



FEASIBILITY ANALYSIS OF INTEGRATION AND EXPANSION

MEM PROJECT REPORT

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ABSTRACT

This report details a MEM project that was undertaken to explore the feasibility of expansion and business integration with Concision Panelised Technology (Concision). Concision have identified with Spanbild that there is a growing demand for prefabrication within the New Zealand construction industry and by expanding their potential to supply and lowering their overheads they can capitalise on the market.

Literature reviews and due diligence on the construction were undertaken to provide a platform that a feasibility study can be undertaken. This report details the development of a budget, process improvement and improving staff knowledge.

An implementation plan and recommendations have been developed to aid Concision and ensure they are able to deliver an increase in supply and decrease their overheads providing improvements to their revenue.

ACKNOWLEDGEMENTS

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I would also like to extend my thanks to the following people who have been of constant support through the entire year and the MEM project:

- Beverley Hall – Course administrator

I would also like to acknowledge the MEM class of 2018 for the enjoyable year. It has been fantastic to complete the year with everyone.

DISCLAIMER

This project report has been completed in partial fulfilment of the requirements for the Master of Engineering Management (MEM) course at the University of Canterbury for the use of Concision Panelised Technology.

A copy of this report will be submitted to the College of Engineering to partly fulfil the MEM degree requirements.

The student, supervisor, nor the University will have any legal responsibility for statements or recommendations made in the Project Report and any legal claims made in relation thereto.

EXECUTIVE SUMMARY

This report details a project undertaken with Concision Panelised Technology (Concision) in partial fulfilment of the Master of Engineering Management (MEM) course at the University of Canterbury. This report provides a feasibility analysis for expansion and integration of different business units within Concision's Rolleston factory. Justification for the direction of research undertaken and relevant findings have also been provided.

Introduction

Concision specialise in the manufacture and construction of prefabricated buildings. Concision is based in Rolleston and is a subsidiary of Spanbild NZ LTD (Spanbild). Other subsidiary companies include contain Versatile, Portabild, Totalspan, and Idea Buildings. The issue that is facing Concision is a growing demand in medium to high density living. Concision have identified an option that they can integrate other businesses with Spanbild into their Rolleston factory and look at expanding their current factory.

Methodology

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graph LR; A[Initial analysis] --> B[Detailed analysis]; B --> C[Feasibility study];
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Initial analysis

Initial analysis was undertaken to understand the background of the project, what Concision and Spanbild do, what the current conditions of the industry are and what the industry is predicted to do in the future.

Detailed analysis

Detailed analysis was undertaken to understand more about the processes and product offering. The processes were analysed in as much detail as possible so that potential improvements could be identified and explored.

Feasibility study

A feasibility study was undertaken to produce a high level implementation plan for the future. The feasibility study included developing a budget for the project, improving current processes and increase staff knowledge of process.

Cost benefit

Table 1 presents a summary of potential cost benefits that have been identified.

Table 1: Summary of potential cost benefits

Item	Budget cost	Benefit
Integration of Portabild at Rolleston.	\$45,000	\$230000 rent and overhead decrease
Integration of timber at Rolleston	\$30,000	\$100,000 overhead decrease
POD improvements	\$40,000	\$750,000
Expansion of current factory/cutting cell	\$1,500,00 + \$70,000 salary new sales staff	No direct cost saving all costs come from improvement of other process.

Table 2: High level implementation plan

Project	Tasks	Risk and Mitigation Strategies	Requirements	Results
Financial Approval	<ul style="list-style-type: none"> - Detailed cost benefit received from financial team - Approval from board to advance project - <u>Complete by end of February 2019</u> 	<ul style="list-style-type: none"> - Board may not approve capital. Need to have developed clear benefits that will be seen - Budget underestimated. Costs exceed allocated budget. Need to apply reasonable contingency 	<ul style="list-style-type: none"> - Finance cost benefit analysis - Non-monetary benefits need to be explained 	<ul style="list-style-type: none"> - Capital approved
Integration of Portabild at Rolleston	<ul style="list-style-type: none"> - Widen existing roller door to allow units to smoothly enter and exit - Transport all plant and machinery from existing facility to Rolleston - Construct dedicated EPS cutting cell at Rolleston - <u>Complete by year June 2019 (lease expires at current Portabild factory)</u> 	<ul style="list-style-type: none"> - Tight time frame to have integration completes before lease expires - Localising facilities present risks from “act of god” event. Ensure that all changes meet required code. - Moving to a smaller facility if demand increases meeting it could present challenge. Ensure planning in advance and collaboration between Concision and Portabild sales is known 	<ul style="list-style-type: none"> - Council to approve building consent - New lease for Rolleston factory 	<ul style="list-style-type: none"> - Smooth transition of Portabild to Rolleston and units are easier able to leave factory - Reduction in overhead cost through less rent
Integration of timber at Rolleston	<ul style="list-style-type: none"> - Mover timber framing from Waterloo road site to Rolleston - Transport of trolleys from Rolleston to Waterloo road to load cladding and trusses. - <u>Complete by year end 2019</u> 	<ul style="list-style-type: none"> - Lack of buy in and reluctance from staff to move to Rolleston. Need to ensure benefits are realised - Logistics for moving trollies to Waterloo road. 	<ul style="list-style-type: none"> - Either purchasing own truck and hiring driver or entering contract with transport company. Cost tbc. 	<ul style="list-style-type: none"> - Reduction in overhead labour costs.
Expansion of current factory	<ul style="list-style-type: none"> - Undertake business case for cutting cell. Show that this is viable - Design and structural plans needed for any new work - Plan for how disruption downtime - Undertake expansion - <u>Tentative completion year end 2020</u> 	<ul style="list-style-type: none"> - Largest capital cost. Need to be sure that there is guaranteed return. Can perform stop gate throughout the process to ensure that expenditure is as anticipated and on budget - Project blowout. Occurs from poor planning. Ensure contractor presents detailed plans and schedule. - Carparking requirements risk. Need to ensure new resource consent is applied for and exemption got. 	<ul style="list-style-type: none"> - Structural design - Building and resource consent from council - Established and reputable contractor to perform building modifications 	<ul style="list-style-type: none"> - Business case showing returns possible. <u>This will give go or no go indicator</u> - Contractor hired to undertake work required

Recommendations

Table 3 provides a summary of supplementary recommendations for Concision.

Table 3: Summary of recommendations

Item	Description
Future proof Concision	<ul style="list-style-type: none"> - Concision needs to be aware of new innovations that are occurring within industry. Need to understand how they could be a disruptive technology and what the effects of it could be. - Concision should develop a morphology that can be used to delineate problems and help describe multi-disciplinary problems
Improve process	<ul style="list-style-type: none"> - Seek continuous improvement. Utilise feedback loop and cybernetics within the organisation to achieve synergy between management and staff
Manage organisation knowledge	<ul style="list-style-type: none"> - When people leave a business, it is important that their knowledge and methods for completing tasks are known. This is to ensure that future staff are able to pick up and understand what has been completed.

Conclusion

From the feasibility study, Table 4 provides a summary of the conclusions that have been made.

Table 4: Summary of conclusions made

Item	Description
Impact of poor product quality	<ul style="list-style-type: none"> - Undertaking a large venture Concision must ensure that even with any disruptions that are experienced this does not hamper their product quality - It takes a long time to build a reputation but a short time to destroy one.
Awareness of the “Fog of War”	<ul style="list-style-type: none"> - The “Fog of War” describes how there can be uncertainty faced when management and employees values are not aligned and everybody must have the same end goal in mind to achieve the target
Comparison to best practice	<ul style="list-style-type: none"> - Concision’s feasibility study aligned closely with what literature presented as what the best practice is to follow. This ensured that the best result can be obtained by trusting tested methods.

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INTRODUCTION

This report details a project undertaken with Concision Panelised Technology (Concision) in partial fulfilment of the Master of Engineering Management (MEM) course at the University of Canterbury. This report outlines who the sponsor company is, the problem faced, purpose of the project, methodology, recommendations and conclusions made.

In construction, contractors work for clients to complete a variety of projects that are designed to meet the needs of their clients. There are different ways that companies go about trying to do this, each trying to achieve a balance between producing the best possible product for their client and still being profitable.

Concision Panelised Technology

Concision is a construction-based company that specialise in the manufacturing of panelised buildings whether these are for homes, schools, apartments. Concision makes building panels in their Rolleston factory that are then transported and erected on site. There are numerous benefits that come as a result of this. The time spent working on site is greatly diminished as houses can be erected in under day. The panels can also come preinstalled with all the required cabling again saving time spend on site with subcontractors installing these. Prefabricated panels are also more sustainable and produce less waste then traditional methods. Additionally, Concision relies on the precision German CNC (computer numerical control) cutting machines to produce cuts to the mm whereas traditional onsite manufacturing produces accuracy to the cm.

Concision is a subsidiary of Spanbild NZ LTD (Spanbild). Other subsidiaries are Versatile, Portabild, Totalspan, and Idea Buildings. There are manufacturing facilities for each of these different brands around Christchurch. These business units make a wide variety of products from garages, modular buildings and POD bathrooms. These can be fully customisable to clients' needs. This allows for unique, boutique designs to be manufactured for clients.

Pain Point

Concision's pain point is unique in the fact that they are able to produce high quality products constantly. However there has been identified a shift in living arrangements to more medium to high density living. Additionally there has been forecasted that there is to be an increase in demand for many products within the Spanbild group that are currently operating at maximum capacity. There are high overheads associated with operating different business units and if this can be reduced by integrating into one facility then the profitability of their products will be much higher.

A analysis was undertaken using the PESTLE methodology (Political, Economical, Social, Technology, Legal and Environment) to have a greater understanding of the external factors that affect Concision and drive this pain point. The PESTLE analysis is found in Appendix A. A SWOT analysis was undertaken to better understand the internal factors. The SWOT analysis is included in Appendix B.

Purpose

The purpose of the project was to undertake a business analysis focusing on the feasibility of expansion for Concision's Rolleston factory. The project will look at the possibility of integrating the other business units particularly Versatile, Totalspan, Portabild and POD Bathrooms into the new factory. This is seen as a game changer for Concision and is a positive change to improve from business as usual.

For a feasibility analysis there will be several key factors that will be considered;

- Size;
- cost; and
- production.

Size

The size of the new factory will need to be considered as it will be important to make the expansion large enough for each of the business units to meet demands. It is important to have this planned correctly because there is no point in expanding and then realising that the new expansion does not have enough room to meet demand.

Cost

Cost is a large driver for feasibility analysis. It needs to be seen that the returns generated by the product can pay back the required capital investment. Analysis needs to be undertaken throughout the project to ensure that costs fall within a budget price and this is not exceeded.

Production

The production of the different products is again a large driver in a feasibility analysis. It needs to be determined that all the products can be manufactured at the new site. It is important to make sure that there will be no problems integrating other business units to Rolleston. It is important to consider their supply chain and existing arrangements that they have with their suppliers or contractors.

Within the consideration of production there is a large focus on production improvement. As new business units are moving to Rolleston there is a clean canvas for them to get the facility exactly how they would like. This is a key consideration as learning from the current set out about what is desirable and what is not can be applied to the new factory. In doing so, the production process will be more efficient. Additionally, it is important to consider all products in this project. Different products from different business units could be produced on the same line and decrease the footprint required.

