaknesses and waste instances so that these can be addressed directly. Using Pareto and Why-Why analysis methods we can prioritise changes that will yield the most significant impact.

Process Refinement and Redesign for Enhanced Efficiency

Once we have identified the processes requiring improvements, we will explore strategies to enhance their efficiency. We offer numerous improvement suggestions guided by the application of four thinking styles for systemic ideation. Recker and Roseman outline a strategic framework for organizations to generate creative improvement solutions using one of four perspectives: Derive, Enhance, Design, and Utilize (Recker & Rosemann, 2015). In addition to this, we will also apply heuristic process redesign principles at the task, flow, and process levels to deliver analytical enhancement strategies.

Measuring Improved Efficiency

After presenting these strategies, we will use BPMN to capture the “To-Be” processes which will reflect the improvement recommendations if implemented. Again, we will conduct a flow analysis—this time on the “to-be” models and compare it against our existing "as-is" models. This comparative analysis will provide tangible evidence of the enhanced efficiency of the proposed process.

Implementation Proposal

Following this comprehensive analysis and improvement phase, we will provide a concise proposal outlining the recommended implementation timeline. We will analyse and discuss the timeline, difficulty, and feasibility to categorise each suggestion as either short-term or long-term project.

Process Analysis

In this report, our objective is to complete the Process Analysis and Process Redesign phases of the BPM Lifecycle as opposed to the focus of our initial business report on CKH which had a focus on the Process Discovery stage. Using our established knowledge of the CKH business operating processes obtained during the discovery stage, we can now shift to the next phase where we perform quantitative and qualitative analysis techniques to assess current issues and opportunities for process improvement (Dumas et al., 2019).

To optimise the utility of the diverse techniques employed in this report, we have refined our previous BPMN models in this Process Analysis section of the report. These adjustments have been made with the goal to linear diagrams that facilitate more accessible Flow Analysis. Other notable adjustments include the removal of "lanes", in favour of incorporating the process' performer/s directly within each activity description. Additionally, where necessary we have altered the language used in some task descriptions to ensure the diagrams are highly readable and comprehensible. Finally, we have decided to combine the Level 3 Manufacturing & Level 4 Quality Assurance Process together as these processes are intrinsically linked and deemed a separate analysis would not yield the most insight.

In this section, we will first present our analysis from a qualitative perspective and then apply the quantitative techniques. The main goal of our qualitative analysis will be to review the sequence of process activities to identify the current instances of process waste and subsequently categorise each waste occurrence. We will simultaneously conduct a value-added analysis and waste analysis first. All process steps will be listed in sequential order and then classified as either value-adding (VA), business value-adding (BVA) or non-value-adding (NVA). Subsequently, all NVA activities will get a further classification for waste type. Next, we will apply the quantitative analysis methods on existing processes. We will achieve this by conducting several Flow Analysis methods to ultimately measure time and cost. For each "As-Is" process, we will calculate the Cycle Time (CT), Total Cycle Time (TCT) and Cycle Time Efficiency (CTE), which can offer insights that may uncover bottlenecks, streamline operations, and expose opportunities for process enhancement. With the available information on CKH operations, we will also calculate cost-per-instance-process, mainly focusing on labour & resource costs.

We will conclude this process analysis section with the creation of a comprehensive Issues Register. Using items from this list we will then perform a Pareto Analysis and root cause analysis, respectively, with the aim to identify the business's weak points that have the most pervasive impacts. We will then develop and offer actionable suggestions to directly target these vulnerabilities and greatly reduce or eliminate process waste altogether and create sustainable and successful long-term improvement.

Qualitative Analysis of Manufacturing Processes

Value-Added & Waste Analysis

Task		Value-Added Analysis VA/BVA/NVA	Type of Waste
Building Authority Approval Process	Notify sales that deposit payment has been processed **(Finance Office)**	**NVA**	**Transportation:** movement of documentation
	Send floor plans to Local Building Authority/LBA for review **(Sales Assistant)**	**VA**	
	Review Plans and advise the outcome **(LBA)**	**VA**	
	Make adjustments to plans **(Estimator),** resend plans to LBA for review **(Sales Assistant)**, review plans and advise the outcome again **(LBA)** - **(approx.. 10% of builds)**	**NVA**	**Waiting**: Waiting for responses or revisions **Rework**: Iterating multiple times
	Approval Granted	**VA**	
Send approved plans to Production Manager/PM **(Sales Assistant)**		**NVA**	**Transportation:** movement of documentation
Create a Work Summary (WS) from the plans **(PM)**		**BVA**	
Create a Work Order (WO) for all items in the WS **(PM)**		**BVA**	

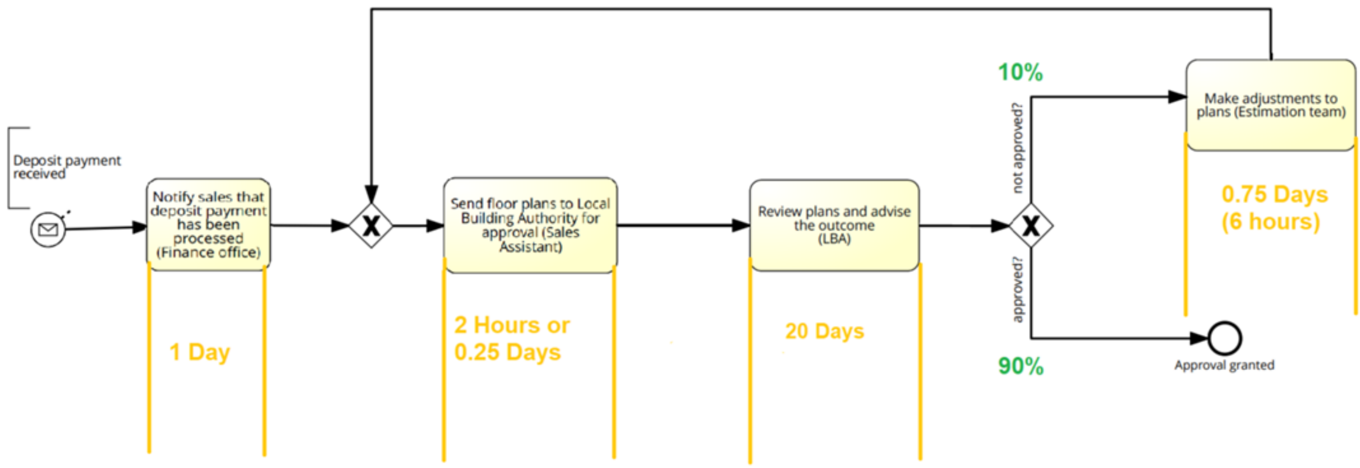
Procurement Process	Send a copy of each WO to a Procurement officer/PO **(PM)**	**NVA**	**Transportation:** movement of documentation
	Check available stock and determine materials that need to be ordered **(PO)**	**BVA**	
	Consult the Suppliers spreadsheet to select suitable supplier/s **(PO)** - **(approx. 40% of builds)**		
	Prepare and send RFQ to supplier **(PO)** - **(approx. 40% of builds)**	**VA**	
	Prepare and send quotes back **(Supplier)** - **(approx. 40% of builds)**		
	Select best quote from responses to RFQ **(PO)** - **(approx. 40% of builds)**	**NVA**	**Waiting:** waiting 2 weeks for response
	Prepare and send supplier PO **(PO)** - **(approx. 40% of builds)**	**BVA**	
	Prepare and deliver materials to CKH **(Supplier)** - **(approx. 40% of builds)**	**NVA**	**Waiting:** waiting 2 weeks for response
	Sign WOs and organise delivery of materials to the designated factory bay **(PO)**	**BVA**	
Manufacturing Process	Schedules each stage of the build **(PM)**	**VA**	
	Send WO to Line Supervisor/LS **(PM)**	**NVA**	**Transportation: movement of documentation**

	Build home in factory **(LS & 6 Building Staff/BS)**		BVA	
	Quality Assurance Process	Send request to Quality Assurance (QA) team that a check is required **(LS)**	BVA	
		Performs QA check **(QA)**	BVA	
		Performs a minor fix **(LS & BS)** - **(approx. 58% of builds)**	NVA	**Defects/Rework**
		Dismantle and rebuild completely **(LS & BS)** - **(approx. 58% of builds)**	NVA	**Defects/Rework**
	Sign completed WO **(LS)**		BVA	
	Forward signed WO to Production Manager **(LS)**		NVA	**Transportation: movement of documentation**
	Mark WS as finalised once all WOs are completed and returned **(PM)**		BVA	
	Build complete **(All)**		VA	-

Quantitative Analysis

Building Authority Approval Process

Assumption	Reasoning
1 working day is 8 hours CBKH operate Monday-Friday	Standard operating hours for businesses in Australia
20 day timeframe for floor plans to be reviewed by local building authority	Average timeframe suggested by Brisbane City Council (2023)
An estimator needs an average of 6 hours to make adjustments	Applied the same time it takes for an estimator to make adjustments following rejection from a structural engineering firm
10% of plans are not approved by local building authority	Applied the same success rate for the building approvals for the post-installation inspection



