

MacDonald & Lawrence Timber Framing Ltd.

'Wilful waste brings woeful want'



Macdonald & Lawrence



Summer 2012



MacDonald & Lawrence Timber Framing Ltd.

Market research regarding wood residue

Thesis forest- and nature management, International Timber Trade

Prepared for: **MacDonald & Lawrence**
1451 Trowsse Road
V0R 2P4 Mill Bay, Canada

University of applied science Van Hall Larenstein
Larensteinselaan 26a
6882 CT Velp, the Netherlands

Contact: **Gordon MacDonald**
gord@macdonaldandlawrence.ca

John Raggars
john.raggars@wur.nl

Steve Lawrence
steve@macdonaldandlawrence.ca

Prepared by: **Jeen Bunnik**
jeenbunnik@hotmail.com

Date: Summer 2012

Disclaimer: The views set out in this publication are based on data and information considered reliable, which are processed in a careful manner into assessments. Neither the project team nor the principal can be held responsible for any existing errors in this publication. Shown views in this publication do not display more than an own vision and may change without notice.



Acknowledgment

Summer 2012, Bamberton Vancouver Island, Canada

Dear all,

Enjoying a moment of tranquillity on the Saanich Inlet banks, swallowed by the shadows of Mount Malahat I am delighted to expound the completion of my thesis on MacDonald & Lawrence Timber Framing Ltd. industrial wood waste, marking the end of *International Timber Trade* at the University of applied science Van Hall Larenstein.

I sincerely thank Gordon MacDonald & Steve Lawrence as well as the whole crew and their families for giving me the opportunity- and experience of a lifetime! The combination of true skill- and craftsmanship together with the warmth, enthusiasm and hospitality I encountered where simply amazing.

In addition I would like to express my gratitude to everybody that I to have met during my studies, by showing and opening up their cultures and ways of living truly enriched me professionally as personally.

Thank you,

Seon Bunnik



Summary

MacDonald & Lawrence timber framing Ltd. is a carpentry company specialised in timber framing residences, public & commercial timber frames and restoration & conservation projects. MacDonald & Lawrence 'tailor makes' every beam designed by its planners-designers for a perfect fit in all distinctive, bespoke projects. When custom milling is done MacDonald & Lawrence have a pinch that there is still some value in their wood residuals.

"What could be suitable end-uses for MacDonald & Lawrence Timber Framing Ltd. industrial wood waste, organised benefiting its relationships?"

In order to find products that could lead to customer- or added value in these wood residuals or fall-outs the following steps were undertaken:

1. **Examine:** current waste capabilities within the present business model.
2. **Identify:** possibilities for added value within the present business model.
3. **Determine:** a strategy- or organisation if value added products are found.

Suitable end-uses for MacDonald & Lawrence timber framing Ltd. wood residuals are:

- ⊗ **Community:** The combination of all MacDonald & Lawrence's wood residuals for 'community' or 'privates'. Being able to

sell local people firewood, [un]edged boards for their garden or other do-it-yourself jobs for instance or helping out the local community organising a fair.

- ⊗ **Decorative frames:** Examples are arbors, garden lattice sheets, grow stacks for plants, entrances etc. Small wooden structures which enhances the ecstastic values but do not require construction grade timbers or other building regulation codes.
- ⊗ **Logs:** or large dimension beams- or blocks to use in public spaces such as parks for decoration, in retail shops as window dressing, art galleries as pillar or just as a stool.
- ⊗ **Wild Play:** this client, who represents a significant part of MacDonald & Lawrence turnover, is enthusiastic about waste remanufacturing and pioneer in 'green' marketing and moreover interested in every octagon shaped piece of wood residual.
- ⊗ **Furniture:** Every once in a while a magnificent piece of wood passes along, when cutting a custom beam, shaping a timber frame or replacing lumber in conservation projects. Throwing pieces with beautiful grain- or an extraordinary pattern in the trash is a waste in both ways. These pieces deserve to be transformed into doors, tables or counters for example, products which catch the eye.

In order to lead to added- or customer value these products need the following organisation:

- ⊗ **Project based working:** None of MacDonald & Lawrence customers required a standard product, all wanted that specific, tailor made and unique solution for their needs. Refurbishing wooden bridges, building high-end houses and canopy entertainment parks all need that bespoke fit, allocating the right people, tools and time to each stand alone project. Within this business model standardises production lines do not fit in, not in the workshop [as in space and set-up], not in the mind-set of its employees. When wood residuals are indentified certain, specific end-uses need to be linked to this particular timber and small range and bespoke products could be manufactured.
- ⊗ **Waste management system:** Wherever there is no waste protocol in effect, lumber is all over the place and trim-ends end up in the same bin as sawdust and possible valuable timber piece deteriorate poorly stacked. Setting up a waste management system for wood residuals results in cost reduction, efficiency and work place safety benefits for MacDonald & Lawrence and 'green' marketing, image and goodwill opportunities for its relationships. The waste management system shows wood residual structures, procedures and clear instructions and responsibilities for management, shop managers and carpenters. So shavings & sawdust end up in the waste bin, sold to soil enhance firms, whereas value grain pieces transform into table tops, beams into wild play octagons and log trim ends as window dressing at the local retail store.



Table of Content

Acknowledgment	3	6. Results	11
Summary	4	§6.1 What are the current input, processing and output capabilities?	11
Table of Content	5	§6.2 What could be possibilities for added value from M&L's wood waste?	16
1. Introduction	6	§6.3 How could M&L organise re-manufacture waste to create added and -/ or customer value?	22
2. Sawmill waste: <i>an exploration</i>	7	7. Conclusions & discussion	35
3. Definition of the problem	8	§7.1 Conclusions	35
§3.1 Definition of the key concepts	8	§7.2 Discussion	37
§3.2 Definition of the problem	8	8. Evaluation, recommendations & continuing research	38
§3.3 Specific research questions	8	§8.1 Evaluation	38
4. Theory & Hypotheses	9	§8.2 Recommendations	38
5. Planning & Execution	10	§8.3 Suggestions for continuing research	38
§5.1 Methodical character	10	List of abbreviations	39
§5.2 Population & Sampling	10	List of tables & figures	40
§5.3 Description and accountability of research instruments	10	Bibliography	41
§5.4 Data collection	10	Appendix	42
§5.5 Data processing & preparation	10	Appendix I: Yard lay-out	42
§5.6 Description and accountability of analysis decisions	10	Appendix II: Workshop lay-out	43
		Appendix III: Balanced scorecard	44





1. Introduction

MacDonald & Lawrence timber framing Ltd. is a carpentry company specialised in timber framing residences, public & commercial timber frames and restoration & conservation projects.