It should be noted that Concision has already begun this project and analysed some of the logistics in regards to factory layout and size required.

Methodology

The project was split into three stages: initial analysis, detailed analysis and feasibility study (see Figure 1). The tasks are described in greater detail within Appendix C. This methodology was developed and used to ensure that sufficient understanding of the industry and Concision was known. From this knowledge about how about Concision's process were understood. Finally, the feasibility study could be undertaken and pooling together all this knowledge and implementation plan can be developed.

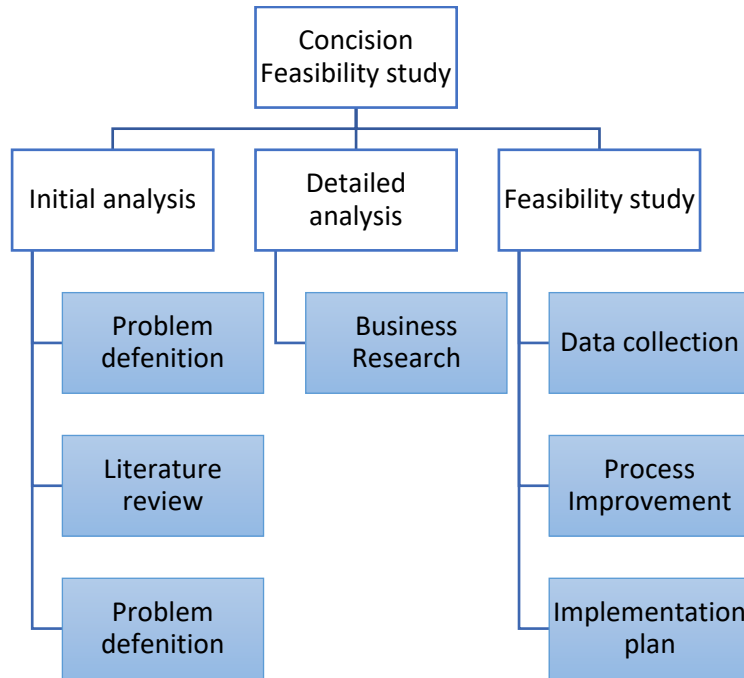


Figure 1: Methodology breakdown

Literature Review

A literature review was undertaken to develop an understanding of how to undertake a feasibility business case study. This was undertaken to what the best practice is and to be aware of any common pitfalls that may occur. Due diligence was also undertaken to ensure that there was sufficient knowledge of the business, the industry that it is in, and what the future is looking like. The review will gather information from a wide variety of sources in order to remove potential biases that may arise from reports published by people who have a vested interest.

First of all there is the need to clarify what a feasibility study is and should be involved in one. A feasibility study should be an investigation into something, which is capable, or not of being successful, such as initiation and continuation of a new project (Jónsson, 2012). It should be noted that although a feasibility study is not perfect it provides more meaningful data to replace wishful thinking. The study gives a rich detailed and accurate picture that includes information that needs to be known rather than information that is just easily available (Jónsson, 2012). By first understanding what a feasibility study is and what its purpose is this provides insight as to what the desired end goal should be.

The 2015 Market Measures Report has four key recommendations that should be followed for businesses to compete as seen in Figure 2.

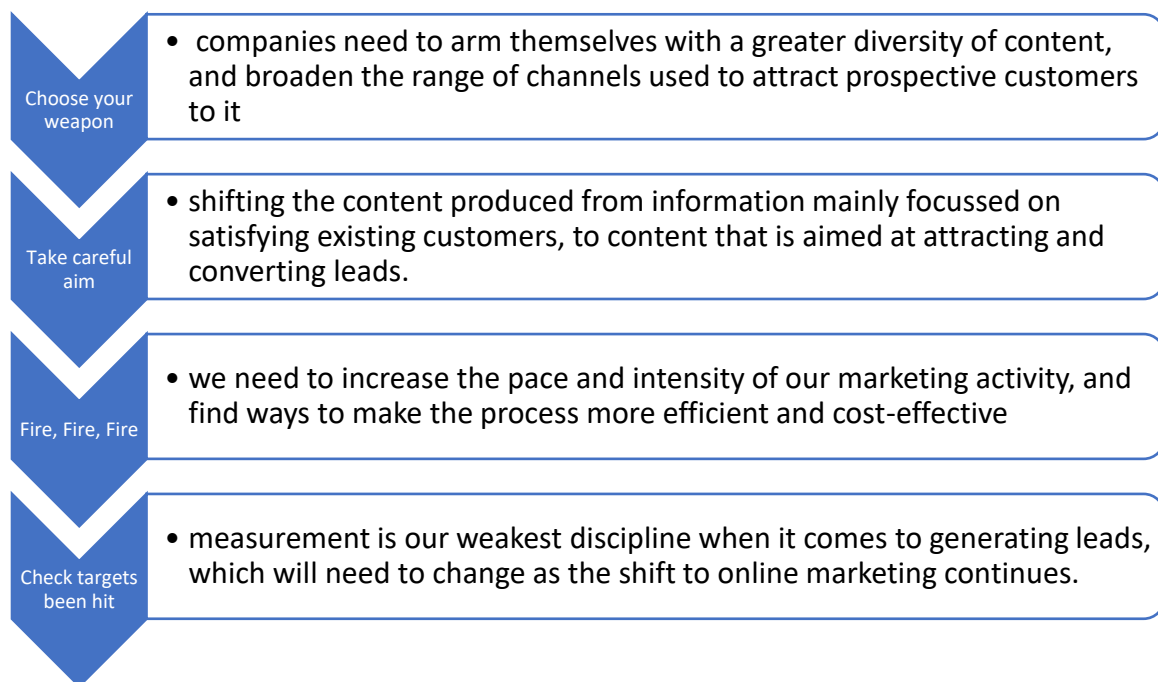


Figure 2: Four key recommendations for business to compete (Concentrate, 2015).

Although designed for technology companies this structure can be easily adapted and implement for any activity that is taking place. Prior to the project commencing Concision had identified that there is a demand in the market for medium to high density housing units and with increased demand in construction there is a shift towards prefabricated technology. It is important that due diligence has been completed early to provide insight around the legal and financial risks of the projects, determining any relevant details that may be needed later on, discover liabilities or risks that may be deal breakers and ensure compliance to relevant laws (Davis, 2009).

Concision have already 'chosen their weapon' to deal with this demand, which is to expand their current Rolleston factory so that they can integrate other business units and produce more of their products. This was

determined prior to the project commencing and the due diligence had already been undertaken. The project is commencing at the 'take careful aim' stage. This stage involves developing an understanding of how to undertake a feasibility analysis and develop knowledge of what is considered best practice. A literature review was undertaken to provide insight as to what the best practice to conduct a feasibility study is.

There are six key components that must be considered to be successful they are seen in Figure 3.

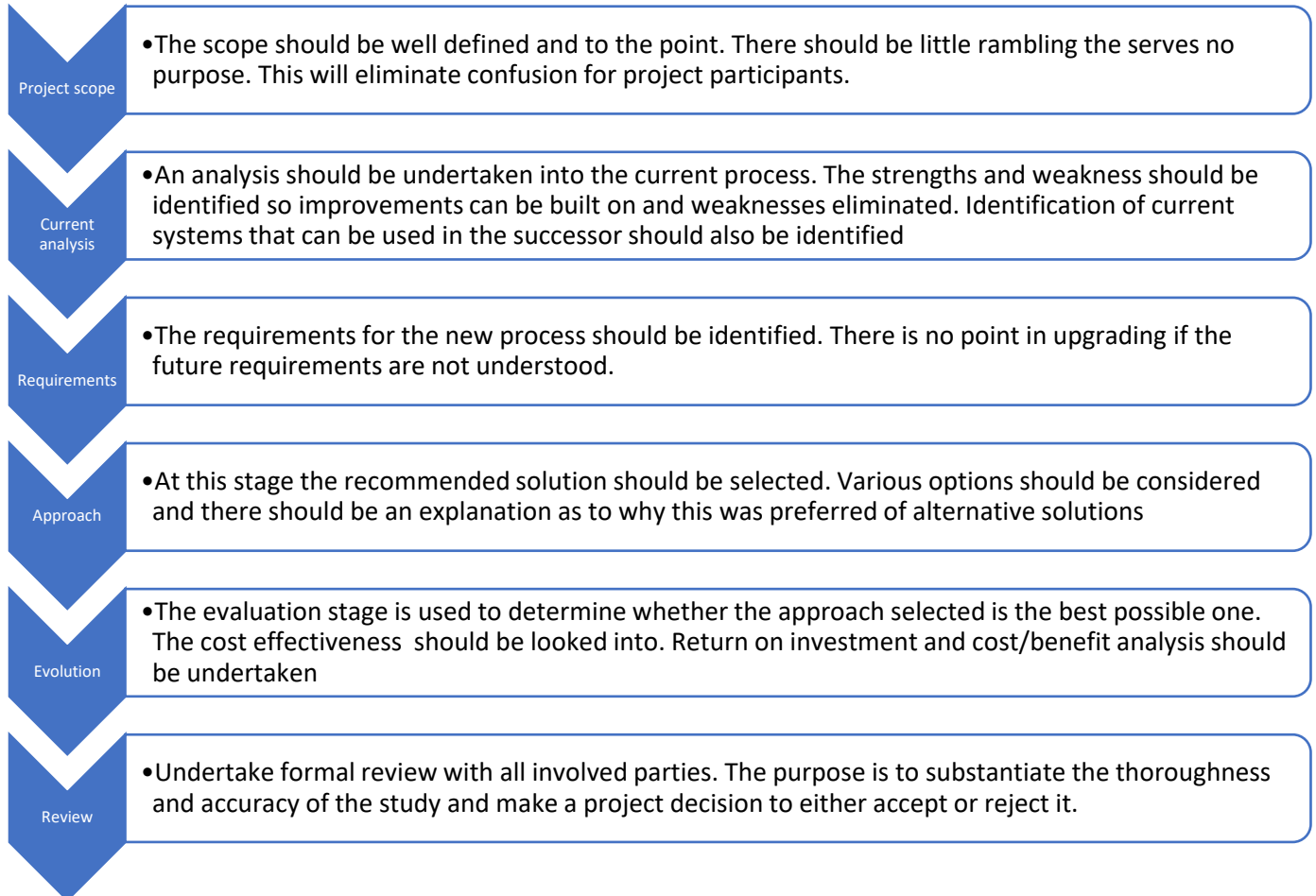


Figure 3: Components of feasibility study (Bryce, n.d.)

In relation to Concisions they;

- identified the increase in market demand,
- understood what their current capacity is, and
- what the requirements would be to meet increased demand.

They have chosen their approach to expand and integrate different business units into one facility. Currently, there is a need to evaluate and review this approach to determine that this is the best possible approach to take.

A review was undertaken to understand the best practices to develop a budget. The purpose of developing a budget is to achieve a strategic goal by allocating financial, physical and human resources (Andersen, 2000). It was identified that the keys to achieving best practices in developing a budget were the following (Lanzkron, 2017):

- One system and one method of input and analysis
- One language: common assumption, input, terminology
- Single chart of accounts and consistent costing methodology

- Ensure it is readable and usable
- Single system not requiring constant tailoring

The main takeaway from undertaking this is to ensure that the budget is as simple and easy for all parties to understand. The people who are reviewing and approving the budget need to be aware of everything that has been included. As the people who develop the budget are very familiar with project, they may not include all details in the budget as it can appear obvious to them, however to reviewers it can be difficult to understand or missed.