Time Flow Analysis of Building Approval Process

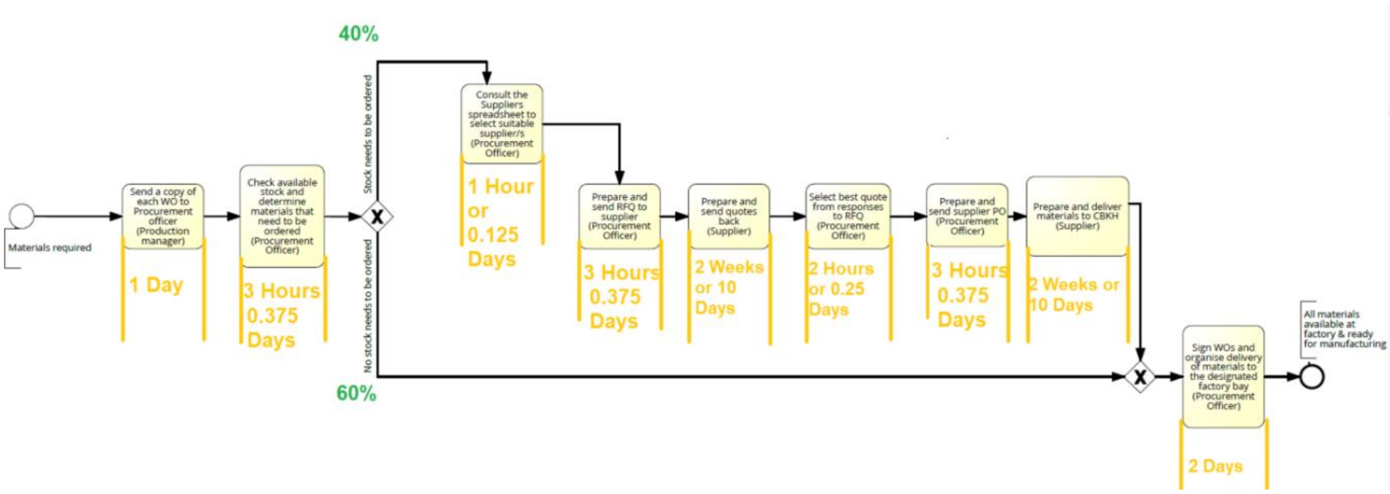
Cycle Time	**Theoretical Cycle Time (TCT)**	**Cycle Time Efficiency (CTE)**
CT = 1 Day + 0.25 Days + 20 Days + 0.1 x (0.75 Days + 0.25 Days + 20 Days) **CT = 23.35 Days or 186.8 Hours**	TCT = 0.25 Days + 20 Days **TCT = 20.25 Days or 162 Hours**	CTE = 20.25 Days 23.35 Days **CTE = 87%**

Flow Analysis of Cost-Per-Process-Instance (CPPI) for Building Approval Process

Task	Labour Cost	Other Cost	Total Cost
1. Notify sales that deposit payment has been processed - **(Finance Office)**	--	--	
2. Send floor plans to LBA for review - **(Sales Assistant)**	$45 x 2 hours = **$90**	--	$90
3. Review plans and advise the outcome - **(LBA)**	--	**$772.40 (**for Brisbane City Council assessment)	$772.40
4. Make adjustment to plans - **(Estimator)** Steps 1-3 are subsequently repeated - **(Sales Assistant, LBA)** **(approx. 10% of builds)**	0.1 x ($65 x 6 hours) = **$39** for estimator labour 0.1 x ($45 x 2 hours) = **$9** for the Sales Assistant labour in the repeated activity **Total = $48**	0.1 x $772.40 = **$77.24** for the reassessment by Brisbane City Council	$48 + $77.24 = **$125.24**
Approval Granted	--	--	--
Total cost-per-process- instance			$987.64

Procurement Process

Assumption	Reasoning
1 working day is 8 hours CBKH operate Monday-Friday	Standard operating hours for businesses in Australia
Procurement officer takes an average of 3 hours to check stock availability	CKH processes appear very manual and information suggests they use spreadsheet-based data management
Procurement officer takes an average of 2 hours select a quote from those received	It takes an average of 3 hours for a procurement officer to prepare a RFQ. We have used this as a guide but assumed it will take less time for selection
Takes 2 days to arrange the delivery of materials to the designated factory bay	Applied the same success rate for the building approvals for the post-installation inspection



Time Flow Analysis of Procurement Process

Cycle Time	Theoretical Cycle Time (TCT)	Cycle Time Efficiency (CTE)
CT= 1 Day + 0.375 Days + 0.4 x (0.125 Days + 0.375 Days + 10 Days + 0.25 Days + 0.375 Days + 10 Days) + 2 Days = **11.825 Days** **CT = 11.825 Days or 94.6 Hours**	TCT= 1 day + 0.375 Days + 2 Days **TCT = 3.375 Days or 27 Hours**	CTE = 3.375 Days/11.820.5 Days **CTE = 28.5%**

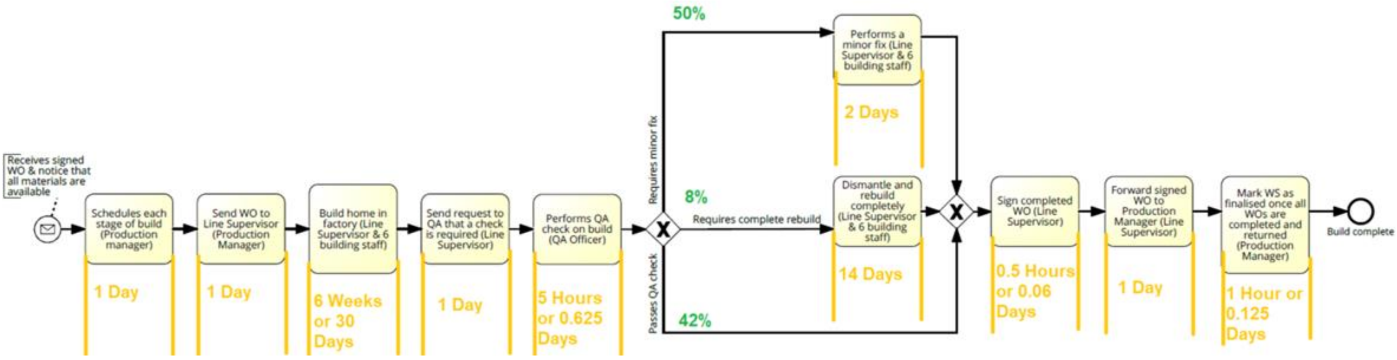
Flow Analysis of Cost-Per-Process-Instance (CPPI) for Procurement Process

Task	**Labour Cost**	**Other Cost**	**Total Cost**
Send a copy of each WO to Procurement Officer - **(PM)**	--	--	--
Check available stock and determine materials that need to be ordered - **(PO)**	$45 x 0.75 hours = **$135**	--	$135
Consult the suppliers spreadsheet to select suitable supplier/s - **(PO) - (approx. 40% of builds)**	0.4 x ($45 x 1 hour) = **$18**	--	$18
Prepare and send RFQ to supplier - **(PO) - (approx. 40% of builds)**	0.4 x ($45 x 3 hours) = **$54**	--	$54
Prepare and send quotes back - **(Supplier) - (approx. 40% of builds)**	--	--	--
Select best quote from responses to RFQ - **(PO) - (approx. 40% of builds)**	0.4 x ($45 x 2 hours) = **$90**	--	$90

Prepare and send supplier PO - **(PO) - (approx. 40% of builds)**	0.4 x ($45 x 3 hours) = **$54**	--	$54
Prepare and deliver materials to CKH - **(Supplier) - (approx. 40% of builds)**	--	--	--
Sign WOs and organise delivery of materials to the designated factory bay - **(PO)**	$45 x 16 hours = **$720**	--	$720
Total cost-per-process- instance			**$1,071**

Manufacturing & Quality Assurance Processes

Assumption	Reasoning
1 working day is 8 hours CBKH operate Monday-Friday	Standard operating hours for businesses in Australia
Production manager spends 1 day scheduling the stages of each build	Efficient scheduling requires a dedicated day to plan, allocate resources, and coordinate tasks, ensuring a well-organised production process.
Line supervisor takes 0.5 hours to sign a completed WO	Signing completed Work Orders is a straightforward administrative task, typically taking about half an hour for verification and record-keeping.
Production manager spends an average of 1 hour finalising and marking a WS as complete	Finalising a Work Summary involves reviewing the project, coordinating documentation, and ensuring readiness for delivery.



<u>Time Flow Analysis of Manufacturing & Quality Assurance Processes</u>

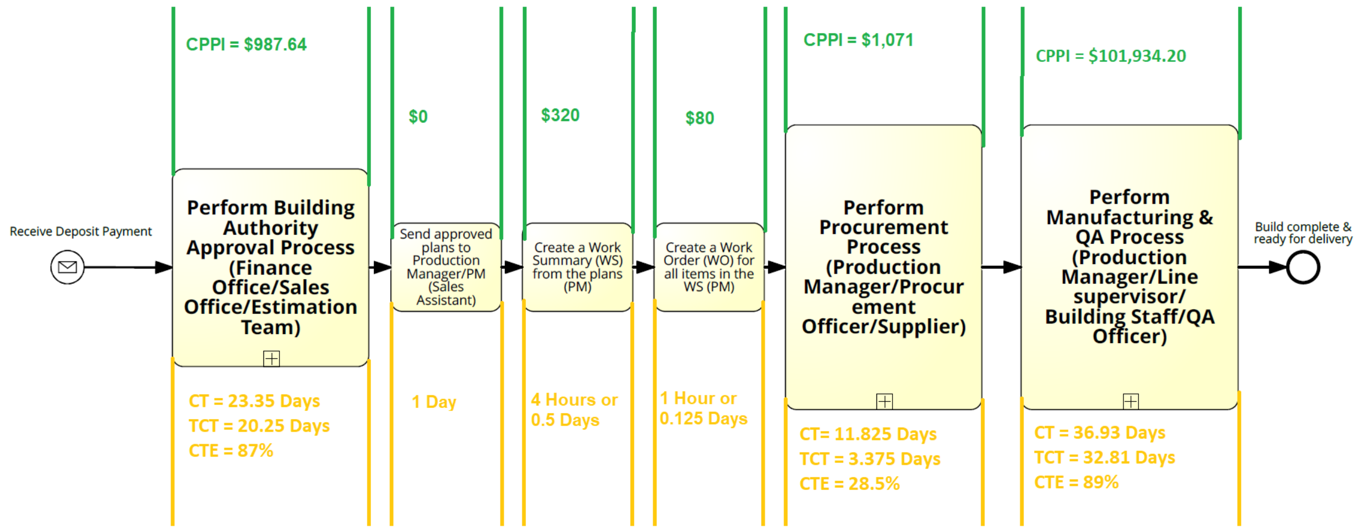
<u>Cycle Time</u>	<u>Theoretical Cycle Time (TCT)</u>	<u>Cycle Time Efficiency (CTE)</u>
CT = 1 Day + 1 Day + 30 Days + 1 Day + 0.625 Days + (0.5 x 2 Days) + (0.08 x 14 Days) + 0.06 Days + 1 Day + 0.125 Days **CT = 36.93 Days or 295.44 Hours**	TCT = 1 Day + 30 Days + 1 Day + 0.625 Days + 0.06 Days + 0.125 Days **TCT = 32.81 Days or 262.48 Hours**	CTE = 32.81 Days36.93 Days **CTE = 89%**