Figure 1: An example of a timber frame home, community square commercial timber frame and a restoration & conservation timber frame project

Located on Vancouver Island, British Columbia Canada, MacDonald & Lawrence consist of approximately 35 full-time staff of various nationalities, operating a full-equipped 12,000 square feet workshop, offering a range of services to design, assist and build timber structures- or components for private and professional clients. MacDonald & Lawrence is proud to be the first- and only FSC-certified timber framing company in Canada

Within in this context MacDonald & Lawrence, as a high-end timber framer, has to 'tailor made' every beam designed by its planners- designers. To illustrate a simple process: logs are cut and lumber re-cut to the demanded specifications for a perfect fit in all distinctive, bespoke projects.

Due to this extensive sawing, re-cutting and the utilisation of quality logs (for construction proposes et. all). The issue arises: *What do to with the timber being cut off?* To phrase *the Economist* of April 14th: "Although it is the buried toms and the lost cities that get all the press, one of the most valuable things an archaeologist can dig up is waste. Palace murals and heroic statues record the sanitised, official version of history, but a society's garbage tells the true story of how its members lived". Throwing 'it' out is a waste of good, quality lumber but nor does it end-up as planks, freezes, doors, tables or benches etc. all potential applications for this 'waste' product



2. Sawmill waste: an exploration

In order to formulate an accurate problem definition and so starting wood residual research an exploration of the matter is conducted. Below follows a brief summary of each publication which influenced- or helped formulating specific research questions.

An interesting article in *Popular Science* in May 1990 named *Reinventing Wood* by *Phil Cafferty* describes several engineered wood products which enable sawmills to reach an 80% lumber yield. Most appropriate; Parallam, parallel strand lumber, construction beams glued together from ½ inch-wide eight-foot-long strips out of Douglas Fir or Southern pine. By combing pieces of wood, they can create dry, predictably sound 2x12s, for example, from trees that could only provide 2x4s through conventional methods.

Estimating hardwood sawmill conversion efficiency based on sawing machine and log characteristics by *Michael W. Wade* et al. 1992 (Published in the Forest Products Journal). Gives an insight assessing conversion efficiency trends and potential benefits from gains in sawmill efficiency in general. An equation was developed to estimate lumber recovery factor for hardwood sawmills. Variables included in this model were: headrig type, headrig kerf, average log diameter and length and the influence of total sawing variation.

Factors' determining Lumber Recovery in sawmilling by *Philip H. Steele*, forest products technologist for the U.S Department of agriculture, 1984 identifies and discusses, in detail, seven factors influencing lumber volume recovery.

1. Log diameter, length, taper and quality
2. Kerf width
3. Sawing variation, rough green-lumber size and size of dry-dressed lumber.
4. Product mix
5. Decision-making by sawmill personnel
6. Condition and maintenance of mill equipment
7. Sawing method.

Past and current research is cited, and examples are given to illustrate the points made.

In *Circular sawmills and their efficient operations* by *Stanford J. Lustrum* commissioned by the USDA Forest Service in 1993. Provides a manual "written for circular sawmill operators for who recognize the need for producing the maximum yield of well manufactured lumber in the shortest time possible". Focus within this manual is on the first and most important step, primary sawing and all mechanical components that affect the primary sawing function.

In addition of the above mentioned literature survey a more practical exploration was conducted. To orientate on industrial sawmill waste a couple sawmills in the Netherlands were visited, with simple questions regarding their wood residuals and lumber yield. *Houtzagerij Han Hengeveld* in Stroe, *Rondhoutzagerij Midden Nederland* in Uddel, *Houtzagerij L.H Verhoeven* in Harskamp, *Houtzagerij Van Rooijen* in Echteld were visited. The main specie being sawn was Douglas fir fit for packaging purposes and construction beams. To increase yield logs where debarked, first cuts chipped and cut offs with *un-demanded* dimensions perished the same fate. To avoid handling costs single planks- or freezes are not cut and stored but rather be chipped. The bark and chipped wood are sold separately to end up for instance in playgrounds, bio fuel and-/ or the panel industry.



3. Definition of the problem

In the last few years MacDonald & Lawrence acquired an own sawmill to fulfil the need for custom shaped timbers, for instance octagon instead of square, or special 'fine sawn' customer specifications.

When sawmilling these custom timbers, wood residuals are accumulated and left to waste. Management feels that these fall-outs contain value, possible generating extra revenues. The objective of this humble research is to find suitable, end-uses for MacDonald & Lawrence wood residuals. Requiring inspection, design, manufacturing and marketing efforts leading to value added products and-/ or markets for MacDonald & Lawrence's wood residuals. This has been broken down into the following sub-objectives:

1. To **examine** current waste capabilities within the present business model.
2. To **identify** possibilities for added value within the present business model.
3. To **determine** a strategy- or platform if value added products are found.

§3.1 Definition of the key concepts

- ☼ **Suitable**: right or appropriate for a particular person, purpose or situation.
- ☼ **End- use**: the application or function for which something is designed or for which it is ultimately used.

- ☼ **Wood**: the hard fibrous material that forms the main substance of the trunk or branches of a tree or shrub, used for fuel or timber.
- ☼ **Waste**: use or expend to no purpose.
- ☼ **Benefit**: an advantage or profit gained from something.
- ☼ **Relationship**: the way which two or more entities are connected.

§3.2 Definition of the problem

"What could be suitable end-uses for MacDonald & Lawrence Timber Framing Ltd. wood residuals, organised benefiting its relationships?"

§3.3 Specific research questions

- ☼ What are the current input, processing and output **capabilities**?
- ☼ What could be **possibilities** for added value from M&L's wood waste?
- ☼ How could M&L **organize** waste use, if value added products are found?