Due Diligence

Due diligence was taken to gain knowledge of the construction industry and understand where prefabrication sits, what the benefits of prefabrication are, and what the general process are.

Industry overview

There are three sectors that have been defined by in New Zealand (Ministry of Business, Innovation & Employment, 2013):

- Building construction (residential and non-residential)
- Heavy and civil engineering
- Construction (land development and site preparation, building structure services, building installation services building completion services, and other construction services)

Current construction methods in New Zealand indicate that New Zealand as a whole is much less productive than other countries. When comparing with the construction sector in Australia, Australian employees add on average 28% more value than New Zealand. Australian construction employees add on average \$104,000 (NZD) gross added value compared to \$75,000 (NZD) gross added value for New Zealand employees (Eaqub, 2013). This is a striking statistic and shows a need to improve production methods to improve employee added value.

Looking further at the construction industry it is evident that there is support for embracing new innovations that occur. Innovation rate is defined by the Ministry of Business, Innovation and Employment as the percentage of firms in a sector that undertook any activity during the last two financial years that resulted in the development or introduction of something new or significantly improved (Ministry of Business, Innovation, and Employment, 2014). It can be seen in Figure 4 that the number of firms that report innovation activity within construction fall below the New Zealand average.

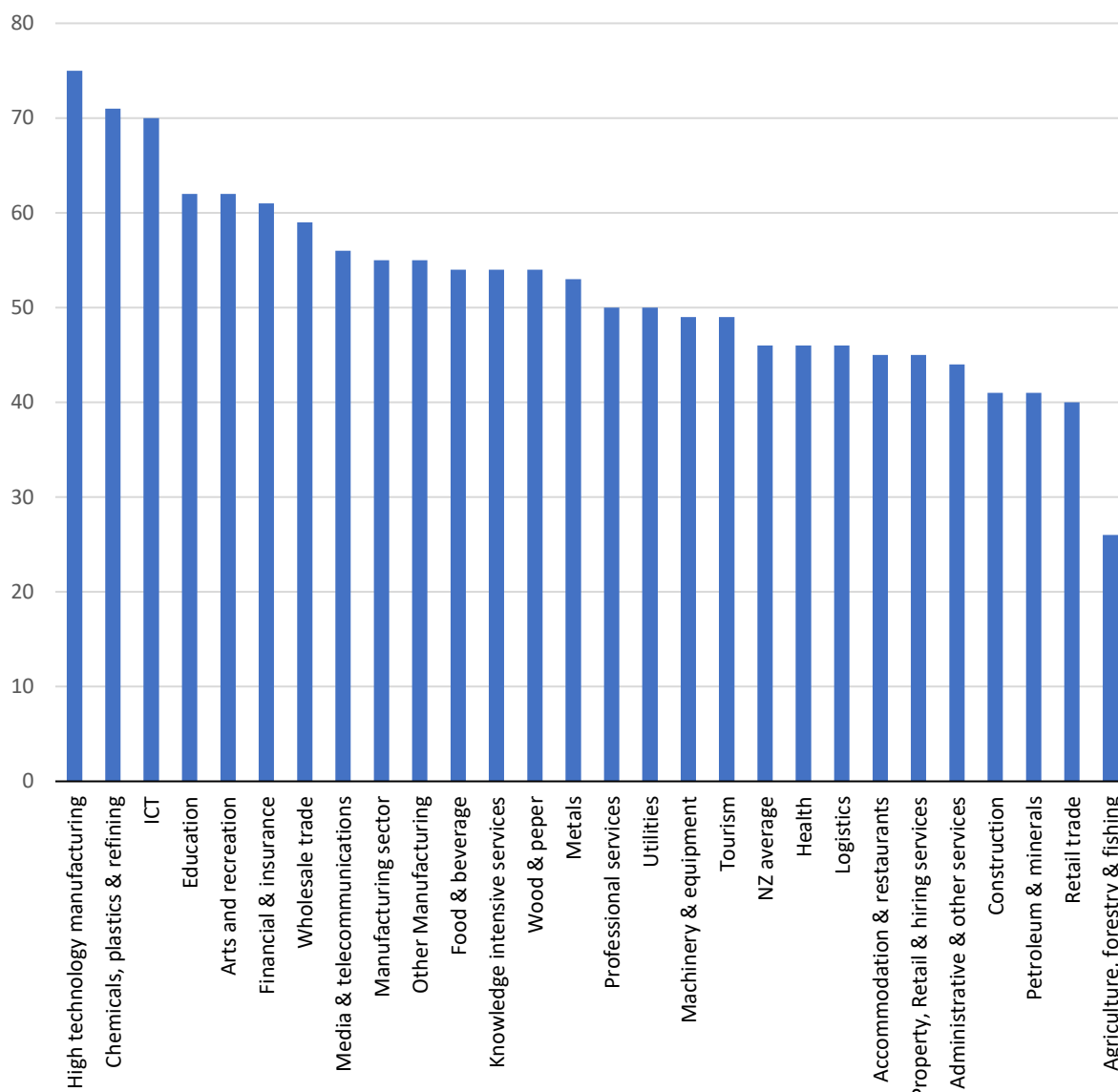


Figure 4: Innovation activity within different New Zealand industries

Off-site construction

Off-site construction is the process that involves planning, designing, fabricating, transport and assembling of building elements on-site. The history of prefabrication can be traced back to as early as the 1600's when the United Kingdom would send prefabricated house to the United States (Malti, 2014). The first known prefabricated apartment blocks were first seen in Liverpool in 1906, however it was not until after the Second World War that there was a large increase in prefabrication. In the six years following the war there was over 156,000 prefabricated houses built in the United Kingdom. In New Zealand the first prefabricated house was gift to Te Pahi in 1806 (Schrader, 2013). Throughout the early 1900s there were many prefabricated houses built however this number is minor compared to traditional method. However, given the recent demand increases in housing, prefabrication has been seen as a method that can be employed to ensure demand is met (Scofield, Potangaroa, & Bell, n.d.).

On-site these elements can be installed much faster than traditional construction method (Smith, 2016). Off-site construction has been prevalent in Europe for some time but within New Zealand this is an emerging market. It

is important to consider what the benefits of using this construction method are and why it should be used. The key factors that must be considered for every construction project are (Smith, 2016):

- Cost: capital and operational investment
- Labour: skilled and unskilled human workforce
- Scope: extent of project program
- Quality: meeting design and construction goals
- Risk: exposure to potential financial loss

Undertaking off-site construction has been found to have numerous benefits that relate to the aforementioned factors. These are (Smith, 2016):

- shorter construction schedules
- greater degree of predictability in cost
- reduced material waste
- reduced carbon emissions due to transportation to and from site associated with on-site construction
- reduced site disturbance, and finally
- an increase of safety and security of labourers and trade equipment.

Analysing a case study of Saint Joseph Hospital in Denver Colorado clearly shows the tangible benefits for off-site construction. The hospital was \$623 million, 8310 square feet constructed using prefabrication technology. The key numbers from the project were (Mortenson, 2014):

- 1.13 benefit to cost ratio. For every dollar that was spent on prefab, approximately 13% of the investment is expected to be returned as quantifiable benefit to the project
- Improvements in schedule and cost certainty. 18% scheduled compression enabled, 29,500 hours in labour saved, and 6% direct cost premium.
- On-site labour density. Improved productivity, flexibility, housekeeping and safety. \$2.6 million job productivity loss avoided, 150,500 labour hours diverted offsite
- Fewer safety incidents. Reduced congestion and schedule demands, improved positions and spaces. 7 safety incidents avoided
- Manpower consistency. Enhanced efficiency reduces training costs and reinforces cost certainty.

It should be noted that off-site manufacturing is not always the best solution. Every project needs to be fully understood to consider whether off-site or traditional is the best construction method. The disadvantages that can be found with off-site manufacturing are (Smith, 2016):

- Structural bulkiness
- Transportation limitations
- Configuration of design can be restricted
- Lack of transparency in overhead, profit margin, transport
- Flexibility and changeability of structure through future renovations become more difficult.

Another consideration is construction trends and what is forecasted for the future. Undertaking this will give insight into the future of the construction market. When the Labour government entered power, they introduced the Kiwibuild scheme with the aim of constructing 100,000 homes by 2028 (New Zealand Government, 2018). Kiwibuild issued an invitation for off-site manufactures in the last quarter of 2018.

Additionally, it is important to look at the overall construction industry to ensure that there are more channels to market than solely relying on Kiwibuild. It has been seen that residential construction remains a key driver for possible growth. From 2017 to December 2019 it is expected that the construction sector will grow by another 14%. Within this 14%, the residential sector accounts for two thirds of the expected growth.

Market analysis

Porter's five forces was used to gain a greater understanding of the market for off-site construction (Kenton, 2017). This is explained within Table 5.

Table 5: Porter's five forces

Force	Market analysis
Threat of new entry	There is a low threat of new entry for offsite manufacturing. There are several reasons behind this including: <ul style="list-style-type: none">- Large overhead costs associated with setting up a factory for production- Knowledge over industry is not as well established as traditional construction
Threat of substitution	Threat of substitution of offsite construction is the threat of traditional onsite construction.
Buyer power	New Zealand has a relatively small construction market compared to other international markets due to the small population size. There is high power buyer as a result because of this. Buyers will be more put off but damages to reputation and for a company to replace these buyers will be difficult.
Supplier power	There is not large supplier power within the industry. This is because there are several different suppliers of construction materials and materials used in offsite are very similar to traditional onsite.
Competitor rivalry	There is competitor rivalry from other prefabricated construction firms.

The market analysis from Porter's five forces indicate that it appears to be favourable conditions for Concision within their industry.

PrefabNZ devised a roadmap for 2013 – 2018 that highlighted their measures of success for prefabrication (PrefabNZ)

- Client receive increased value through high-quality functional building delivers on time and on budget
- Specifiers collaborate with clients and producers early on, and use digital technology to share files with producers
- Producers collaborate early on to achieve cost and time savings using innovation and technology where possible
- Regulators use consistent terminology for prefab terms, are familiar with different systems and use online tools for assessments
- Government takes a proactive approach to continuous improvement, leading by example and communication

DETAILED ANALYSIS

A detailed analysis to unpack what Concision's needs and the needs of the other business units within Spanbild was undertaken.

Business Unit Understanding

An important first task was to develop an understanding of the different business units that are operating within the Spanbild group. These were Concision, Versatile/Totalspan, Portabild and POD Bathroom. This was a necessary task as it is imperative to have a sound understanding of what products are being manufactured and that their requirements were.

Development of knowledge was done by undertaking site visits and meeting with production managers at each location. Prior to arrival on site a set of questions was prepared and sent to the production managers to give them an idea of what information was required. The questions were designed so that anyone could understand what we require, so that they can suitably prepare for meetings. Included in Appendix D is the completed questionnaire that was used.

There was a clear difference noticed in the quality of information gained from managers depending on whether they had previously read the questions. When they had, they knew exactly what was required and could deliver the required information as well as give additional information and insights into the production process that they deemed useful. It is recommended that before any meeting that information is given early to all parties involved and everyone understands what the desired outcome is.