<u>Flow Analysis of Cost-Per-Process-Instance (CPPI) for Manufacturing & Quality Assurance Processes</u>

Task	Labour Cost	Other Cost	Total Cost
Schedules each stage of build - **(PM)**	\$80 x 8 hours = **\$640**	--	\$640

Send WO to Line Supervisor - **(PM)**	--	--	--
Build home in factory - **(Building Staff (BS) & LS)**	LS: $65 x 240 hours = **$15,600** BS: $55 x 240 hours x 6 staff = **$79,200**	--	$94,800
Send request to QA that a check is required - **(LS)**	--	--	--
Perform QA check - **(QA)**	$55 x 5 hours **= $275**	--	$275
Performs a minor fix - **(LS & BS) - (approx. 50% of builds)**	LS: 0.5 x ($65 x 16 hours) = **$520** BS: 0.5 x ($55 x 16 hours x 6 staff) = **$2,640**	--	$3,160
Dismantle and rebuild completely - **(LS & BS) - (approx. 8% of builds)**	LS: 0.08 x ($65 x 14 days x 8 hours) = **$582.40** BS: 0.08 x ($55 x 8 hours x 14 x 6 staff) = **$2956.80**	--	$3539.20
Mark WS as complete and finalised - **(PM)**	$80 x 2 hours = **$160**	--	$160
Build complete and ready for delivery	--	--	--
Total cost-per-process- instance			**$101934.20**

Combined Production Processes



Time Flow Analysis of Combined Production Processes

Cycle Time	**Theoretical Cycle Time (TCT)**	**Cycle Time Efficiency (CTE)**
CT= + 1 Day + 0.5 Days + 0.125 Days + 23.35 Days + 11.825 Days + 36.93 Days **CT = 73.73 Days or 589.84 Hours**	TCT = 0.5 Days + 0.125 Days + 20.25 Days + 3.375 Days + 32.81 Days **TCT = 57.06 Days or 456.48 Hours**	CTE = 57.06 Days/73.73 Days **CTE = 77%**

Flow Analysis of Cost-Per-Process-Instance of Combined Production Processes

Process	**Cost**
Building Approval Process	$987.64
Send approved plans to Production Manager (Sales Assistant)	--
Create a Work Summary (WS) from the plans (PM)	$320
Create a Work Order(WO) for all items in the WS (PM)	$80
Procurement Process	$1,071
Manufacturing QA Process	$101931.20
Total	**$104,392.84**

Issues Register

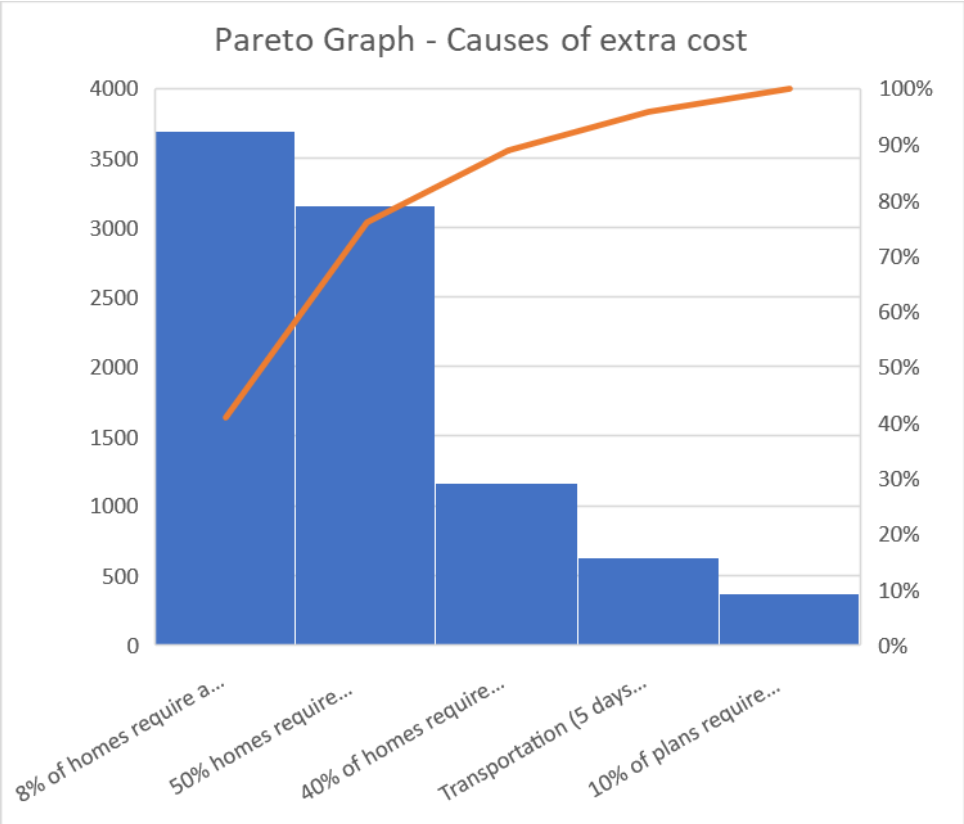
Name	Type of Waste	Explanation	Assumptions	Qualitative Impact	Quantitative Impact
Delays due to slow internal communication	Transportation	There are 5 instances of communication between departments accounting for 5 days wasted.	That any message sent between departments are actioned the next day.	This impacts on the customer satisfaction as the project will be delayed 5 working days (1 week)	
Lengthy procurement process	Waiting	There are 2 instances of 2 week wait times in the procurement processes	As above	This impacts on the customer satisfaction as the project will be delayed 20 working days (4 week)	

10% of plans require resubmission to the LBA for approval	Rework	Adjustments to plans	Plans require 6 hours of work from estimation team and need to be resubmitted	Delays project for 4 weeks and costs extra, it also demonstrates a lack of quality workmanship creating a bad impression	On 10%of jobs Cost to CBKH is resubmission fee and 6 hours work from estimation team and 1 hour from sales team= 0.1 x ($65 x 6 hours) + ($45 x 2 hours) + $772.40 = **$125.24**
Defects/Rework	Defects/Rework	50% of all builds have minor defects that need fixing	It takes the building team 2 days to fix the problems	Slight delay, but a half of all builds suggests mistakes are accepted and expected in this workplace, and additional labour & material costs to CBKH	LS: 0.5 x ($65 x 16 hours) + BS: 0.5 x ($55 x 16 hours x 6 staff) =**$3160**
Defects/Rework	Defects/Rework	8% of all builds need to be dismantled and rebuilt	It takes the building team 14 days to dismantle and rebuild	Delay to the project on nearly 3 weeks, a look of incompetence to the customer, and additional labour & material costs to CBKH	LS: 0.08 x ($65 x (14 x8) hours) + BS: 0.08 x ($55 x (14 x8) hours) x 6 staff) =$3539.20

Pareto Analysis

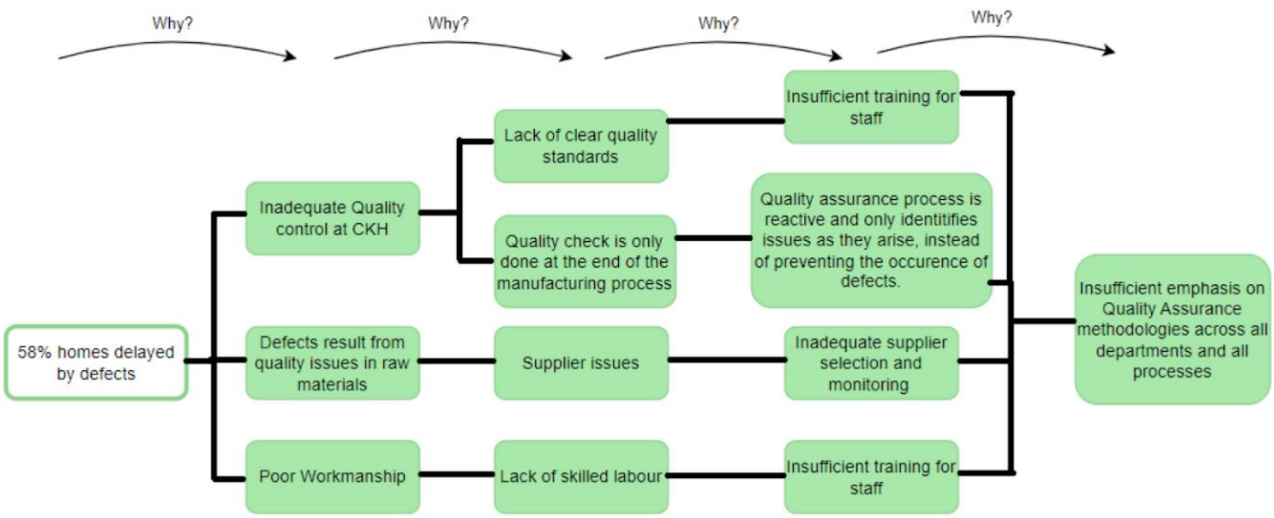
We assume that a cost to the customer is also a cost to “Custom built kit homes” as it is money the customer could have spent on the home or it affects ongoing business as we may lose potential customers due to dissatisfaction. Any delay to the building process will be calculated at the average rental price in Brisbane of $626 per week or $626/7 per day* (SQM Research, 2023). As the customer will need to stay in their current accommodation for longer.