To visualize the complexity and framework a conceptual model is made and shown below:

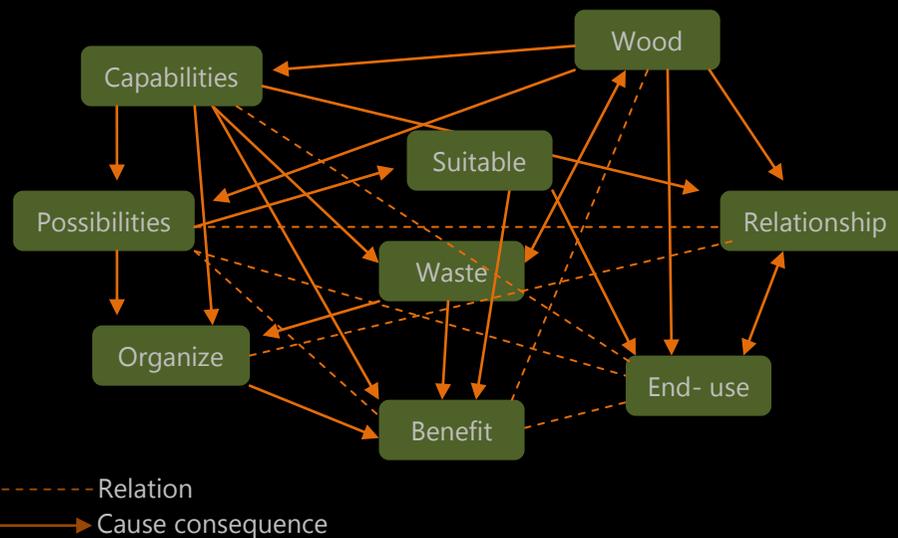


Figure 2: Conceptual model



4. Theory & Hypotheses

Given the thesis exploratory nature it is too early to have a consistent theory or pin-pointed hypotheses to be verified- or falsified. However, there are some ideas about certain connections or relationships regarding MacDonald & Lawrence's wood residuals.

Within the forestry sector the flow of raw material withholds a critical position. Availability, sustainability, environment- and social aspects are just a few timber supply issues influencing planners and policy makers to consider the efficiency and utilization of the timber resource. Improvement would favourably impact direct profits and corporate branding.

Lumber recovery in the forestry sector is determined by a confusing interaction of several variables. Since no two, for instance, sawmills are alike, the variables that influence lumber recovery are seldom the same from one sawmill to another.

More specific for MacDonald & Lawrence, it is not your typical sawmill. Speed and optimum in logistics and bulk production are not of importance. The added value is created by craftsmanship rather than 'waste management'. So the set-up of machinery and waste logistics do not add up to their core activity of timber framing due to several reasons yet.

The question remains, what to do with the waste and organisation of it. Possible answers at the beginning of the supply chain could imply procuring larger dimension of timber, and cutting of tradable sizes, or buying larger lower grades and accepting more fall outs. At the end to the value chain it could result in clients paying a premium for having 'no waste' or 'waste' products incorporated in their projects and-/ or investments, in time as well as financial, in waste transformations into more demanded, disposable forms. All within the given requirements of being sustainable, in a matter of continuous rather than being 'green- or blue', and cost effectiveness.



5. Planning & Execution

§5.1 Methodical character

As mentioned before the thesis has an exploratory character, more tangible it means that it aims to develop and-/ or formulates clear statements which could be verified, not merely register and describe business processes.

An exploratory research is not planned into the details but is executed in a trail & error way, different [possible] connections are examined, ideas intensify and assumptions are adjusted to interim results. With other words: found information 'has to speak for oneself' and this thesis has to explore what possibilities are 'inside' so to speak, holding the practical significance for MacDonald & Lawrence as leading principle.

A basic questionnaire is used within this particular exploratory research. As much information as possible is being gathered, in a informal way regarding MacDonald & Lawrence staff and in a more formal way towards management. This questionnaire is designed to be brief, with minimal disturbance.

§5.2 Population & Sampling

MacDonald & Lawrence has projects all over Canada and beyond, this makes it hard to

interview the total employment. People who directly handle and organise waste are given priority this to created base for further phases. Thus employees present at the workshop premises given the time of the first phase of the research.

§5.3 Description and accountability of research instruments

In regard to desk-research this is carried out to refine the objectives and provide guidelines for the next stages. Specifically, desk research phase gathered information on sawmill yield, lumber recovery and sawmill efficiency in general. But beside general efficiency information prices, machines, end-uses and requirements are based on several, reliable second-hand sources. Its credo: to **examine, determine and indentify!**

Field-research however is used to explore and understand sawmill efficiency and supply & demand requirements of [potential] clients. More tangible: current **capabilities**, possible **end-uses** and **the organisation**. Through personal- and telephone interviewing relevant respondents were contacted, an online approach was not desirable. The personal- and telephone gives the opportunity to select accurately and swiftly, this gives an assurance of achieving the desired type of respondents.

§5.4 Data collection

Employees were interviewed on site, requiring a quiet moment asking just a couple minutes at the workshop having actual waste nearby to visualise and pin-pointing possible end-uses. Management on the other hand was approached in a more formal way, setting-up meetings, interviewing and pitching ideas in a structured way.

§5.5 Data processing & preparation

Data is presented in the classical question, answer way or, if required, accompanied by charts and-/or tables. Answers are not coded in statistical software or kept in an archive; data collection is designed to be hands on, creating base and practical 'handles' on site.

§5.6 Description and accountability of analysis decisions

As planned gathered information was checked and examined, solutions verified by management and staff. Progress reports [oral & written] circulated through the organisation, as a boxer sparring, making sure the project stayed on track and heading in the right direction.



6. Results

§6.1 What are the current input, processing and output capabilities?

Which species are used?

80% of the timber used is the Coastal Douglas-fir [*Pseudotsuga menziesii* Franco]. Douglas fir is a large tree which reaches heights of 85 meters on the coast and 42 meters in the interior of Canada.

Coastal Douglas-fir is a much bigger tree than Interior Douglas-fir. The timber from the Coastal trees is generally lighter in colour, and more uniform in texture than that of Interior trees. Both have the same wood properties, however, one main difference is that Interior Douglas-fir is less permeable to preservative treatments.

Western Red Cedar [*Thuja plicata* Donn ex. D. Don] makes up the remaining 20%. It is a large tree up to 60 meters tall when mature.

Western Red Cedar lumber is often sold green due to its unique properties and longer drying times. When dried, lumber is dried according to end-use and customer specifications. Kiln drying inhibits natural staining of the wood, improves its strength and stiffness, and enhances its appearance as well as its resistance to decay and insect attack.



Figure 3: Douglas



Figure 4: Red Cedar

In which dimensions lumber is delivered?

What is the lumber grade used? What is the average purchase price?

	Dimension	%	Lumber grade	Purchase price
Round logs	Ø -	5	Construction grade	-
Turned poles	Ø 17' / 45 cm L 35'45'70'/10 13 21m	30	ANSI H1 Class	\$165.- 625.- piece
Sawn lumber	-	65	NLGA No.1 & Btr.	\$900.- \$1200.- 1000bf./2,35 m ³
	Beams, [solid, laminated etc]			
	Dimensioned timber [ready to frame]			
	Square edged timber [2"x4" decking etc]			

Table 1: Delivered lumber, grade and purchase price

Which saw machine(s) is/are used + waste output?