It was also essential to undertake these meetings to make contact and have introductions with others in the business early in the project. This enabled me to build the necessary professional relationships with people who are involved in the process. This made it easy to talk to people later and ask questions. This is necessary, as it is impossible to gain the knowledge that production managers have from one meeting. Therefore, building early rapport allowed for ability to talk to them throughout the duration of the project. This meant it was significantly easier to gather more information and produce recommendations that are more beneficial. The work that is being undertaken is also confidential and there could be restructuring occurring. Until final plans are confirmed the board want to keep the project confidential. This means that I had to appreciate the sensitive nature of the project and know who to talk to and who is allowed to know about what the project involves.

Site tours have been essential tool to give a greater understanding of the business. It is easier to visualise the processes after seeing the manufacturing process in action. Undertaking them it was clear to see the different processes and how they relate to each other. Knowing how processes relate to each other gives the ability to ensure that tasks can be positioned correctly in a new facility and there is less down time moving from machine to machine. Additionally, bottlenecks in production could be identified and noted, so that later they can be analysed and improved upon. It is crucial that bottlenecks are noted as when moving to a new facility these should be removed where possible. It was found that the main bottlenecks were drying time for the POD production and timber packaging at Waterloo road.

Key insight: *Developing holistic overview of entire manufacturing process allows for systems thinking to be applied. Cybernetics theory can be applied to understand how the communication and feedback loops operated.*

A feasibility study was undertaken to pool together the prior analysis a create a high-level implementation plan for the option of expansion and integration.

Budget Development

The project is focused on the feasibility of expansion and identification and understanding of design and implementation costs is critical to business. It is important to prepare a global budget to give an idea to the board about what the costs of expansion would be. From this the board can give a go/no go decision on different sections.

This is an extremely useful step as there are ideas that the production managers wanted to explore to improve their process however, they were ultimately too expensive and the benefit did not outweigh the costs. An example of this was an investigation into using a waterjet to cut EPS panels. This was suggested as a potential improvement however talking to suppliers, they said the price would be \$400,000+ for a process that currently is being done by hand and within the accuracy tolerances this was not feasible to continue investigating option.

A key takeaway is that you need to be able to identify early, with sufficient level of confidence, when something is not worth the continued input of resources (time) into and then be able to make a timely decision to discontinue or modify the approach being taken. By continuing to investigate you are leaving yourself short on other more important topics. This is particularly important when you are working to a deadline and spending time on process that you can rule out at the start as unfeasible it vital.

While it is important to keep focused and aware of the deadline, there is also a need to push and challenge production managers on what they said was required. If new ways could be thought of to propose improvement and decrease the cost it is important to bring this up and say so. An organisation that allows people to challenge management and add their own input breeds a culture that strives to be the best possible company that it can be.

Within the budget there are prices that could not be received back from contractors before the budget was due, estimates must be added for this to the budget. Prices were added for these by talking to people who had experience dealing with something similar before. Consequently, a price that is close enough can be added to the budget and a larger contingency is added. This ensures that the budget is not exceeded keeping the board and stakeholders satisfied. It is important to ensure that the budget prices do have this contingency so that for unexpected variations can be covered and the budget is not exceeded.

The project is focused on a feasibility analysis of expansion. One of the most prevalent drivers of feasibility is cost (Munthali, 2016). The development of a budget was not only useful for the board to give a go/no go indicator it also is useful for those developing and implementing it. By being cost conscious this forces you to be aware of what you are doing and why you are doing it. You look for innovative ways to approach problems such that you maximise your capabilities while minimising your cost.

Examples of this were trying to look for alternatives to waterjet cutting. While it was found that the machine would be too expensive, the process could still be improved. The main driver for waterjet cutting was due to the current noise that is created. By deciding early that this was unfeasible, the focus was to look at the actual noise problem and identify ways of soundproofing an area that would be a more cost-effective option. Encouraging people to think of innovative options can cause cheaper and simpler options to be implemented.

Once the budget is completed it will be sent to the financial team to determine that the initial capital investment will be worth the increase in production. This means that our budget needs to be thorough and complete to give them the best possible picture. It is also important that it when dealing with different departments that it is clear

and understandable for everyone. Terms should be as simple as possible to avoid and confusion that could arise. In the same vain, there should be communication channels that everyone is aware of. Everybody should know who developed the budget and what are the main assumptions used to prepare the budget so that they can go to them with any questions. There are separate offices in different locations where people are working and this highlights the need for communication channels to be known as it is not as simple as going across the office to talk to someone. This was found to be in line with the best practice found from the literature review.

Key insight: *It is important that during the budget development that optimism bias is not experienced sufficient contingency should be applied to items. It can be easier to think that nothing bad will happen and presenting a lower budget will be beneficial enabling the project to happen however, this can happen from optimism bias and cause projects to go over the allocated budget (Flyvbjerg, 2008)*

Simplification of Tasks

During this project it was important to simplify and make processes understandable for everyone. For some procedures they were only known by certain people and the information was not written down to see and understand. By documenting the process and making it easy to visualise for everyone, knowledge can be shared and easily understood by everyone. It is important to make it visual and simple to follow as opposed to making a list of just words. Having a list is difficult to easily recognise where you are in tasks and what the next steps are. Additionally, undertaking this task fits the company's ethos of lean construction. It is designed to remove down time and waste thus increase the overall efficiency of manufacturing.

By making the knowledge of tasks easily accessible it empowers people complete work to their best standard. It has been found that advantages of employee empowerment are (Imran, 2014):

- Increased job satisfaction
- Effective teamwork
- Increased employee participation
- Reduced turnover rates
- Increased trust in the organisation
- Less employee conflicts

These charts can be presented at board meeting and can be used to show tasks that are removed by having different integration options. Board members time are valuable and having them view a something that is visual rather than a list of works allows for better use of time. They can quickly glance over and see by changing process where the time savings would be. The different charts have been included within Appendix F that show the proposed options for timber integration at Rolleston and the changes that will occur as a result.

Key insight: *Management reward employees when tasks are completed, and employees go above and beyond what is expected. However, when mistakes occur there should no blame to the individual if it was an honest mistake and management should look at the system that caused this to occur opposed blaming the individual (Walton, 2006). Developing this culture is key to employee feeling empowered.*

Current Process Improvements

Process improvement is looking at how to make things better. It benefits companies by allowing companies to look at how they work, what are the major factors involved and how can waste be eliminated. The ideal outcome is that jobs are done cheaper, quicker, easier and safer (Melbye, 2010).

POD bathrooms

Undertaking the feasibility analysis to moving the POD bathrooms' manufacturing into Rolleston providing an opportunity to analyse the current production methods and come up with way to improve production.

Within the current POD facility in Kainga there is a demonstrated output of 45 PODs per month. The theoretical output based on having all three lines operational and running at maximum efficiency is 60 PODs per month. It is clear from this that there is lost time somewhere in this process and by removing this will allow for more revenue to be generated and less downtime experienced. It is important to identify this as well because the predicted output for 2019 is expected to be approximately 100 PODs a month. Therefore, it is imperative that the manufacturing is as efficient as possible. Prior to the proposed integration at the Rolleston factory manufacturing of the PODs will continue at Kainga however due to increased demand there needs to be changes made in production so that the Kainga's factory output is improved.

Undertaking site visits view the current manufacturing process provided a valuable insight as to how they were made, how many staff are required, time taken for each stage and identification of manufacturing methods that can be improved.

From this it is possible to come up with areas that can be improved upon and present back to the manufacturing team to receive their thoughts and input. Suggested process improvements are the following:

1. At the early stages of manufacturing there are activities that are completed on the lines that can be removed. By doing this it will decrease the overall time that PODs stay in the line. The proposed activities that can be removed are the application of resin and fibreglass to the floor panels, cutting the channels for the triboard, installation of channels to floor and resin outside of POD with epoxy. These activities can be completed in Rolleston offline and then either transported to Kainga to go onto the existing lines or be placed on the lines at Rolleston once integrated. Implementing this change could save approximately 13 hours on the line at the beginning of manufacturing.
2. If the Rolleston factory does use CNC cutting to cut the PODs this can allow the tiles for the POD floor and roof to be pre-cut. Current construction methods can produce PODs that are slightly out form the specified dimensions. This means that tiles need to be cut from measurements taken from the actual POD not the design. Pre-cutting of tiles can only be implemented if there is assurance that the POD will be accurate to the design specified. This will save the tiler which is a subcontractor time spend measuring the PODs and result in lower overall costs.
3. At the end on the manufacturing process there is time that the POD is on the line that could be removed, and the closeout be completed offline. These tasks include the silicone of PODs, shrink wrapping, labelling, and loading of PODs. Time saving from this change could reduce total line time by approximately 7 hours.
4. Currently the POD doors all have their hardware assemble with the door already installed on the POD. What this means is that while the hardware is being installed there cannot be any other work that is completed inside the POD. Currently the doors are removed to be painted and then rehung after painting. To save time on the line the door hardware can be installed after painting and before being rehung. This would allow for multiple parts of the POD to be worked on at the same time again decreasing the overall time on the line. There is approximately 2.5 hours that can be saved but installing door hardware offline.

Within Appendix G is the Gantt Chart that shows what activities can be moved offline and the total time that will be saved as a result.

Wall line

Additional process improvement that has been investigated is a portable roller system that can remove panels from the existing wall line. This process will look at increasing the efficiency of the overall process and decreasing man-hours that are required to currently remove panels. The rollers need to be removable as they are set up in the existing wall racking and when walls are being produced this racking is needs to be used. The proposed solution was to install permanent U sections to the existing vertical racking supports and have rollers that can be inserted and removed as required. At the time of reporting, designs and prices are still with the contractor. Once retrieved cost/benefit analysis of labour hours vs overall cost can be undertaken to determine the payback period and breakeven point.

Key insight: *Concision is in a unique position where they can implement what they have learnt from experience manufacturing different products. Moving into a new facility it is important that Concision pool this knowledge together in to create the most efficient and effective processes possible.*

COST BENEFIT

High level cost benefit has been undertaken to ensure that returns on investment are possible and within a general range that is to be expected. It is emphasised that the return on investments are approximate and the Financial Team within Spanbild are conducting thorough return on investments and payback periods.

Table 6 provides a cost benefit of all the different options. Included is the budget price. The complexity of the options, the quantitative benefits and the qualitative benefits. The complexity is included to highlight that while there may be overall a low budget price there will be additional tasks that could impact and cause other costs such as lost time of production.

There can be significant cost benefit from each of these options as seen from a high-level analysis. Detailed financial benefits to be presented from the Financial Team in February.

Table 6: Cost benefit of options

Stage	Budget cost	Complexity	Quantitative benefits (per year unless specified)	Qualitative benefits
Integration of Portabild at Rolleston.	\$45,000	Down time of Portabild construction during transport	\$200,000 rent removed \$30,000 Removal of utilities overhead	Concision staff can be used to make Portabild units if high demand
Integration of timber at Rolleston	\$30,000	Low complexity. Minimal additional items that could affect option	\$100,000 overhead decrease from labour savings (redundancy payment needed)	More room at Waterloo road to make more steel products
POD improvements	\$40,000	Many moving parts. New training for staff will be needed to understand process	\$750,000 if sales forecast is correct and can meet 100 POD a month demand.	Less waste, currently not tracked but CNC cutting will ensure much more accurate cuts
Expansion of current factory/cutting cell	\$1,500,00 + \$70,000 salary new sales staff	Significant complexity from council. Cost can rise from new resource consents potentially need TBC.	No direct cost saving all costs come from improvement of other process.	Ability to supply other building companies. Can be seen as a new business (Business case needed) <u>Need to determine what new sales will be, critical task.</u> Adds ability to pivot if demand is high on certain product Decrease in lead time Increase in material utilisation Increased racking options available

CONCLUSIONS

From this project, the following conclusions can be inferred.