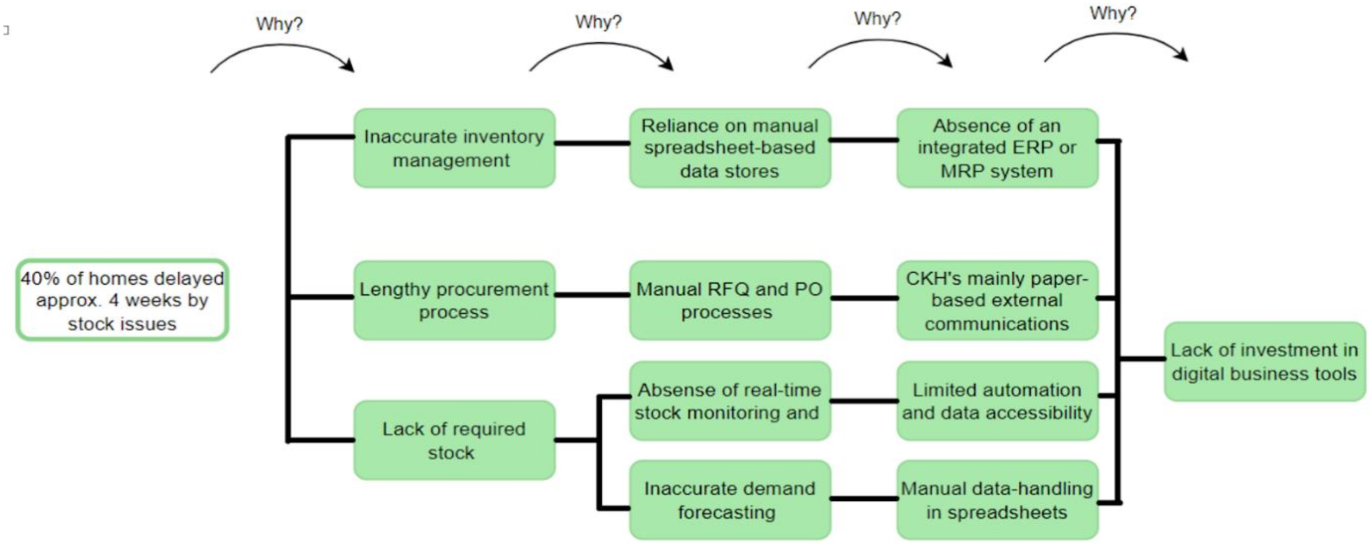
Cause of extra cost	Cost	Type of Waste	Cost per year (300 homes)	Cumulative cost	Percentage of cumulative cost
8% of homes require a rebuild	LS: 0.08 x ($65 x (14 x8) hours) + BS: 0.08 x ($55 x (14 x8) hours) x 6 staff) =$3539.20 Cost to customer (3 week delay) = 0.08 x 3 x 626 = $150.24 Total cost = **$3689.44**	Defects/Rework	$19675	$3689.44	89.28%
50% homes require minor fixes	0.5 x (($65 x 16 hours) + ($55 x 16 hours x 6 staff) = **$3160**	Defects/Rework	$948000	$6849.44	$58.42%
40% of builds delayed due to stock issues	0.4 x (($45 x 1 hour) + (($45 x 3 hours) +($45 x 2 hours) + ($45 x 3 hours)) = $162 Cost to customer (4 weeks delay) = 0.4 x 4 x 626= $1001.60 Total cost = **$1163.60**	Waiting	$349080	$8013.04	79.93%
Delays due to slow internal communication	5 working days (1 week) = **$626**	Transportation	$187800	$8639.04	97.54%
10% of plans require resubmission	0.1 x ($65 x 6 hours + $45 x 1 hour + 772.40) (resubmission) = **$120.74** Cost to customer (4 week delay) = 0.1 x 4 x 626 = **$250.40** Total cost = **$371.14**	Rework	$39879	$9010.18	100%
Total cost per year	$9010.18 per house		$2703054		



The above Pareto analysis clearly demonstrates that there appears to be the most waste of resources dedicated to the quality assurance process. With "8% of homes requiring a rebuild" costing over $3500 per house representing approximately 40% of identified waste and "50% of all homes needing a minor fix" costing over $3000 per house accounting for nearly 35 % of all identified waste. The other major source of waste was because "40% of all homes require ordering of material" costing on average $1163 per house, accounting for just above 12% of all identified wastage. This shows that moving forward to make the most positive change we need to target the quality assurance and the procurement processes.

Root Cause Analysis





Process improvement

Issue (transportation) - short-term solution - “Real time communication system”

When analysing the provided information about current practice it is clear that the communication between departments, with customers and also with external bodies is in need of an overhaul. Information is slow to be dispensed and even slower to action. We live in a world where information can be passed on immediately and it is time for CBKH to implement a real time communication system. A real time communication system is one in which information is passed on without delay. One such system is “Docuware” which is a cloud based document management system. This system when implemented in a laboratory setting increased efficiency by 20% (Pinelli et al., 2018).

These findings were supported by AmeriSource Corp (an American distribution company) who also reported increased productivity of 20% (Auguston, 1995). These have both suggested at increases in efficiency, in CBKH real time communication system will be used to target the days wasted sending messages between departments but no doubt will have further reaching impacts especially signing of documents. Although this may have an initial cost in terms of development of an implementation strategy by the IT department, and possible improvement of infrastructure to make it possible as well as professional development of all staff, longer term there may be some savings in terms of the reduction in required printing capability.

In the following processes we have assumed that sending messages will happen immediately and have no impact on the time of completion.

Issue (Waiting) - medium-term solution - “Preferred Supplier Partnerships”

What we are proposing is using a multipronged approach that will lead to savings both in money and in time. There appear to be 4 issues to target when approaching recommendations to save money. From the Pareto Analysis we can see the most important thing to target is the quality assurance process which accounts for nearly 80% of all wastage. The next issue that needs to be addressed is the time wastage in the procurement process. The final two items to address are the time wasted during the communication process and lastly the time and money wasted during the Approval process.

Am noticeable issue we wish to target are the time wasted during the procurement process and the inefficiencies around the approval process. The reason we wish to target these processes simultaneously is that their solution revolves around a similar process, a preferred supplier program (PSP). A study by the Department of Defence (DOD) outlined the advantages of a PSP. “Under the PSP, contractors that have demonstrated exemplary performance, at the corporate level; in the areas of cost, schedule, performance, quality, and business relations would be granted

Preferred Supplier Status (PSS). Contractors that achieved PSS would receive more favourable contract terms and conditions in DON contracts (Preferred Supplier Program [PSP], 2010). For the Approval Process a preferred supplier would provide a faster service at a cheaper cost. An example is Innovative Building Solutions as a guide and therefore assumed the approval will take an average of 10 days, at a cost of $650 as outlined on their website (INNOVATIVE BUILDING APPROVALS, 2023).

We would look at hiring a certifier that is able to complete certifications:

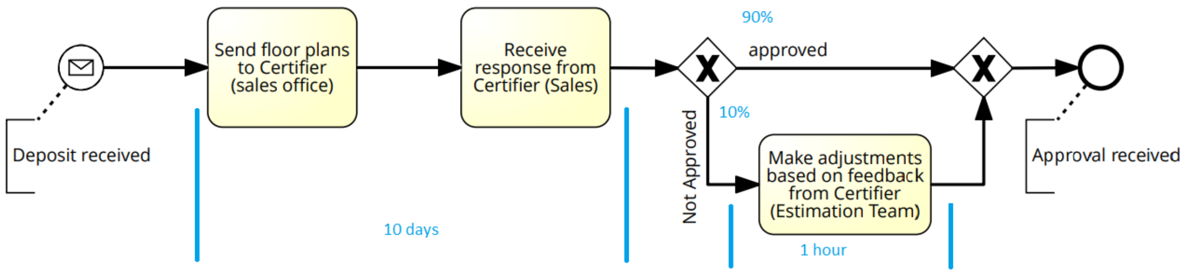
- Within 10 days
- A cost of $650
- And problems to be solved with a phone call rather than a resubmission.

Over time we would expect very few problems given that most homes would be repeated designs or similar and they have been previously signed off by a structural engineer.

Given there are 300 homes a year this would generate $195000 income for the certification company and would therefore be attractive to a certification company.

For this refinement the assumptions made are:

- Certification completed within 10 days
- Cost of $650
- No resubmission required
- !0% of submissions require adjustment which takes on average an hour of estimators work due to the clarification from the certifiers phone call.



<u>**Cycle Time**</u>	<u>**Theoretical Cycle Time**</u>	<u>**Cycle Time Efficiency**</u>
CT= 10 Days + 0.1 x 0.17 Days **CT = 10.017 Days or 80.1 Hours**	**TCT = 10 Days or 80 Hours**	CTE = 80 Hours/ 80.1 Hours **CTE = 99.99%**

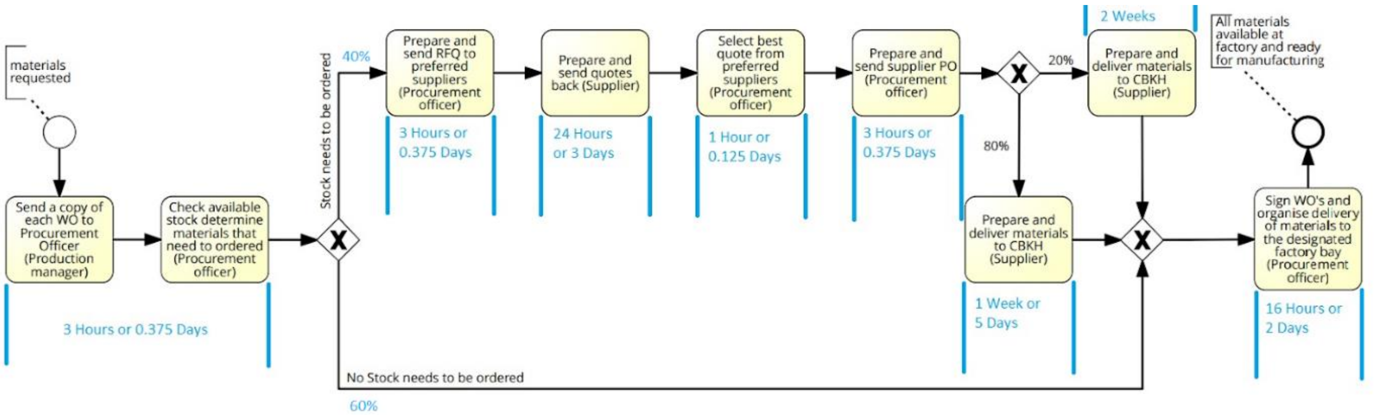
Savings:

Time = Original Cycle Time – Improved Cycle Time = 23.35 - 10.017 = 13.333 Days
Money = Original cost-per-process-instance – Improved process costs = 987.64 - 650 - 1 x 45 + 0.1 x 1 x 45 = $288.14

For the procurement process the preferred supplier would be able to provide a faster service at a cheaper cost. This simplifies the quoting process. Given the volume of materials for 300 houses there would be a strong desire to be a preferred supplier , so we believe it would give us a competitive edge on pricing materials but also time taken to supply the materials.