Tool	Description	Sawdust	Shavings	Solid wood
Cook machinery	SA3230 horizontal band saw accompanies by 20 m. / 65 ft. long carriage and able to handle up to 80 cm./32" Ø.	☼		☼
Delta power tools	X5 Type I 50-785 & DJ-20 planners		☼	
Steel city tools	Deluxe Rip Table saw	☼	☼	
Makita Canada	Radial arm saw	☼	☼	☼
Meber s.p.a.	SR 900 vertical band saw	☼		☼
Norwood Inc.	Lumbermate 2000 movable horizontal band saw, able to handle up to 85 cm./34" Ø.	☼		☼
General tools	Portable tools like arm saws, mortisers, routers, planers, chisels etc.	☼	☼	☼

Table 2: Machinery and with waste output

Which saw blade (kerfs) is used? How is the state of used saw equipment? What is the cutting method?

Saw	Blade with	Kerf	State	Cutting method
Cook machinery	1,05mm/0.0042"	2,38mm/ 3/32"	Good/new	Ripping
Standard	-	3,18mm/ 1/8"	-	-
Norwood Inc.	1,05mm/0.0042"	2,38mm/ 3/32"	Good	Ripping
General tools	various	3,18mm/ 1/8"	Good	Cross-cut

Table 3: Overview blade width, kerf, equipment state and cutting method



Who is the sawmill operator (experience, decision making)?

The main saw miller has over 20 years of experience in milling. Owns an older circular sawmill which is out dated due to large kerf. Takes time to asses lumber requiring milling, a calm perfectionist. A capable and skilled labourer experienced in logging, wood- and metal works.

What are the asked dimensions?

Depending on the projects nature but roughly divided into three product groups:

- ⊗ Residential frames, depending on the desired specifications. Possibilities from a 'straight forward' frame to a full customised house requiring larges dimensions, unique curves and finished moulding. Unique, one-of-a-kind dream houses.
- ⊗ Commercial frames require larger dimensions, wide spans. Less design more practical, safety requirements.
- ⊗ Heritage, one of a kind customized and bespoke timber requirements.

Due to the unique and specification driven lumber demand it is hard to quantify– qualify the amount of waste from demand dimensions. 65% of the timber intake is sawn, ready to use, timber. Resulting waste: trim-ends, shavings and sawdust, small amounts of low value waste.

Milling, and thus significant waste, is only done 'in-house' if sawmills are unable to supply timber in regard of lengths or 'special' dimensions. Within this context the 35% poles/log intake is interesting. The bulk is used for specific client, Wild Play element parks. The rough round wood is being transformed to sawn lumber; demanded dimensions are octagon shaped poles- or beams for their parks. Therefore in addition to general waste enquiries, focus will be on Wild Play and 'their' waste.

Which products are produced?

All square timber needed for framing such as: beams, columns, posts, crucks, braces, joists, ties, trusses, stringers, collars, rafters, parlins , rails, treads, newels, pendants, balusters, ridges, plates, decking et all.

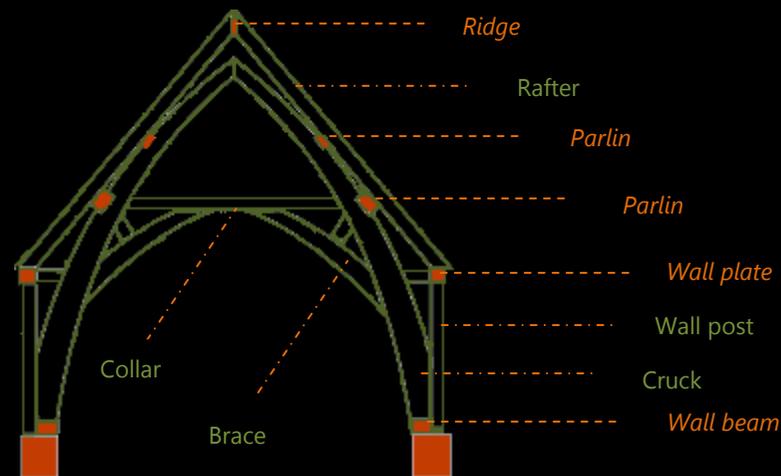


Figure 5: Cruck timber frame example

Octagon shaped poles- or beams and decking for Wild Play, element parks

Spars	Bottom: Ø 14" / 35 cm	Top: Ø 9½" / 24 cm	Length: 20- 65' / 6- 19 m.
Poles, beams	2½" / 625 mm		Length: 6- 9' / 180- 270 cm
	3½" / 875 mm		
	4½" / 1125 mm		
	5½" / 1375 mm		
Decking	1" / 25 mm x 5½" / 1375 mm		Length: 5- 6' / 150- 180 cm

Table 4: Example lumber specification Wild Play, Kelowna BC



How many times [re]-cutting is needed?

In general there is no pin-pointed re-cutting data. MacDonald & Lawrence does not make standard products, every design is tailor made, and a statement about an average [re] cut is not possible. What could be said is that all beams require some short of re-cuts, creating joists for instance or 'fine sawn' beams.

For Wild Play the sequence of cutting follows the procedure of debarking [if necessary], cutting into squared beams and cutting off edges, from square beam, making an octagon. The minimum number could be set as eight, four cuts to make a beam plus four edge cuts.

What is the rough tally-to-finished product size?

Is not of any significance due to ordering sawn dimensioned timber, Wild Play lumber is used green.

What is the waste flow in quantities?

Is be identified at the workshop in three fold, waste on site is disregarded.

- ⊗ **Daily:** shavings, sawdust and trim-ends. Avg. 8,500 bf / 20 m³ a month, covering all lumber processes.
- ⊗ **Regularly:** off cuts from milling, especially during Wild Play projects. To have an indication Wild Play, Kelowna BC has been monitored. Circa 8,500 bf / 20 m³ solid timbers in various dimensions such as slaps, edged lumber and posts in 3 weeks for this particularly project.

- ⊗ **Incidental:** returns from project and -/ or 'special' timber from renovating- heritage projects. Estimated to be 38,000 bf / 90 m³ in the past years, stocked at the workshop premises.

What is the waste quality, handled and value?