Impact of Poor Product Quality

While the construction industry may appear large, reputation is vital to maintaining relationships with clients. Producing poor products for major clients such as the government or other large construction firms can result in loss of future work. Word of mouth, reviews, reports and historical knowledge are all means that word is spread. It is important that when transitioning and businesses are making changes to the processes that the final product is delivered on time, on budget and on quality. It takes time for a good reputation to be built however this can quickly be gone through one piece of poor quality.

Comparison to Best Practice

Comparing how Concision operates compared to the best practice found in literature it is evident that there has been thought and research taken as to how Concision will undertake this feasibility study. This has allowed for tasks to be completed without over complicating them. By doing this result have been able to be produced that are desired. It is important to follow best practice as these methods have been tried and tested and are proven to show that they are reliable.

Awareness of Fog of War

Much like in the “Fog of War” is a term coined by Carl von Clausewitz used to describe describes the uncertainty faced by soldiers in the field of battle (Bonchek & Fussell, 2013). Within this project the “Fog of War” could be seen when dealing with the different managers. Everybody needed to understand the overall goal, why this was being done and how this would be achieved. Senior management need to make decisions that can guide everybody and ensure that they are aligned with the final goal.

Closing statement

Concision is looking for a game changer that will separate them from other businesses within the construction industry. It has been seen that given the current market demand there is an opportunity for Concision to lower its overhead costs and increase the number of products it can supply. Reflecting on the purposes of the MEM project it has been successful as it provided insight to the sponsor that the overall project of expansion and integration is feasible. Moving forward Concision should continue to search for game changes to remain an industry leader.

RECOMMENDATIONS

Additional recommendations beyond the scope of the project have been made to ensure Concision can position itself in the its most competitive position.

Future Proofing Concision

As with any new idea it is important to consider how future innovations could impact the new idea. For Concision it is important to consider how innovations in construction technology could either positively or negatively affect them.

New technology trends that can be seen is the innovation of 3D printing within the construction industry. 3D printing is not a new technology however using it to construct buildings is something that has recently started to be done in the USA (Vialva, 2019).

It is important that Concision are aware of innovation as they could be detrimental in the future and be a disruptive technology. It should be noted that while the example of 3D printing has been used this could be replaced by any other innovation such as increases in automation. What is important for Concision to ensure is that they are aware of what the market is doing and any new innovations that are being implemented around the globe. It is important the Concision set themselves apart from disruptive technologies so that they are not hampered in the future and the return on investment is reduced for any upgrades that are undertaken. This can be considered as a wicked problem as there is a need to undertake this expansion and integration however future trends that cannot be predicted could hamper the revenue gain made. A general morphological analysis can be used to delineate a wicked problem. A morphological field can be used to help describe multi-disciplinary problems and are a tool that Concision could implement further in the future to ensure awareness of innovations and their effects in construction.

Being aware early will be beneficial because it will allow Concision to be an early adaptor of new technology and avoid being caught with the late majority. It is reported that only 8% of firms are classified as “cutting edge visionary” and it is vital Concision position themselves as close or in this group as possible (KPMG, 2016).

Embracing Change

Given the future of Concision and the entire Spanbild group it is evident that there needs to be buy in from everyone body involved and change needs to be embraced. This will allow for new processes to be embraced and acted upon. By embracing change outdated processes can be removed and improved and replaced with more streamlined tasks. It is important when changes happen that the people who can be affected by them are considered. People do not resist change brought on by technology because of the technology itself. They resist the effects of this change whether they are real or perceived (Beukman, 2018). This is particularly important in the construction industry as is an industry that is renowned as an industry that is a slow adopter of new techniques, materials and technologies (Robinson, 2018).

Improving Processes

It is important to keep looking for ways to improve processes to ensure Concision remains at the forefront of the industry. Feedback loops are critical for higher management to learn about what is going well and what can be improved. When management is aware of problems that are being faced it allows for new process to be investigated. This ties into having a no blame culture that ensures anybody is comfortable saying something that when went wrong and instead of fear for being blamed about the mistake it can be an opportunity for learning.

IMPLEMENTATION PLAN

Table 7 on the following page is a high-level implementation plan that has been developed to highlight the next steps that should be followed.

Implementation support

Support throughout the implementation is critical for the success of the project. Within Appendix H the key contractors have been included along with their contact details. Furthermore, in house support will be vital to following the implementation plan. Key Concision and Spanbild staff need to be aware of what is happening and how it could affect business at all stages. This includes disruptions to manufacturing while changing facilities and processes.

Risk management

A more detailed risk assessment has been undertaken and is included in Appendix I to highlight what potential risks can be encountered and what mitigation strategies there are.

Table 7: High level implementation plan

Project	Tasks	Risk and Mitigation Strategies	Requirements	Results
Financial Approval	<ul style="list-style-type: none"> - Detailed cost benefit received from financial team - Approval from board to advance project - <u>Complete by end of February 2019</u> 	<ul style="list-style-type: none"> - Board may not approve capital. Need to have developed clear benefits that will be seen - Budget underestimated. Costs exceed allocated budget. Need to apply reasonable contingency 	<ul style="list-style-type: none"> - Finance cost benefit analysis - Non-monetary benefits need to be explained 	<ul style="list-style-type: none"> - Capital approved
Integration of Portabild at Rolleston	<ul style="list-style-type: none"> - Widen existing roller door to allow units to smoothly enter and exit - Transport all plant and machinery from existing facility to Rolleston - Construct dedicated EPS cutting cell at Rolleston - <u>Complete by year June 2019 (lease expires at current Portabild factory)</u> 	<ul style="list-style-type: none"> - Tight time frame to have integration completes before lease expires - Localising facilities present risks from “act of god” event. Ensure that all changes meet required code. - Moving to a smaller facility if demand increases meeting it could present challenge. Ensure planning in advance and collaboration between Concision and Portabild sales is known 	<ul style="list-style-type: none"> - Council to approve building consent - New lease for Rolleston factory 	<ul style="list-style-type: none"> - Smooth transition of Portabild to Rolleston and units are easier able to leave factory - Reduction in overhead cost through less rent
Integration of timber at Rolleston	<ul style="list-style-type: none"> - Mover timber framing from Waterloo road site to Rolleston - Transport of trolleys from Rolleston to Waterloo road to load cladding and trusses. - <u>Complete by year end 2019</u> 	<ul style="list-style-type: none"> - Lack of buy in and reluctance from staff to move to Rolleston. Need to ensure benefits are realised - Logistics for moving trollies to Waterloo road. 	<ul style="list-style-type: none"> - Either purchasing own truck and hiring driver or entering contract with transport company. Cost tbc. 	<ul style="list-style-type: none"> - Reduction in overhead labour costs.
Expansion of current factory	<ul style="list-style-type: none"> - Undertake business case for cutting cell. Show that this is viable - Design and structural plans needed for any new work - Plan for how disruption downtime - Undertake expansion - <u>Tentative completion year end 2020</u> 	<ul style="list-style-type: none"> - Largest capital cost. Need to be sure that there is guaranteed return. Can perform stop gate throughout the process to ensure that expenditure is as anticipated and on budget - Project blowout. Occurs from poor planning. Ensure contractor presents detailed plans and schedule. - Carparking requirements risk. Need to ensure new resource consent is applied for and exemption got. 	<ul style="list-style-type: none"> - Structural design - Building and resource consent from council - Established and reputable contractor to perform building modifications 	<ul style="list-style-type: none"> - Business case showing returns possible. <u>This will give go or no go</u> - Contractor hired to undertake work required

Personal Reflection

Undertaking my project with Concision has provide me with a greater insight as to how businesses operate and make decisions about future projects. I have been able to gain valuable insight into the construction and manufacturing industry. MEM has the slogan 'stand out from other graduates. After completing my project, it became clear that this wasn't just a fancy slogan there to fill a box. Table 8 summaries MEM learns and how they were applied in the project.

Table 8: Application of MEM to project

Aspect of MEM	How It Helped
Systems thinking	When developing understanding of business units it was important to think about how they would relate and interact with each other. It was important to consider how a changing one thing may have certain benefits but there could be hidden unexpected negatives that occur as a result
Innovation	When trying to come up with new approaches to streamline current process and improve productivity it was important to keep in mind lessons learnt from innovation. An example of lesson learnt from innovation within MEM was the reluctance to be an earlier adopter as a general trend in industry. Within informal conversation people appeared hesitant to want to adapt something new without others having done it and it been shown to improve work.
Project management	This is a large project and as a result much planning and management is needing to ensure that it is kept on track and schedule. It was important to keep all relevant stakeholder informed with how progress is tracking and any issues that were to arise and what mitigation methods were being implemented as a result
Operations	While not having used it as much as some other course it was evident to see just how beneficial the lectures will have been. When looking at six sigma and lean it was clear that these can help reduce waste and inefficiencies. These principals lead the path that was chosen to improve process

Notably throughout the project it was seen that those who can go the extra mile and put in the effort outside of work are rewarded for their time. This was emphasised throughout the MEM course and was particularly great to see how within industry this is a skill that is an asset. While it may not mean working an 18-hour day putting in extra time to complete a task, it was something favourably looked at by management.

Another aspect learnt from MEM not in any class was about meetings and how to successfully run them. Throughout the year we were made aware of how meeting can be unproductive and drag on. This was extremely evident when the meetings did not have a set agenda. When this happened, people tended to go off topic and discuss other things. While they may have been important not everyone at a certain meeting needed to be there for that and delayed the meeting getting to the gist of what it is about. However, it was also seen that when meetings were taken it was easier to set targets and ensure that everyone was on the same page.

Undertaking this project has provided a valuable insight as to how businesses are run particularly within the construction industry. Previously I have had very little experience within a consultancy only and have only been in the actual construction side. I was glad that this opportunity presented itself to see more of the design side

and how everything comes together. On site there is often complaints the consultancies are out of touch and do not understand the complexities involved with constructing a certain design. However now that I have seen the design side, I understand that there is thought given to how it will be constructed, and designers do try and make it easier.

Within Appendix J is a full breakdown of lessons learnt throughout the project.

Improvements

If I were to have the option to repeat the project, there would be some things that I would improve upon. This would help get better results and ensure a smoother project. They are summarised in Table 9

Table 9: Improvements if the project was repeated

Item	Improvement
Scope Creep	Throughout my project I encounter scope creep happening. Often this meant that I would end up spending time on tasks that may not be as value added as other tasks. I think a main example of this would be during the literature review I jumped straight into it without clearly defining my goals and what I wanted to achieve from it.
Pre-project work	There were delays that occurred before my project began due to there being issues with confidentiality. This meant that I was 2 weeks late starting and had to try make up my hours later. If I had the option again, I would be more forceful with organising my start date and follow up more to ensure that everyone knows what is happening.
Literature review	Had I the opportunity again I would try find sources who were had done similar upgrades and what problems they encountered with the process. Given the timeframe and the uniqueness of the project it was difficult to find people to interview.