For this refinement the assumptions made are:

- Preferred suppliers will be given 3 days to provide Quotes
- 80% of PO's will be supplied within the week with the other 20% provided within 2 weeks
- The Quote selection time will take less time as there are fewer quotes (1 hour rather than 2 hours)



<u>**Cycle Time**</u>	<u>**Theoretical Cycle Time**</u>	<u>**Cycle Time Efficiency**</u>
CT = 0.375 Days + 0.4 x ((0.375 Days + 3 Days + 0.125 Days + 0.375 Days + (0.8 x 5 Days + 0.2 x 10 Days) + 2 Days = **6.325 Days** **CT = 6.325 Days or 50.6 Hours**	TCT = 0.375 Days + 2 Days **TCT = 2.375 Days or 19 Hours**	CTE = 2.375 Days/6.325 Days **CTE = 37.5%**

Savings:

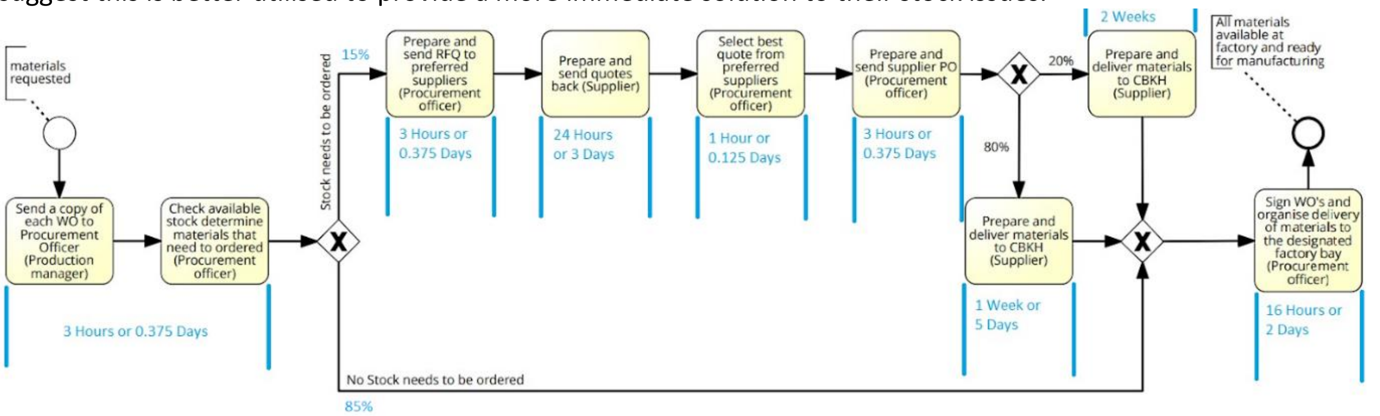
Time = Original Cycle Time – Improved Cycle Time = 12.5 - 6.325 = 6.175 Days
Money = Original Process Cost - Improved Process Cost = 1071 - 3 x 45 + 0.4 x (3 x 45 +1 x 45 + 3 x 45) + 16 x 45 = $90

Resource-focused (Utilisation) Innovation

Forecasting: Using data for dynamic inventory management

We suggest CKH establish a dynamic inventory management system by using their historical data. Through periodic reviews of past and projected resource consumption, the business can apply a data-driven approach to the inventory and procurement systems. Forecasting methods will enable CKH to determine the Safety Stock (SS) and provide a cushion or buffer against unexpected variations in demand or supply lead times (Gallego-García et al., 2021). Demand forecasting techniques can determine resource demands for each month in the future, and reduce instances of both excessive and low stock levels, and see a considerable reduction in stockout occurrences. Consequently, the procurement team can use the SS to determine a re-order point and calculate the optimum order for each material at the lowest cost. Upon the implementation of a dynamic inventory control system, Racal Recorders Ltd., a manufacturer of recording systems, observed a stockout reduction of 25%, and the stockouts generally occurred in less important products (Potamianos et al., 1997). Using this example, we project that by implementing a proactive inventory system, CKH will see the instances of build delays caused by stock-outs drop to 15%.

There are a variety of ways in which to achieve this. While the use of a Material Requirements Planning (MRP) is ideal and would allow for automation of many tasks and calculations, these software packages can be costly to implement - both in capital and in time. While we suggest CKH consider the eventual investment in a digital inventory management system, there are a variety of techniques to perform forecasting either manually, or with the assistance of spreadsheet software. CKH are already using spreadsheet tools in their procurement processes so we suggest this is better utilised to provide a more immediate solution to their stock issues.



Cycle Time	Theoretical Cycle Time	Cycle Time Efficiency
CT = 0.375 Days + 0.15 x ((0.375 Days + 3 Days + 0.125 Days + 0.375 Days + (0.8 x 5 Days + 0.2 x 10 Days) + 2 Days = **3.8562 Days** **CT = 3.8562 Days or 30.85 Hours**	TCT = 0.375 Days + 2 Days **TCT = 2.375 Days or 19 Hours**	CTE = 2.375 Days/3.8562 Days **CTE = 61.6%**

Savings:

Time = Original Cycle Time – Improved Cycle Time = 6.325 (after PSP) - 3.8562 = 2.4688 Days (saving a further 2.4688 Days)
No Change after PSP

Elevating Quality Assurance Processes with Six Sigma & DMAIC

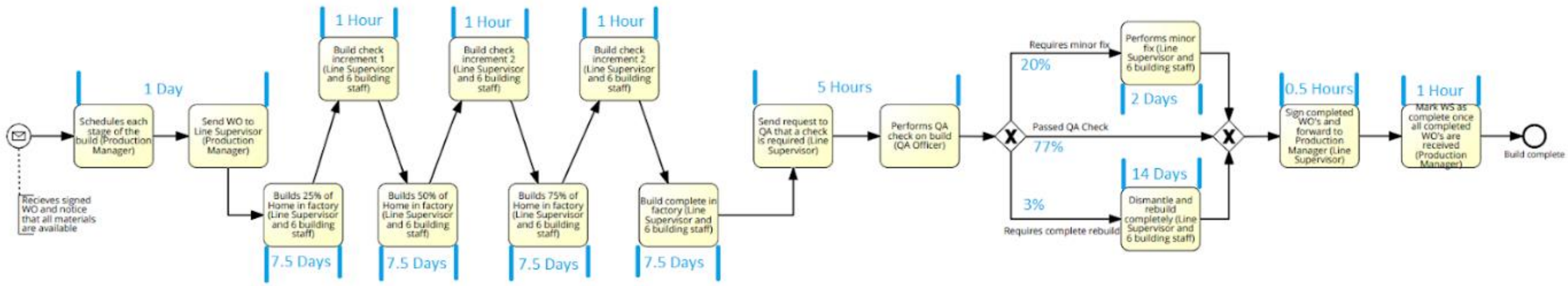
We also suggest a business-wide implementation of Six Sigma tools, specifically DMAIC methodology, to drastically reduce the occurrence of defects & reworks. Six Sigma (SS) is a business strategy that provides tools to help manufacturers achieve high quality products through efficient production (Taghizadegan, 2006). DMAIC is an acronym short for Define, Measure, Analyse, Modify, Improve, Control, and helps businesses apply a data-driven approach to quality.
The current processes at CKH have seen 58% of all builds are impacted and subsequently delayed by defects - less than half of all builds currently pass the QA check. Through our root-cause analysis we have determined that this likely caused by a number of factors including:

- Inadequate quality assurance systems currently
- Defects resulting from quality issues in raw materials
- Poor workmanship as a result of insufficient training.

Through further consideration of these factors, we were able to ultimately trace these back to one issue: an insufficient emphasis on quality control methodologies across all departments and business processes. The goal of the SS DMAIC tool is to address the root cause of a defect and ultimately reduce or eliminate its recurrence. DMAIC is a five-step approach to addressing the root cause of the issue (Mittal et al., 2023). When an issue occurs, the business will follow the below phases:
Define: Define the issue.
Measure: Quantify and measure the current issue and its impact
Analyse: Analyse the current process and circumstances to identify the cause and possible solution.
Improve: Implement a solution to directly address the issue.
Control: Monitor the results after implementation to ensure the problem has been permanently fixed.
Empirical data provides numerous examples of manufacturing businesses who have managed to significantly reduce defects occurring after adopting a SS DMAIC strategy. In one case, an Indian weather strip manufacturer was able to reduce the rate of defects by 55% after they applied the SS DMAIC method (Mittal et al., 2023). Additionally, a manufacturer of auto parts in Brazil saw considerable defect reduction using SS and DMAIC and had the total number of rejected parts drop by 92% (Condé et al., 2023).
We suggest CK improve their quality assurance strategy through the following:

- A document with a standardised template for a DMAIC analysis that is circulated to all departments
- A quality inspection checklist to be used throughout the build and goods inwards processes respectively
- Quality assurance checks to be completed incrementally throughout the build process, in addition to the check done at the end of manufacturing
- Training for all workers within the production department to establish the expected standard of quality for every process

Ultimately, we estimate that by implementing the above, CKH will observe a considerable reduction in overall defects for builds. Consequently, we hope this strategy will see the number of minor works reduce from 50% to 20% and the need for complete rebuilds drop from 8% to 3%.