As mentioned in *delivered lumber dimensions* and *lumber grade used* lumber is graded to NLGA structural light framing structural joists and planks No.1 & Btr. This quality grade is also applicable for the turned poles due to the milling which 'transforms' the poles from ANSI H1 Class for wooden poles to NLGA No.1 & Btr. construction lumber grade.

Rate of growth	Medium in DF
Pockets	Large
Shakes and checks	Several up to 2' long, none through
Skips	Hit & miss – 1/16" maximum 4' length
Splits	Short
Slope of grain	1 in 10
Stain	Allowed in any amount
Wane	¼" thick x ¼" with in addition ½" thick x 1/3" width x ¼" length in 5% of pieces
Pin holes	30 per square feet worst face
Grub or Teredo holes	Twelve ¼" holes per inch of hole permitted measured of worst face
White specks	Not allowed
Honeycomb	Not allowed
Peck	Not allowed
Unsound wood	Not allowed
Knots	Sounds, firm, encased and pith knots allowed if tight and well spaced ¾" up to 3 ¾" in widths 3" to 12".

Figure 6: NLGA Construction timber No1. & Btr.

- ⊗ **Daily:** No automatic shavings, dust handling. all is handled manually and dumped in [paid] container or given away to staff as fuel wood. Handled in such way represents no significant value.
- ⊗ **Regularly:** Are bundled, [poorly] stacked- or just randomly set aside anywhere in- or outside the workshop. Due to several reasons; size, grain or texture represents at least the procurement value [= avg. purchase price poles \$250 1000bf. x 8,5= \$2150 for 8,500 bf. / 20 m³]
- ⊗ **Incidental:** Bundled and -/ or packed, stacked and stored on the premises surrounding the workshop. Has more value than the purchase price for grain, textures, history/heritage or emotional value reasons on top of the value of the raw material cost alone.



Yard & workshop lay-out?