Ethical Considerations

Due to the nature of the project trying to improve process and integrate other business units into one facility consideration has to be made to ethical issues that could arise as a result. There are processes that will be streamlined, this could and will more than likely result in positions not being available and redundancy of employees. It was important to consider this because you are dealing with peoples' careers and livelihood. It was important to keep this project confidential and only those that needed to know did. This was important as nothing is finalised, and you do not want to speculate with people that people could be losing jobs.

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APPENDIX

Appendix A: Pestle Analysis

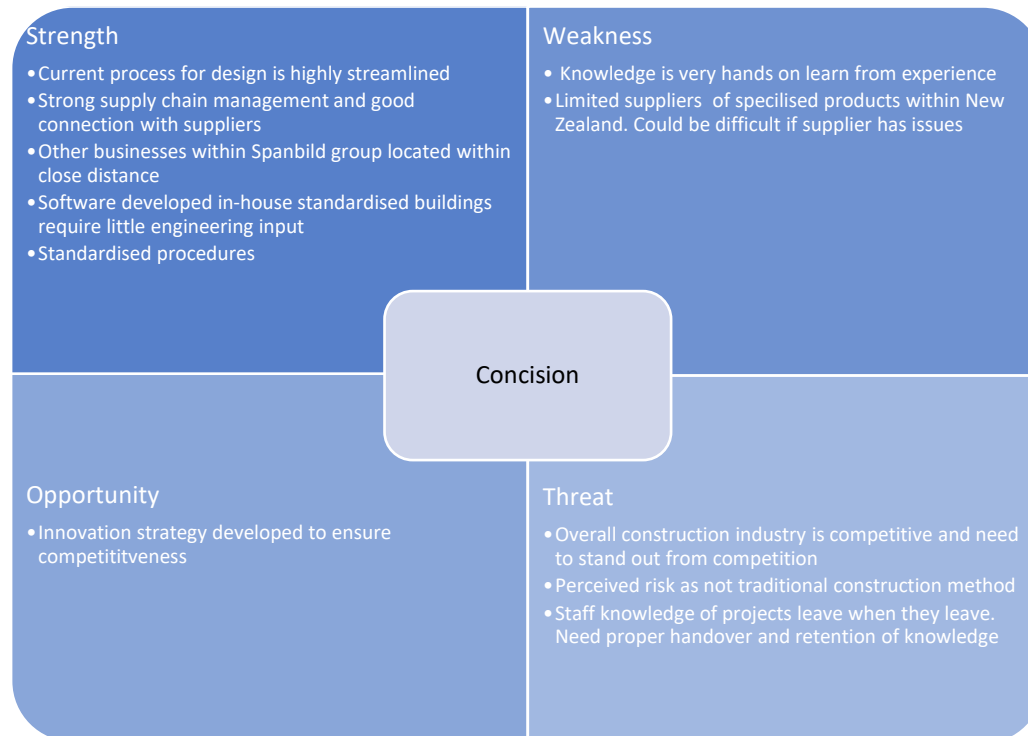
The following factors were considered with how they relate to Concision

Table 10: Pestle analysis of Concision

Factor	Effect
Political	Government project such as Kiwibuild have influenced the market and what is required from construction firms. Major stakeholders to projects could include iwi, residents, local and/or regional council.
Economic	The ability to increase supply of products to match an increase in demand ensures that there is a more return
Social	Constructing residential buildings Concision have a responsibility to deliver on time for the community. Delays could impact peoples livelihood.
Technological	Technology is increasing at an faster and faster rate this includes within construction industry. Companies are able to increase the speed of construction and decrease costs
Legal	Concision is required to deliver their products on time and at budget as specified by project contracts
Environment	Strict environmental regulations within construction. Within Prefabrication not as much affected due to construction in factory

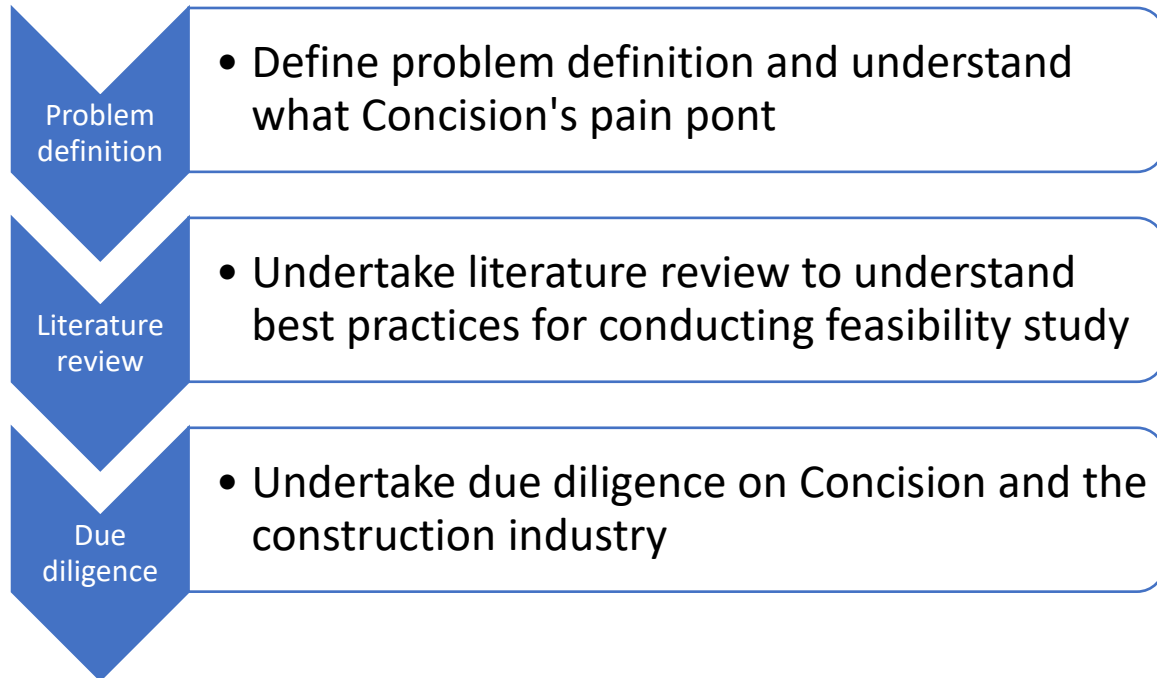
Appendix B: SWOT Analysis

The following SWOT analysis was undertaken for Concision to greater understand their internal factors



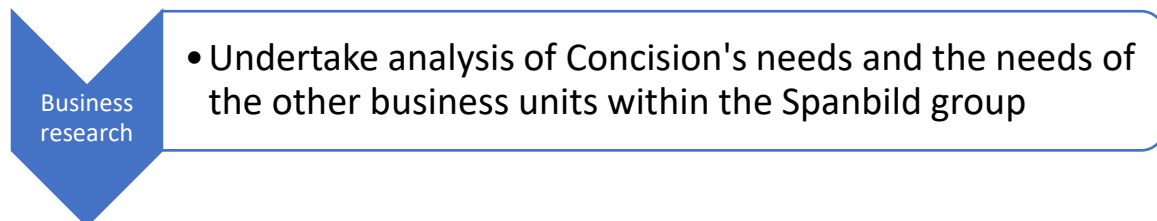
initial Analysis

The aim of this stage in the methodology is to obtain background research



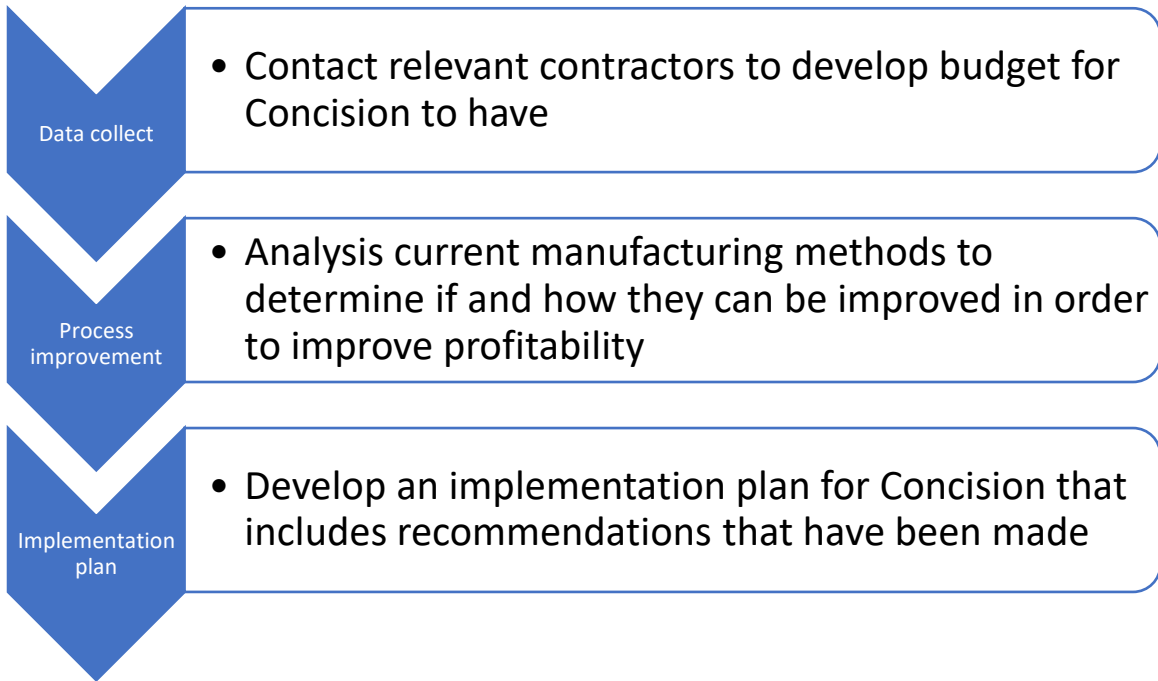
Detailed analysis

The aim of this stage was to undertake analysis at great depth.



Feasibility Study

The final stage of the project is to undertake the actual feasibility study for the project



Portabuild business research

About business overview:

What is the range of products that you manufacture? (differences in quality level, difference in sizes, etc...)

- 2 fundamental designs, Simplex, Duplex
- Approx. 29 standard ranges of products, each customisable.
- Length increases in 1.2m increments up to 13.2m
- Width varies from 1.2-4m Standard sizes 2.4m, 2.9m, 4m
- 5 tonne heaviest building
- Prices based on fit out not quality of material, quality remains constant throughout

What are the most recurring products manufactured?

- Most common sizes are 6x2.9m and 9x2.9m

What are your current manufacturing processes?

- Very manual
- Building as opposed to manufacturing
- Steel base by contractor
- 40mm polystyrene underfloor insulation
- 17mm H3 plywood floor
- 75mm EPS coloursteel panel walls and roof
- Aluminium double-glazed joinery
- Wiring for electrical, lights, and data. Fit off by contractor.

What volume has been budgeted for 2019?

- Current production is at 1 duplex a month plus maintenance. Potentially able to produce 2 duplex a month
- Ideal situation would be 1 building a week with correct training, tools, etc

What is the forecast in terms of order and volume associated in future?

About business needs:

What are your minimum production footprint requirements?

- 20x15m to build a single building. Allows for full run of panel, foot egress around all sides of the building and forklift egress on one side and one end.