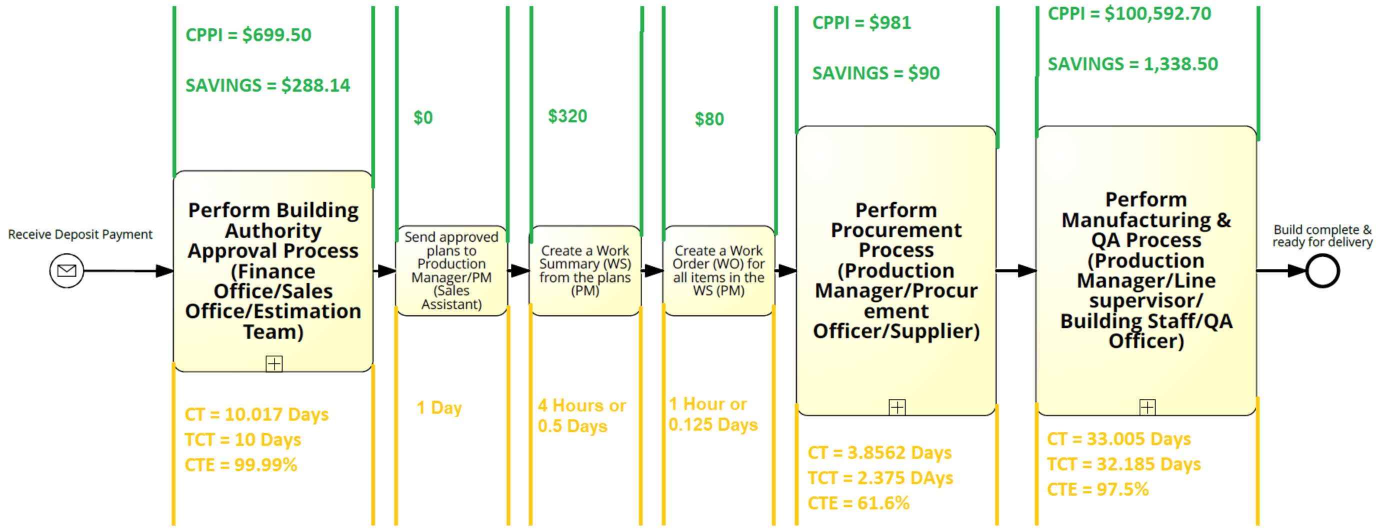


Cycle Time	Theoretical Cycle Time (TCT)	Cycle Time Efficiency (CTE)
= 1 Day + 30.375 Days + 0.625 Days + (0.2 x 2 Days) + (0.03 x 14 Days) + 0.06 Days + 0.125 Days **CT = 33.005 Days or 264.04.44 Hours**	= 1 Day + 30.375 Days + 0.625 Days + 0.06 Days + 0.125 Days **TCT = 32.185 Days or 257.48 Hours**	= 32.185 Days/ 33.005 Days **CTE = 97.5%**

Savings:

Time = Original Cycle Time – Improved Cycle Time = 36.93 - 33.005 = 3.925 Days
Cost = Original Process Cost - Improved Process Cost = \$101931.20 - (8 x 80 + (30.375 x 8 x (6 x 55 + 65)) + 5 x 55 + (0.2 x 2 x 8 x (6 x 55 + 65)) + (0.03 x 14 x 8 x (6 x 55 + 65)) + 0.5 x 65 + 1 x 80) = \$1338.50

Overall Intervention Effectiveness



Cycle Time (CT)	**Theoretical Cycle Time (TCT)**	**Cycle Time Efficiency (CTE)**
CT= **33.005 + 3.8562 + 10.017 + 1 + 0.5 + 0.125** **CT = 48.5032 Days**	TCT= **32.185 + 2.375 + 10 + 0.5 + 0.125** **TCT = 45.185**	CTE = 45.185 Days/ 48.5032 Days **CTE = 93.2%**

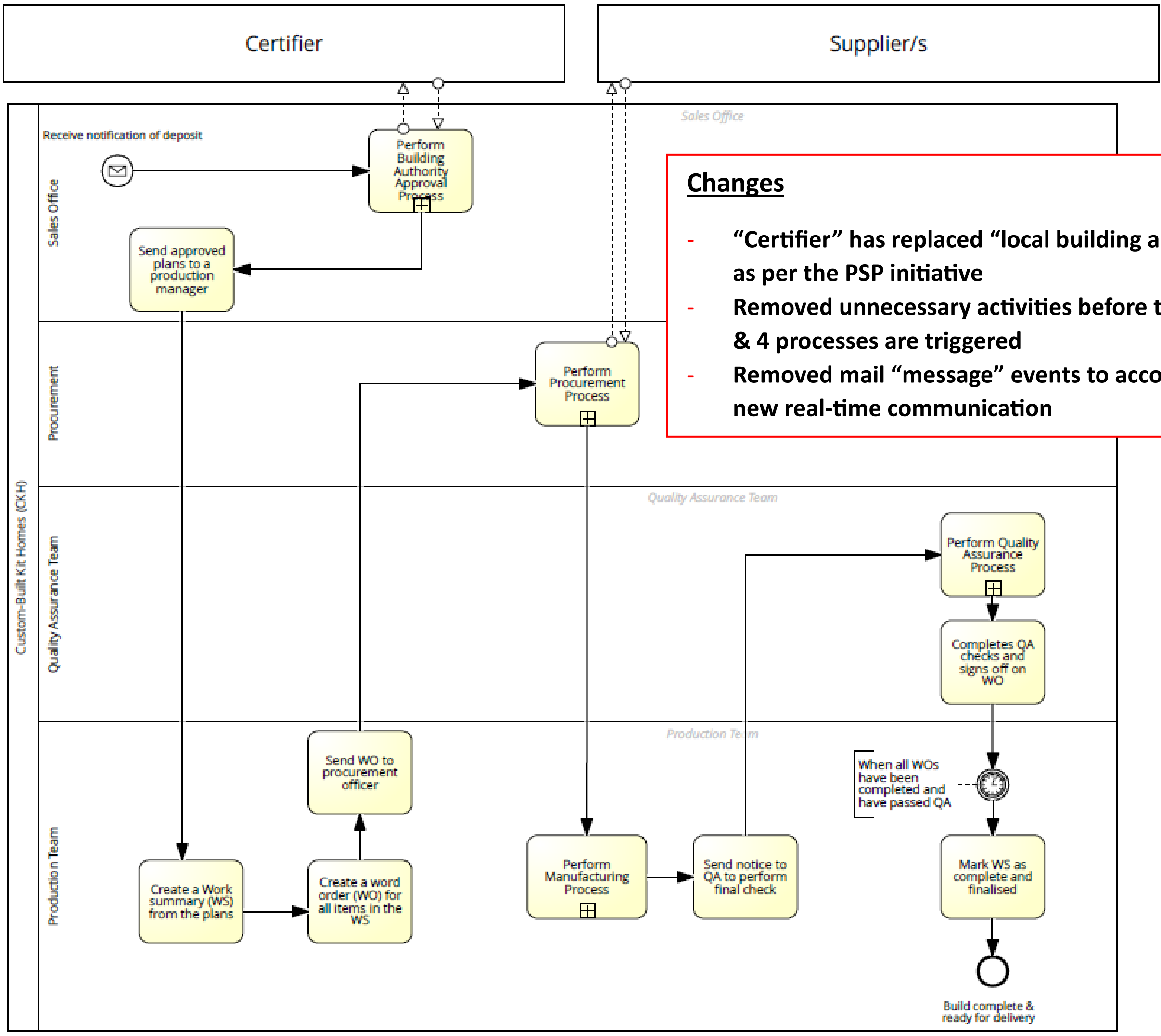
Savings:

Time = Original Cycle Time – Improved Cycle Time = 3.925 Days + 6.175 Days + 13.333 Days = 23.433 Working Days
Cost = Original Process Cost - Improved Process Cost = $1338.50 + $90 + $288.14 = $1716.64

Overall, it can be seen the time taken for each house has been reduced by about 23 working days, which equates to completion about 1 month sooner. Increasing the speed of production is important as not only does it make the customer happy but it also means that the factory floor will be clear sooner allowing for the potential increase in production. The decrease in production costs of about $1700 will have a major impact on the company, potentially increasing revenue from the 300 houses by about $500,000 per year. These savings in both time and money are achieved at an impressive 93% cycle time efficiency well up from the as is cycle of 77%.

“To Be” Process Diagrams:

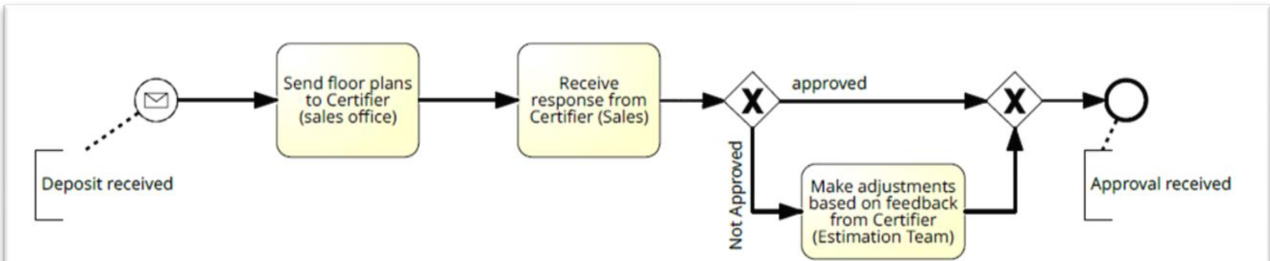
Level 2 – Production Process



Changes

- “Certifier” has replaced “local building authority” as per the PSP initiative
- Removed unnecessary activities before the Level 3 & 4 processes are triggered
- Removed mail “message” events to account for the new real-time communication