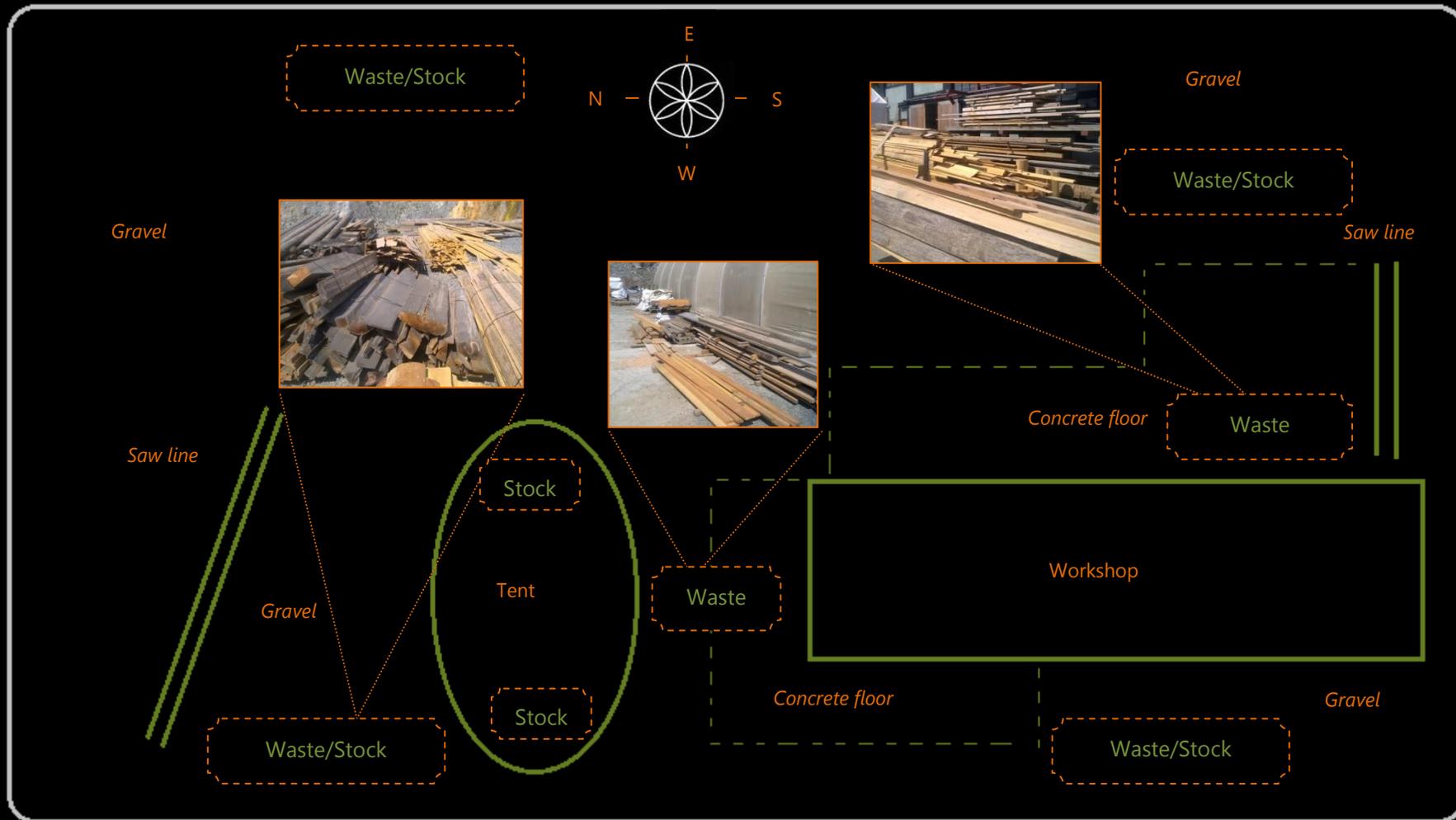


Figure 7: Yard lay-out

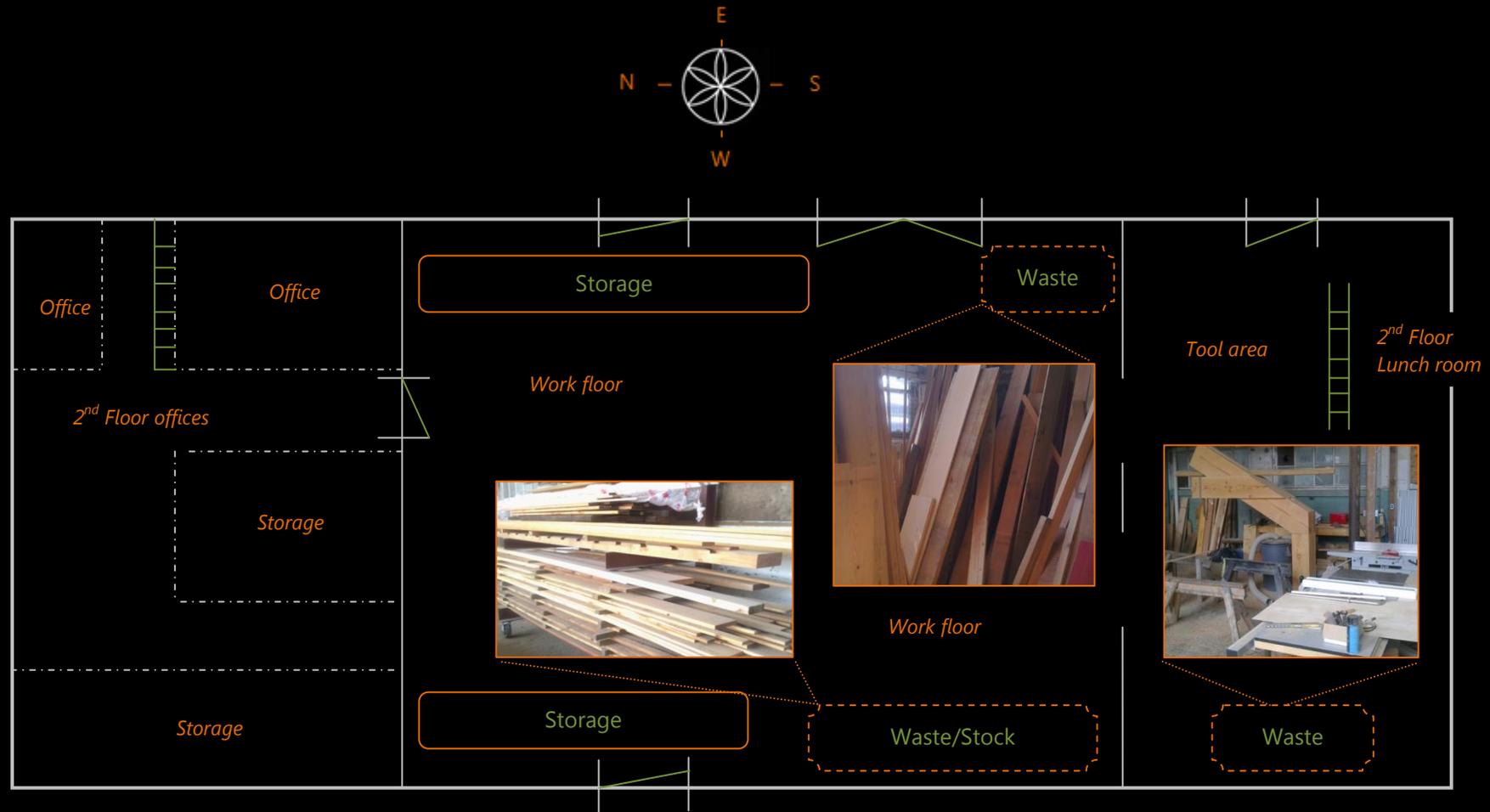


Figure 8: Workshop lay-out



§6.2 What could be possibilities for added- or customer value from M&L's wood waste?

What could be possible end-uses?

Both species, Douglas-Fir & Western Red Cedar, are known for their versatile timber usage. What Oak is for Europe, the Douglas-Fir is for Northern America being used in all possible timber applications, ranging from general building & construction, sashes, doors, windows, millwork, flooring, cabinets, veneer, vats, boat construction, transmission poles and marine pilings. Douglas-fir is available in the form of lumber, timber, pilings and plywood.

Douglas-Fir is known for its strength properties and workability. The wood dries rapidly with small dimensional movement. It is relatively easy to work but care for machinery due to resin content. It turns planes and shapes well and can be sanded to a smooth finish. The wood glues moderately easily, has moderate nail and good screw holding ability, and takes a good finish¹.

Western Red Cedar on the other hand is known for its durability and dimensional stability leading to uses such as roof shingles, exterior & interior siding, exterior cladding, decking, greenhouses, poles, posts, fencing, ship & boat building. Red Cedar is popular wood for outdoor furniture, playground equipment, sashes, doors, windows, ceiling, sauna-/ and wall panelling.

Western Red Cedar is a lightweight wood, which is moderately soft and low in strength. It is known for its excellent working properties, and its ability to take a smooth finish with sharp tools. It is relatively easy to work but care for machinery due to resin content. It planes and shapes well and can be sanded to a smooth finish. The wood glues easily, has moderate nail and screw ability, and takes a good finish².

In order to determine possible end-uses for MacDonald & Lawrence a mind-map is made with the input from employees, management and external sources. The mind-map is displayed on the next page.

¹ Douglas-Fir Factsheet FPIinnovations Forintek Canada Corp.

² Western Red Cedar Factsheet FPIinnovations Forintek Canada Corp.



Figure 9: Mind-map possible end-uses



How do the employees at MacDonal & Lawrence perceive wood waste?

Throughout the company the idea of doing 'something' with their waste is extant. On an abstract level waste is 'value but do not know how to package it'. However using as much waste is an ideology perspective driven by cost of a paid waste bin. All employees share the thought of utilizing the waste and seeing potential in it if waste has sufficient quality, short handling time and easy access.

What are suitable end-uses?

In order to judge suitable end-uses, groups of applications [deducted from the mind map] are rated according to several criteria.

1. **Cost effective:** Is there an adequate financial return in relation to the costs?
2. **Customer value:** Does the end-use represent any value on top of its material cost?
3. **Lumber grade:** Does the product fit in light construction grade as in strength and appearance properties?
4. **Marketable:** Is there an existing market, like Wild Play, or does the end-use be kept in stock and made according to specification?
5. **Capabilities:** To what extend is M&L capable of milling/producing the product?
6. **Sustainable:** Is the material flow continuous?
7. **Space:** How much space does the end-use require?
8. **Business model:** Does the proposed end-use fit in with the current business model?