- No allowance made for special projects
- No allowance made for welding or general stock
- 15x6m approx. for welding bay

What are your minimum goods storage space requirements?

- 10x20m for stock storage does not allow for base steel stock

What is your current inventory/stock management process?

- No process in place currently.
- Stocktakes undertaken however when completing them unsure if items have been allocated to jobs or not
- Need process to record what is taken

What equipment do you require to operate?

- Basic hand power tools
- Forklift to move stock (currently also used to push the buildings out the door)
- Ideally a head crane to move buildings and heavy panels
- Welding and steel cutting drilling machinery
- Timber drop saw and bench

What is your current equipment maintenance process?

- Reactive maintenance, go to store and replace item.
- Test and tag electrical items 3 months
- Forklift maintenance 6 months
- Hight and harness 6 months
- Roller door engineer check 6 months

What are special building requirements? (building WOF)

- Pest control, Rentakill
- Security, Triton
- Cleaning
- Groundskeeping
- Fire
- PPE protocol noise loud for EPS cutting. Mitigation needed.

About business budget costs:

What is your cost in terms of rent? (rent + lease management)

- Approx. \$230,000 a year total

- \$18,000 a month rent
- Lease end in September 2019
- Costs include empty storage yard in Kaianga

What are your costs of facilities maintenance? (electricity, security, building WOF, pest control, cleaning, etc...)

See above included in 230K a year

What are your equipment maintenance costs?

- Small, >\$500 given as consumable not includes
- Combines with renewal cost approx. \$5000 a year

What are your equipment renewal costs?

See above

Kainga Business research

About business overview:

What is the range of products that you manufacture? (differences in quality level, difference in sizes, etc...)

- Pod bathrooms, Top size 4.2x3.1m, Top weight 1.5 tonnes
- Light gauge steel products
- No difference in quality between jobs

What are the most recurring products manufactured?

- Pods ≈ 80% of business
- Steel ≈ 20% of business

What are your current manufacturing processes?

- Mael to input

What volume has been budgeted for 2019?

- 700 Pods for current financial year can increase

What is the forecast in terms of order and volume associated in future?

- Constant
- Approx 60-80 a month
- Want to be able to produce 5 Pods a day

About business needs:

What are your minimum production footprint requirements?

- 15 m needed after cutting
- 20 m needed for 3 lines of pods
- Distance between rails 2100 mm
- Distance between lines 3700 mm
- Steel assembly should be inline else there is a significant decrease in efficiency
- 2 Tables for steel work
- Need 3m between pods in middle and 1.5m on back for working
- Min 8x5 m for fibreglass
- Painting and fibreglass need to be undertaken in separate rooms
- Cannot speed up production process more than 12 a week
- Need to for drying if drying process is speed up shrinkage occurs
- Investigate constant temperature year round

What are your minimum goods storage space requirements?

What is your current inventory/stock management process?

- Currently being developed Work in Progress

What equipment do you require to operate?

- Tile cutting equipment
- Ventilation for fibre glass
- Crane system for boards
- Conveyor lines lower and level

What is your current equipment maintenance process?

- None

What are special building requirements? (building WOF)

- None

About business improvement:

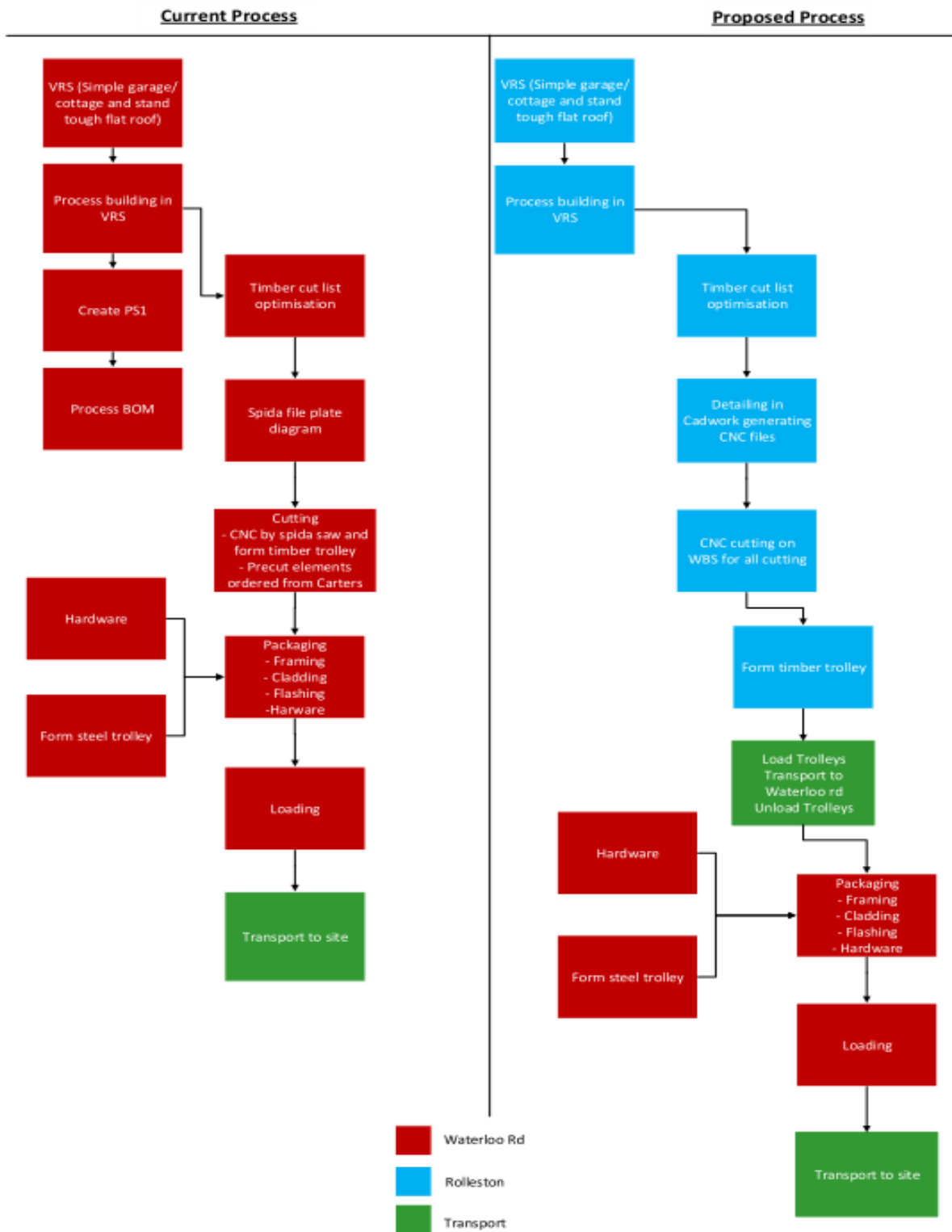
Are there any bottlenecks in your current production line?

Process is reliant on the drying process. This has a 12-day drying time and this cannot be decreased. Decreases time by using heaters cause too much shrinkage to occur. Keeping the factory at a constant temperature throughout the year can help mitigate variation in drying time when temperature is colder or too warm.

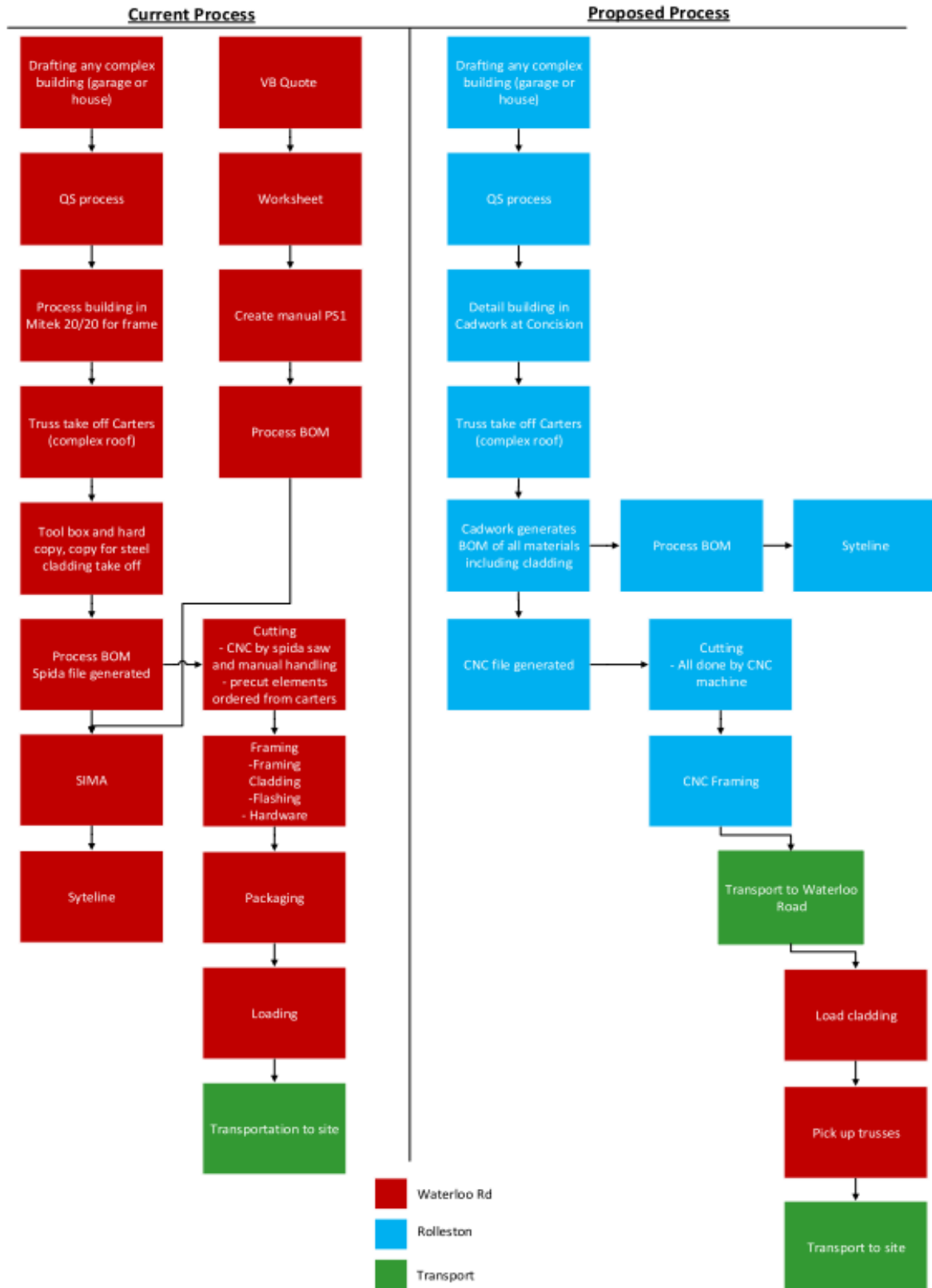
Can the same or increased efficiency be achieved with a smaller floor space?