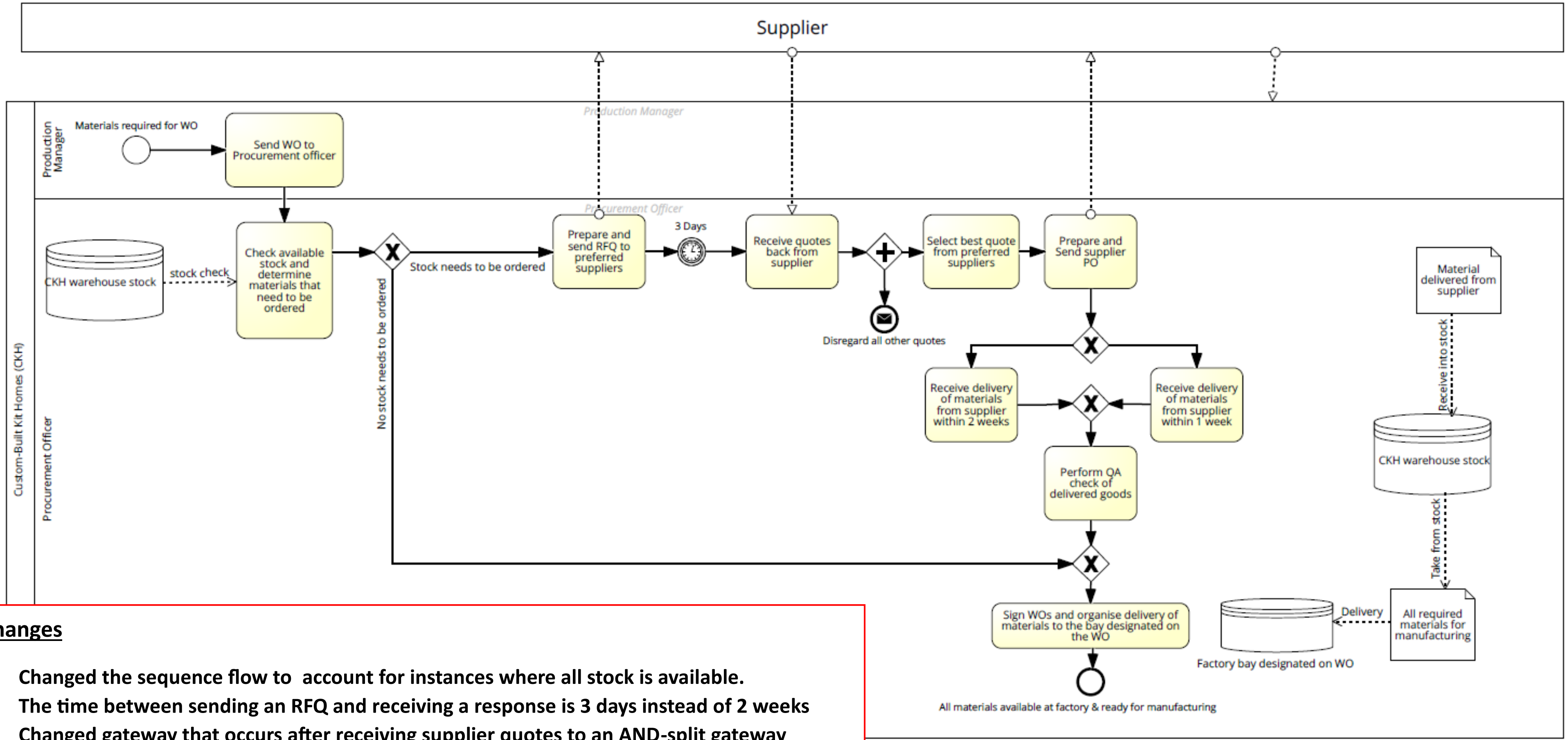
Level 3 – Building Approval Process



Changes

- “Certifier” has replaced “local building authority” as per the PSP initiative
- In the rework loop, the adjustments made are done with feedback from the Certifier

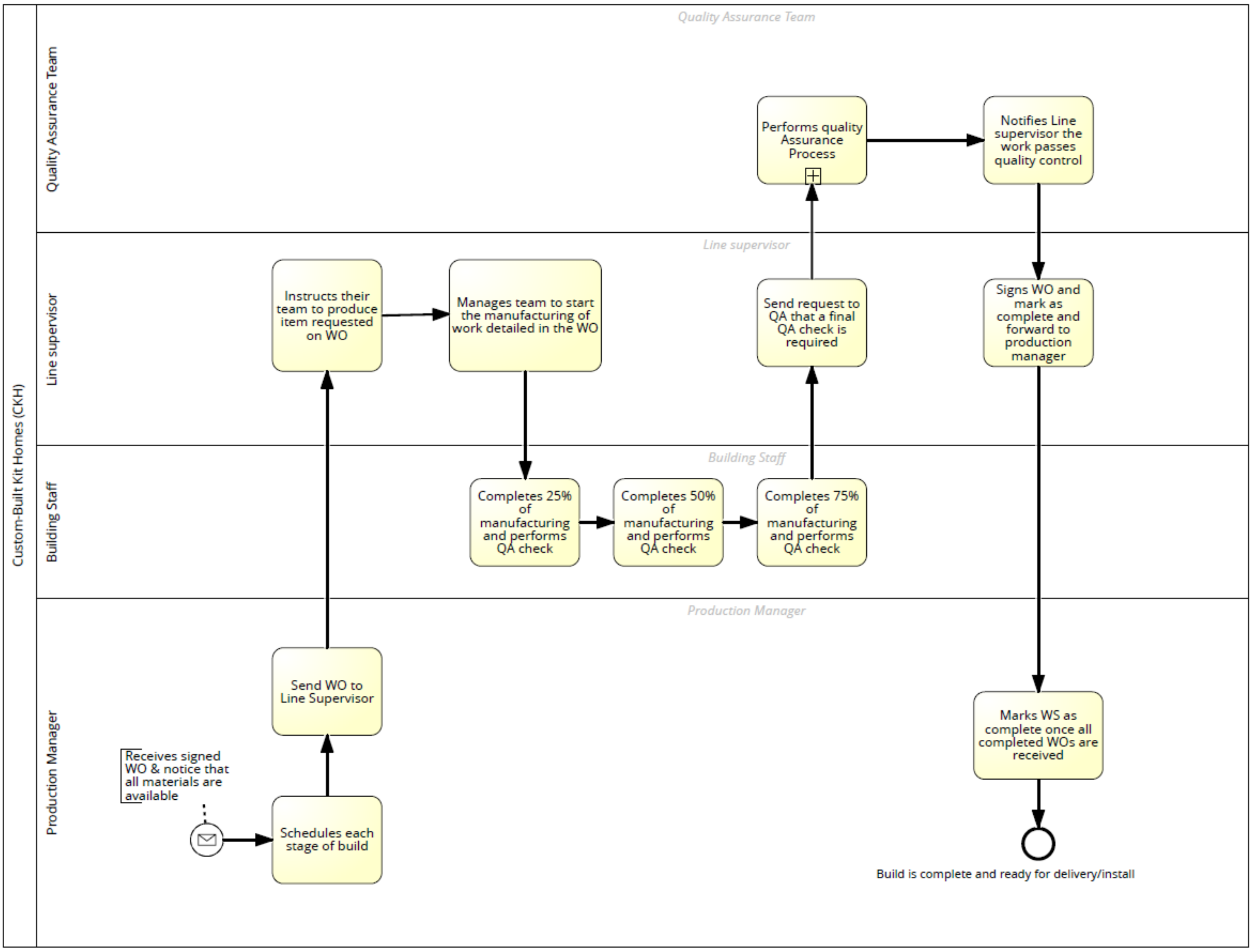
Level 3 – Procurement Process



Changes

- Changed the sequence flow to account for instances where all stock is available.
- The time between sending an RFQ and receiving a response is 3 days instead of 2 weeks
- Changed gateway that occurs after receiving supplier quotes to an AND-split gateway instead of the previous XOR-gateway
- Included new XOR-split gateways after a supplier PO is sent to account for the terms negotiated in the PSP.
- Removed mail "message" events to account for the new real-time communication