End-use	1	2	3	4	5	6	7	8	Total
Points	30	20	15	10	10	5	5	5	
Components									
<i>Treats</i>		-20	+15		+10	+5	+5	+5	+20
<i>Furniture</i>	+30	+20		+10	+10	+5			+75
<i>Community</i>	+30	+20	+15	+10	+10	+5	+5		+95
<i>Framing</i>	+30	+20	+15	+10	+10			+5	+90
<i>Salvage</i>		+20		+10	+10	+5		+5	+50
<i>Wild Play</i>	+30		+15	+10	+10	+5	+5	+5	+80
<i>Packaging</i>			+15		+10	+5			+30
<i>Shop</i>			+15		+10	+5			+30
Products									
<i>Chips</i>		-20	+15	+10	-20	+5	+5	-5	-10
<i>Shavings</i>		-20	+15		+10	+5	+5	-5	+10
<i>Logs</i>	+30	+20	+15	+10	+10	+5		-5	+85
<i>Solid wood</i>									
<i>Craft- art</i>	+30	+20	-15		+10		+5		+45
<i>Interior</i>		+20	-20		+10			-5	+5
<i>Exterior</i>									
<i>Frame</i>	+30	+20	+15		+10	-5	-5	+5	+70
<i>DIY</i>	+30		+15		+10		-5		+50
<i>Furniture</i>	+30	+20	+15		+10	-5			+70
<i>Garden</i>	+30		+15	+10	+10	+5		-5	+65
<i>Decorative framing</i>	+30	+20	+15	+10	+10	+5		+5	+95

Legend: **First priority** **Second priority** **Third priority**

Table 5: Rating suitable end-uses³

³ Scores assigned to the different criteria is done by Gordon MacDonald, highest points were given to the highest priority and most importance to MacDonal & Lawrence timber framing Ltd. Point rating is done by Chris Tucker, project manager.



Which suitable end-uses could be produced and in which quantities?

The following suitable end-uses are deducted from the previous matrix and ranked according to priority:

1. **Community:** All former 'waste' products; edged boards, beams, logs etc for community uses or fire wood.
2. **Decorative framing:** short/smaller lumber sizes for non structural purposes like knee braces or porches.
3. **Frame:** most frequent uses framing dimensions⁴.
4. **Logs/beams:** pedestals, bollards, stools.
5. **Wild Play:** octagons, decking.
6. **Furniture:** table tops, table legs, doors, flooring, panelling, siding sizes.
7. **Maintenance & Packaging:** general repairs on and at the workshop, sawhorses, jigs, package covers and stackers.

At all times there should be a clear distinction, in wood, between 'just' wood, heritage/conservation, appearance boards, interior and exterior use. Some end-uses are joined together such as whole frames and frame components, whole furniture and table tops for instance.

⁴ Based on: Birds eye cove barn, Sunset drive, Greg's RV, Cowichan martime centre and Aaron & Aubrey's

End-use	Required			Available			
	Grade	Labour	Machinery	Lumber	Grade	Labour	Space
Community	-	5 h.	3 h.	√	√	√	-
Decorative frame	-	5 h.	2 h.	√	√	√	12,500 bf.
Frame	NGLA	5 h.	2 h.		√	√	13,500 bf.
Logs/beams	-	1 h.	1 h.	√	√	√	8,500 bf.
Wild Play	NGLA	5 h.	4 h.		√	√	7,500 bf.
Furniture	-	10 h.	3 h.	√		√	8,000 bf
Maintenance & Packaging	-	1 h.	1 h.	√	√	√	2,000 bf

Table 6: Producing end-uses

Due to the 'creation' of products, lumber grades needs to be formulated from MacDonald & Lawrence perspective and has the NLGA No.1&Btr grade as a base. Labour and Machinery estimates concern handling time and machine use per product group. For example 'creating' boards have more handling and sawing time than frame dimension lumber.

Although there is a total 12,000 square feet workshop + yard space an estimated 3,000 square feet is possible storage space. Main criteria where; accessibly, ground surface and height. 3,000 square feet allows a minimum of 9,000 ft.³ [250 m³] with 3 ft. [1 m] heights to maximum 20,000 ft.³ [550 m³] if stacked properly and ground surface can cope with the weight.

What are the costs for found suitable end-uses?

End-use	Costs			
	Lumber	Labour	Machinery	Investment
Community	\$ -	\$ -	\$ -	No
Decorative frame	\$6005, - [7,800 bf.]	\$2250,-	\$540,-	No
Frame	\$6545, - [8,500 bf.]	\$2500,-	\$600,-	No
Logs	\$4080, - [5.300 bf.]	\$312,5	\$187,5	No
Wild Play	\$3540, - [4,600 bf.]	\$1250,-	\$600,-	No
Furniture	\$3850, - [5,000 bf.]	\$2750,-	\$495,-	No
Maintenance & Packaging	\$960, - [1,250 bf.]	\$75,-	\$45,-	No

Table 7: Estimated costs



To following parameters are taken into account determining the estimated costs. Available [theoretical] space is divided by 1.6. The amount of lumber is multiplied by \$770, - MBf. the average purchase price of poles/logs and sawn lumber. Work hour rate; \$25, - machinery: \$15, - per hour.

How do neighbouring companies process their waste [Benchmark]?

According to the size of the company's size the extension of waste utilisation or lumber yield is higher. The smaller companies have straight forward, simple systems of automatic dust and shavings disposal. Trim-ends are used within their current production process or given away as firewood. Companies with more purchasing power are able to invest in possibilities such as finger jointing or pellets. All companies sell their dust, shavings to a third party. Principles behind waste remanufacturing have a pure economical base other reasons named are a zero waste policy or space/stock use.

Is waste usage sustainable in a continuous matter?

As a whole wood residuals are 'produced' in reasonable amounts. Saw dust, shavings and trim-ends could fill one container on a monthly basis. Waste quality however, for 'appearance' product groups rather than construction grades, material flows look doubtful. Apart from the earlier named daily shavings, saw slabs, project returns and salvage/heritage pieces material flows will be irregular.

What are the dimensions needed for found end-uses?

Product group	Grade description	Dimension indication
Community	'Look good grade' meaning; no loose knots, large/deep checks, no stain, properly stacked. Sellable for consumer eyes.	1", 2" boards in trade lengths [per foot], edged or un-edged, small sized logs/beams, poles, fence material briefly all ready consumer items.
Decorative frame	Disregarding NLGA No.1 is possible due to non construction requirements. More defects are allowed if not decreasing the saleability of the product	3" to 6" thick by 6" to 8" widths and 3' up to 8' lengths.
Frame	NLGA No.1	Frequently used standard frame sizes; 8"x8" posts, 5"x8" plates, 3"x4" rafters, 5"x3" studs in 7' up to 20' lengths.
Logs	Minimal 1' Ø with bark, beams or smaller sizes posts joint together.	1' Ø, 12"x12" beams or joint together smaller posts. In 1' up to 4' lengths.
Wild Play	NLGA No.1	Octagon spars, beams and decking [see Wild Play lumber specification on page 13.]
Furniture	Appearance grade, clears [edged grain, 75% defect free] rustic [small knots] no sapwood allowed [unless wane includes in piece] figured grain or colour schemes. And special attentions for salvaged/heritage pieces.	In accordance with timber frame identity thick/bulky or solid looking. In standard furniture length dimensions.
Maintenance & Packaging	No particular quality grade needed.	Small, thin leftovers sawhorses repairs, jigs, package covers and-/ or stackers.