The current plant is running at max capacity. There is no room using current process to increase production

SIMPLE BUILDINGS



COMPLEX BUILDINGS



Appendix G: POD Improvement

The following Gantt chart was produced to highlight where time savings are possible for POD manufacturing

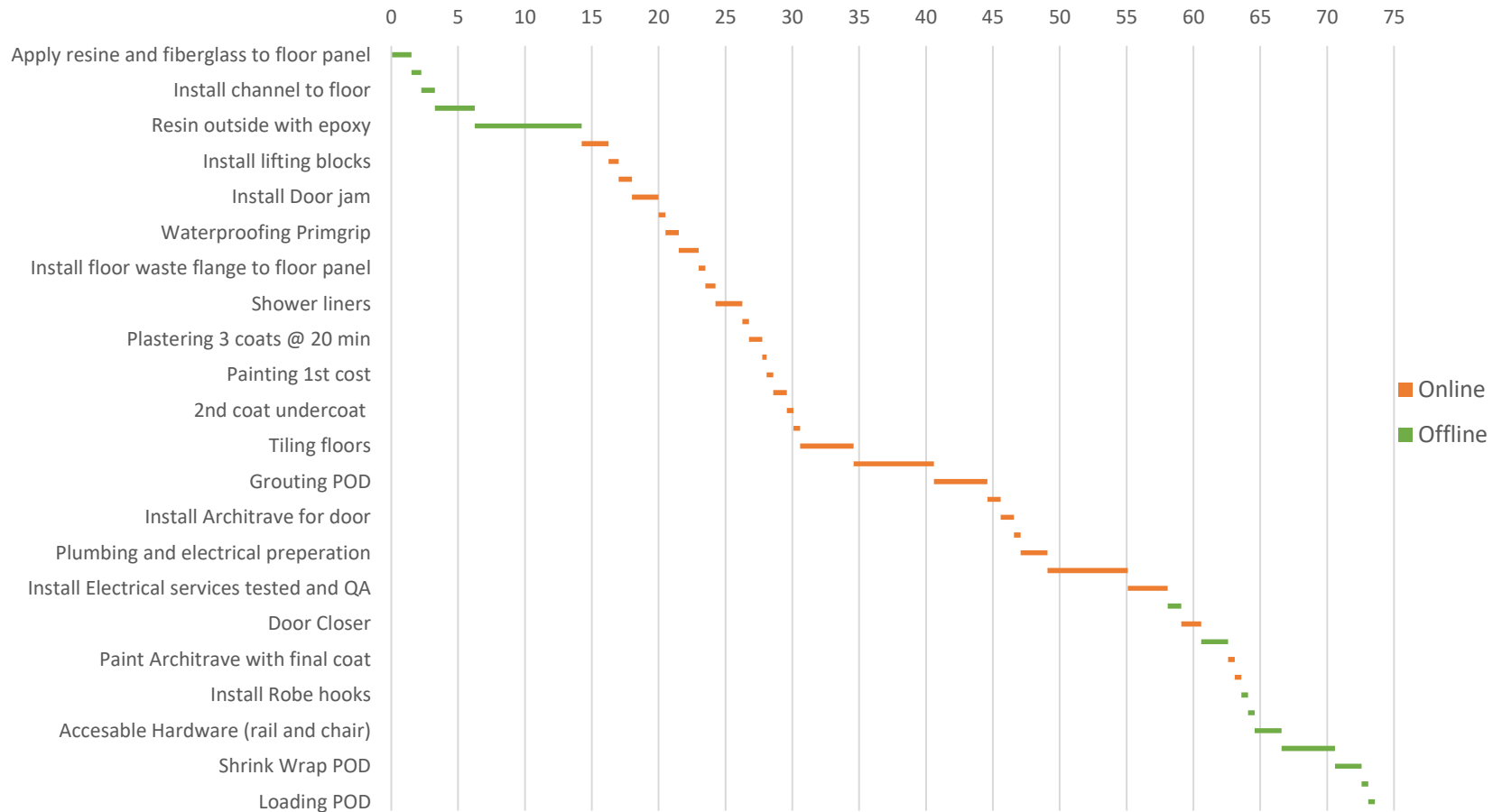


Figure 5: POD production schedule

Appendix H: Key Contacts

Key contact details for contractors contacted throughout project

Table 11: Key contacts for implementation support

Name	Information	Email	Phone
Kevin Weed	ENI engineering	kevin.weed@enieng.co.nz	03 963 7082
Brian Hockly	ENI engineering	Brian.Hockly@enieng.co.nz	03 349 7052
Jason Reints	Bliss and reels	Jason@blissandreels.com.au	61 3 9850 6666
Chris Tyson	Dexion	chris.tyson@dexionscchristchurch.co.nz	03 348 4194
Paul Moncur	Summit Cranes	paul@summitcranes.co.nz	021 0559 278
Ralph Bacon	Baker Cranes	ralph@bakercranes.co.nz	64 9 2770736
Marc Williams	Apex Doors	marc@apexdoors.co.nz	027 534 9823
Philip Nelson	Metalbilt	Philip.Nelson@rcrtom.com.au	
Nick Cairns	Farra	nick.cairns@farra.co.nz	03 338 6386
Tom Holtslag	Industrial Maintenance group	tom@industrialmaintenance.co.nz	03 366 2920

Appendix I: Risk Management

The following risk register was developed over the course of the project to highlight risks that have been identified over throughout the project.

Risk	(L)	(S)	Level	Mitigation
Reliance on subcontractor to deliver Portabild steel base for units	1	3	Medium	<ul style="list-style-type: none"> • Ensure supply chain with contractor is reliable. • Order bases early and have good forecasting for demand
Capital not approved	2	3	High	<ul style="list-style-type: none"> • Ensure benefits are fully understood. Produce detailed budget and cost benefit
Timber components to Rolleston could add non-values added task	1	2	Medium	<ul style="list-style-type: none"> • Ensure sufficient understanding of tasks
Issue with procurement of new equipment	1	2	Medium	<ul style="list-style-type: none"> • Use trusted and reputable suppliers • Ensure guarantee for delivery
Project blowout	2	3	High	<ul style="list-style-type: none"> • Ensure project is properly budget for price and also timeframe is appropriate
Unrealistic benefit	2	2	Medium	<ul style="list-style-type: none"> • Ensure due diligence is take and all benefits are weighed up and arguments taken as to why they are this way
Resistance to change	3	2	High	<ul style="list-style-type: none"> • Demonstrate and prove what the benefits to the organisation and employee are.
Health and safety risks (more up to date H&S) for each task to be complete	2	3	High	<ul style="list-style-type: none"> • Produce detailed health and safety plans. Ensure that people are engaged when going over these and see them as more than just a tick box.
Act of god event less redundancy with less factories	1	3	Medium	<ul style="list-style-type: none"> • Ensure all extensions meet required code. Have up to date insurance
				<ul style="list-style-type: none"> •

Appendix J Lessons Learnt

The key lessons learnt from undertaking this project are the following.

Task	Issue	Mitigation	Lesson learnt
Project scope development	Major - Had to wait until I began working to narrow my scope down and define what tasks I was to complete. First day at office presented a different scope than I anticipated.	Check that project sponsor and I had the same idea of what was required. Made changes early and checking in with sponsor regularly to ensure same idea of scope.	The importance of having good communication channels. Good communication channels do not come instantly. It is a process that must be refined after understanding how people work and what the best way to discuss them with it is This ensures that any questions are answered early and can be given and in-depth explanation.
Project proposal	Major - Delays involved in developing proposal. Project required communication plan and confidentiality agreement signed before proposal could be signed	Developed as much of the proposal as possible before work began. Once I could access confidential information it can be added to proposal	It is important to have a plan in place and contingencies. It should be noted that no matter how much planning is undertaken delays out of your control will happen.
Project plan	Minor - Needed to wait until more guidance was given as to when sponsor wanted work done by. Many times, I just had to make a best guess for it.	Attempted to make a best guess judgement and add contingency to that in order to achieve tasks.	This will be work in progress to determine whether I have been given myself enough time. While it is important to not sell yourself short it is important to be realistic and not be too overzealous in your own ability
Literature review	Minor - There was not much literature around the topic. If more was available would have led to greater understanding pre-start	Read what I could about topic. Review course work	Cannot always be fully prepared. Sometimes experience is the best teacher. Use the resources around you as much as possible, include those you work with. Do not limit yourself to just the internet.
Identify major tasks	Minor- Discussed with project sponsor early as possible to understand the tasks they expected me to complete. Sometimes difficult to find time for relevant people to confirm that the tasks I was completing were what they expect	Discuss early so that everyone knew deadline. Try to push them into getting it done when they can as it benefits them. Understand that tasks towards the end of the project may not be defined however ensure I keep this in mind as project progresses	Understand how others value time. People can get focussed on their work and forget to do things.
Presentation	Somewhat - Issues with the confidentiality requirements of the project. Need to	Talk to sponsor about requirements and run through presentation with them beforehand.	Companies knowledge are what gives them and advantage it is important to protect this for them. By giving away protected

	determine what I can say and what it protected.	Remove any sections that are not protected	information there could be large risks to the company
Project status reports	None- Project status reports are being completed on time and when required.	N/A	It is important to plan out the work ahead. When you know that you have constant deadlines it is best to get the work done early so that when unexpected work happens you can do it and not fall behind
Gather relevant information	Minor - Finding time to ensure that I am meeting with relevant people can be difficult as they may have more pressing tasks.	Engage people early and give them a clear outline of what I want to discuss when I meet them	Again, the importance of planning is highlighted. You realise that while people want to help, they do have higher priorities. Again, giving people pre-warning about what you wish to discuss allows them to properly answer any question when you meet with them. When this wasn't done meetings are not as productive.
Subcontractor interaction	Minor – Some issues getting response back	Follow up ensure that they are aware of deadline. There are other contractors that we can go with if they don't want the work.	Having worked with subcontractors previously I know that they can often brush off what you tell them. However now that I was their direct contact person, I learnt how much you had to push them in order to get them to do what you want or need.
Undertaking relevant work	Minor - There are issues with my working being relevant for the MEM requirements. This could be a large issue as it is important for my MEM that the work is relevant and is adding value.	Be willing to undertake more work that is relevant even when not given to me.	It highlighted the importance of being willing to put your hand up to do anything. The more often you do this the better received in the business you are the more likely you are to be given tasks that are within the scope of your work
Dealing with downtime	Minor- During sections of the project there were times that I had very little to keep myself occupied and this could lead to losing focus about what the goal was.	Always be willing to take on work. Important to show people within the office that you are eager and willing to do anything.	You should always be willing to take the initiative and try do work for yourself. Think outside the square as to what needs to be. It is also alright to ask for guidance about what tasks you should be working on. The company is paying you and if you are not adding value to them why should they pay.
Delivering presentation	Minor - After clarify confidentiality there was very little issues that occurred. Only needed to prepare sufficiently in order to know what I am going to say	Practice, practice, practice. There is no much more I can do except continual practice in front of people and make changes to presentation with suggestions from them	I am representing an organisation. I need to make sure that I give the best impression for the company to industry. Additionally, it is important to be prepared to calm nerves. Presenting in front of large unfamiliar audiences can be daunting and intimidating particularly if not prepared

Development of milestones report	Somewhat - Issues that this is much more a university assignment and feedback. Got to get prioritisation correct with task work and report	Understand that I am still at university while working and am required to put in work after class so that I can complete everything at work in the correct time	
Changes in project scope	Somewhat – Project scope changed a few times over the project from what was initially proposed	Fill in project scope form and have sponsor aware of change. Make sure to have it in writing	It is imperative that you cover yourself and have it signed in writing from sponsor if any changes occur. This way further down that line you are covered if any issues arise.