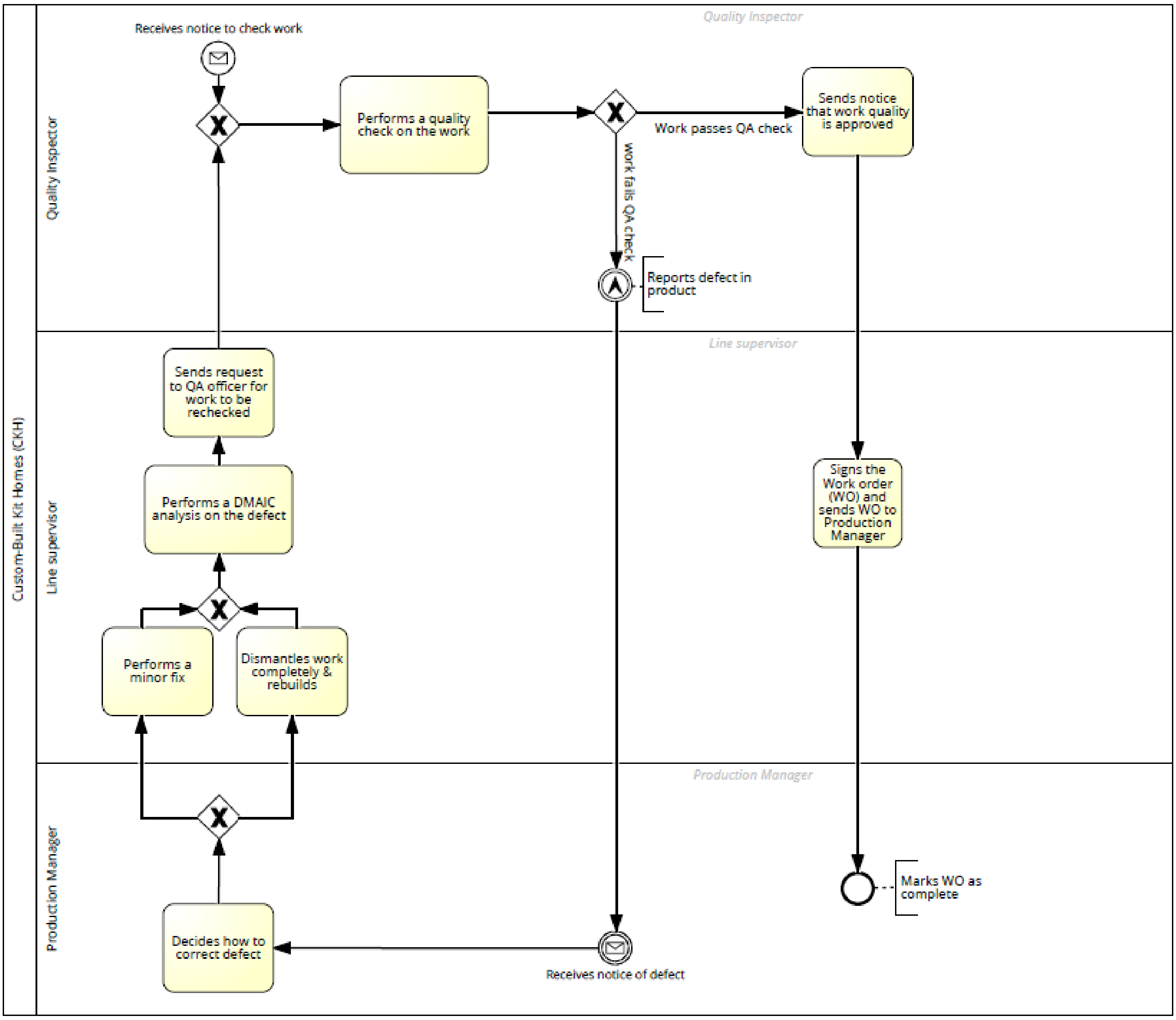
Level 3 – Manufacturing Process



Changes

- A new lane has been created for “Building Staff”
- New activities have been included in the “Building Staff” lane to account for the QA checks the building staff will be completing at 25%, 50% and 75% of the manufacturing phase. The QA Team will still perform the final QA check when manufacturing has been completed.
- Removed mail “message” events to account for the new real-time communication

Level 4 –Quality Assurance Process



Changes

- **A new activity has been added after the joining gateway after the option to either perform a minor fix or dismantle and rebuild. This new activity accounts for the implementation of the SS DMAIC analysis that will be conducted after issues.**
- **Removed mail "message" events to account for the new real-time communication**

Implementation Plan

Suggestion	Staff Involved	Timeframe	Resources	Steps for implementation
Real time communication system – going “paperless”	All departments need to be aware of the changes to communication processes	2 months	There would need to be a considerable investment from the IT staff. Allow all staff for feedback. All staff would need to have internal training.	1. Assessment of current communication infrastructure. 2. Define objectives of the real time communication system. 3. Select and acquire the right technology, keeping in mind the scalability of CBKH. 4. Check new technology in situ. 5. Internal training 6. Change management (allowing all stakeholders to be heard as there is often a resistance to change) This is to underline that CBKH values its relationships. 7. Initial implementation would be a pilot program to fine tune wide scale implementation. 8. Develop performance metrics. 9. Develop methods to provide document feedback and ways to continually improve.

Suggestion	Staff Involved	Timeframe	Resources	Steps for implementation
Preferred Supplier Program (PSP)	Procurement (for materials, sales and estimations for certifier	4 months	There would need to be a considerable investment of time for all staff from each department involved.	1. Define objectives of the PSP. 2. Select criteria for selection including provisions for scaling up CBKH 3. Identify potential suppliers 4. Communicate and negotiate with potential suppliers 5. Build and grow relationships with suppliers by providing them with as much information as required. 6. Initial implementation would be a pilot program to fine tune wide scale implementation. 7. Develop performance metrics. 8. Develop contract agreements. 9. Internal training. 10. Develop methods to provide documented feedback and ways to continually improve

Suggestion	Staff Involved	Timeframe	Resources	Steps for implementation
Dynamic Inventory Management	Procurement Office, IT Department, Manufacturing Staff (Indirectly)	Initial setup: 3-6 months Continuous improvement: Ongoing	- Training and skill development - Historical data & IT Infrastructure	1. Collect historical data on inventory levels, past purchase orders, lead times and demand patterns 2. Select Forecasting method 3. Implement software or digital tool 4. Integrate forecasting into Procurement process 5. Training and skill development 6. Continuous monitoring and improvement

Suggestion	Staff Involved	Timeframe	Resources	Steps for implementation
Enhancing Quality with Six Sigma & DMAIC	Quality Assurance Team, Manufacturing Staff	Initial setup: 6-8 months Continuous improvement: Ongoing	Six Sigma Training and Development Resources Standardisation Templates	1. Six Sigma and DMAIC training for all staff 2. Establish best practice standard for all processes 3. Create QA checklists for relevant processes 4. Begin incremental QA checks during the build process 5. Monitor performance against previous defect/error rate

Conclusion

In conclusion, this report provides a comprehensive assessment of Custom-Built Kit Homes' (CBKH) of the inefficiencies of the manufacturing processes, and the subsequent response to address each of these. The identified wastage includes transportation, waiting times throughout but especially in the procurement and building approval processes and also the massive number of defects reported. The Pareto analysis highlighted the need to target the wastage in the quality assurance and procurement processes. To address these inefficiencies and seize opportunities for improvement, CBKH is recommended to undertake a multi-faceted approach:

Real Time Communication
Real time communication eliminates the wastage of time due to archaic communication methods. By communicating electronically all staff (and suppliers and customers) get information as soon as they can.

Preferred Supplier Program (PSP)
The preferred supplier program is an initiative that will lead to significant benefits in both our building approval and procurement processes. It will achieve this by positively impacting our supply chain, costs, and lead times.

Dynamic Inventory Management

By implementing a dynamic inventory management system, we will be able to adapt our inventory to the customer's changing requirements. This system will allow us to optimise our inventory and minimise wait times.

Six Sigma with the DMAIC approach

By implementing Six Sigma with the DMAIC approach we will be able to enhance product quality and reduce costs. By fostering a culture of improvement, it will drive operational excellence now and into the future for CBKH.

By implementing these recommendations, CBKH can streamline its manufacturing process. It will result in large savings in both time and money. The solutions proposed aim to share required information quickly, reduce delays, create great relationships with suppliers, reduce instances of poor workmanship and reduce the need for inventory issues. Through the implementation of these strategies not only improve CBKH's immediate fiscal position and it's customer satisfaction, but also improve it's potential for scalability, due to the time frame improvements.

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Appendices

IFQ515 Assignment 2 Stephen Spence's Reflection

I enjoyed the learnings from this task. In particular what it takes to analyse and synthesis solutions for business that will make measurable differences to efficiency and profitability. There were great lessons in minimizing non-value adding tasks and ways to quantify, via appropriate assumptions, the impact of different types of interventions. By enhancing current practice, deriving from others practice, utilizing and designing new practice we can implement effective change

I was really lucky to work with such a motivated and professional team member in Jesse, we really do have complementary skillsets. We had regular and robust discussions about how we should go about this task. We were both really happy with our decision to not look at all the processes but showcase a wide variety of skills over the one process.

To begin with in this task, we made a plan to finish with enough time to make sure we can study for the exam, but I was lacking motivation and it was Jesse who got us started and on track to finish this task in a timely manner. In the beginning, she had looked ahead all of the modules and highlighted really important parts that I should look ahead and immerse myself in. After catching up to what Jesse had looked at, I feel that together we made good decisions about what techniques we chose to include to provide value to our client (CBKH).

Whilst we did split up the tasks (Jesse wrote the Executive Summary and I wrote the conclusion and we both contributed to the Introduction). But most of this assignment was both of us contributing to a common goal of helping CBKH save time and money in their manufacturing process. There would have been over 15 hours of online meetings to see this task through and I am really proud of both of us for value adding to CBKH business in such a productive way.

IFQ515 Assignment 2 Jesse Gentle's Reflection

This assignment was an opportunity to apply content learned in the last half of this course - especially the Process Analysis and Process Redesign stages. It was a great opportunity for me to these concepts to a real-world scenario, which was a valuable learning experience. I especially enjoyed how this task stimulated both the analytical and creative parts of me. We applied the content from Modules 4-8 to this assignment as below:

Module 4: Process Identification and Discovery:

- Used these concepts in the report to identify and catalogue the existing processes within CKH that contributed to wastage.

Module 5: Qualitative Process Analysis

- Used qualitative analysis techniques to perform both a waste & value-added analysis
- Used the root cause analysis & pareto analysis techniques to identify the factors that could have the most benefit if addressed

Module 6: Quantitative Process Analysis

- Used quantitative analysis techniques to perform both Flow Analysis on time and cost

Module 7: Process Redesign and Improvement

- Used systemic ideation and redesign heuristics to generate improvement ideas

Module 8: Process Implementation, Monitoring, and Controlling

- Used the concepts learn to conceptualise the practical aspects and resources required for the implementation of our improvement suggestions.
-

This assignment also gave me another chance to work on a project with Stephen who I had established a productive working relationship with in the previous assignment. I was fortunate to be working with a team member that was equally invested in the completing a quality report.

Stephen and I had many video calls in order to plan establish our understanding of the assignment requirements and from there we were able to plan how we approached the assignment. We decided to focus on the Production processes and then we were able to create a list of tasks to complete. We maintained constant communication through video calls, email and instant messenger to keep each other in the loop with how we were tracking and also provide feedback at each stage.

Stephen and I equally contributed to the qualitative and quantitative analysis portions of the report & in the creation of the "To-Be" models and distributed the rest of the tasks as below:

Jesse	Stephen
Report writing: Executive Summary, Process Analysis, Half of the improvement section (Forecasting & Six Sigma & DMAIC), Contents, Reference List, Half of the Implementation section (Forecasting & Six Sigma & DMAIC)	**Report writing:** Introduction, Pareto Analysis, Conclusion, Half of the improvement section ("Real time communication system" & "Preferred Supplier Partnerships"), Half of the Implementation section ("Real time communication system" & "Preferred Supplier Partnerships")

This assignment was a challenge but I'm happy to say it was a rewarding learning experience ultimately and I hope to one day apply these skills in the workplace.