Table 8: product group, grade & dimensions



What is the client attitude towards the waste usage?

For Canada natural resources are an essential part of their economy. Thus caring for nature or the environment is critical and related policies have grown into a basic requirement rather than a need. Local bars promote their compost programs, supermarkets have 'green' roofs and municipalities launch zero waste challenges. All clients relate to, implement own policies and cheer any effort reducing environmental impacts of others.

Is there a demand for the produced end-uses as client benefit?

Beside public and governmental pressure companies identify benefits such as 'feel good' feeling, reduced environmental impacts and sustainability not as direct impact on their business model, customers are not willing to pay a premium. They do see direct advantages in cost savings (in waste disposal, transport costs), the increased competitiveness in comparison with other industries and the potential of 'green' marketing as a promotional tool. According to market researcher Mintel about 12% of the U.S population can be identified as 'True Greens' [seeking and regularly buy so-called green products] another 68% can be classified as 'Light Greens', buying green sometimes.





§6.3 How could M&L organise re-manufacture waste to create added and -/ or customer value?

What are organizational issues?

After getting an insight in the companies important wood residual capabilities in relation with possible end-uses one could quick and explicitly filter and search essential issues in need to overcome or required to be used in later on organisational structures.

'Chance' fields

- ⊗ Multipurpose lumber [Douglas-Fir, WRC]
- ⊗ Dimensioned lumber [less waste]
- ⊗ "Small- or thin" kerf [less sawdust]
- ⊗ Sawmill operator [experienced]
- ⊗ Craftsmanship, handmade [core business]
- ⊗ Project-based [unique, tailor made]
- ⊗ Storage space [workshop premises]
- ⊗ Mind-set [employee, customer attitude]
- ⊗ Workshop location [marketing perspective]
- ⊗ Benchmark [possibilities]
- ⊗ 'Green', environmental awareness [trend]

'Problem' fields

- ⊗ Dimensioned lumber [less flexible]
- ⊗ Saw mill [misfit, set-up]
- ⊗ Sawmill operator [1 present]
- ⊗ Waste dimensions [small size & quantity]
- ⊗ Material flow [not continuous]
- ⊗ Construction grade [limited end-use]
- ⊗ Storage/stock [inefficient]
- ⊗ Lumber storage [degrading]

- ⊗ Sizes [tailor made, no standards]
- ⊗ Unique selling point [difficult]
- ⊗ Competition [intensive]
- ⊗ Customer requirements [too high]
- ⊗ Location [transport costs]

Inside-out: waste structure?

Tracking all MacDonald & Lawrence's 'business activities on one hand and signalling wood residuals at every stage on the other. A simple graphic shows and pin-points MacDonald & Lawrence wood waste structure.

Activity	Wood residue	Who?	Resources
[Frame dismantling]		MacDonald & Lawrence	
↓			
[Transport]		External transport	
↓			
Timber intake: Logs/turned poles Dimensioned lumber		External sawmill	Workshop
↓			
[re] Sawing	Sawdust, fall-out, slabs	MacDonald & Lawrence	Workshop, saw
↓			
Framing	Shavings, trim-ends	MacDonald & Lawrence	Workshop, tools
↓			
Transport		External transport	
↓			
Frame erection	Project returns	MacDonald & Lawrence	
↓			
Timber framed building			

Table 9: Production process & waste structure

As seen in the above table: production process and waste structure most of MacDonald & Lawrence wood residuals occur during workshop activities. In relation with earlier workshop assessments⁵ this

⁵ see §6.1 Workshop & Yard lay-out



asks for structured arrangement regarding the workshop and yard. To do so five key areas were assessed:

⊗ **Surrounding workshop:** A paved strip of 1,750 square ft at the east and north side of the workshop could be used longer and smaller timbers. An area directly in front could be used as 'distribution centre' where inbound timber can be assessed and moved to its designated storing place. The south side should have space to stack slabs from sawmill and a [new to construct] air drying rack for usable wood residue saw mill fall outs. The north side can be used to store smaller, light and green timbers due to a concrete floor accessible for the forklift. Air drying possibility if kept out of direct sunlight and stacked properly. The west side has a small slope and a rocky surface accessible for the tally handler. Storing midsize, dry or- green and slow moving timbers is desirable. Air drying possibility if kept out of direct sunlight and stacked properly.

⊗ **Inside workshop:** An all paved surface to frame with the possibility of 600 ft.² storing single, special, air dried pieces vertical against the walls or the creation of elevated storage space accessible for the small forklift, without blocking the sunlight from the high glass windows. In contradiction to the main hall the joining area should be free to use the machines

however there is room for storing smaller single pieces vertical against the wall.

- ⊗ **North side tent:** a large area of 10,500 square ft easily accessible because of two adjoin gravel roads ideal for timber framing, storing raw material and larger dimension wood residue. Because of large surface 'driving' roads/instructions needed to utilise space as efficient as possible. Air drying possibility if kept out of direct sunlight and stacked properly.
- ⊗ **Inside tent:** The oval strip of 450 square ft is suitable for small, light, dry and slow moving lumber. The tent has a gravel surface and is only accessible by the small forklift. Timber framing is its main purpose and due to insufficient ventilation and irregular temperatures storing green timbers is not desirable.
- ⊗ **East side sea shore:** a long strip of 2,750 square ft easily accessible and suitable for long, heavy and- or green timber. Air drying possibility if kept out of direct sunlight and stacked properly. Due to adjacent gravel road covering timber is desirable to prevent the timber from becoming dusty.

In addition all designated areas described above should have a specific pallet for dunnage, stackers and jigs. A visual overview could be found in Appendix I & II.

Inside-out: wood residue process?

A wood residual system can be expressed as the organisational structure, process, procedures and instructions needed to implement wood residual management. In the below shown figure 10 one could see how the named concepts interact and are connected with one another.

- ⊗ **Wood residue process:** activity systems using resources to realise products.
- ⊗ **Wood residue procedures:** specified way of carrying out an activity
- ⊗ **Wood residue instructions:** detailed stage of procedures

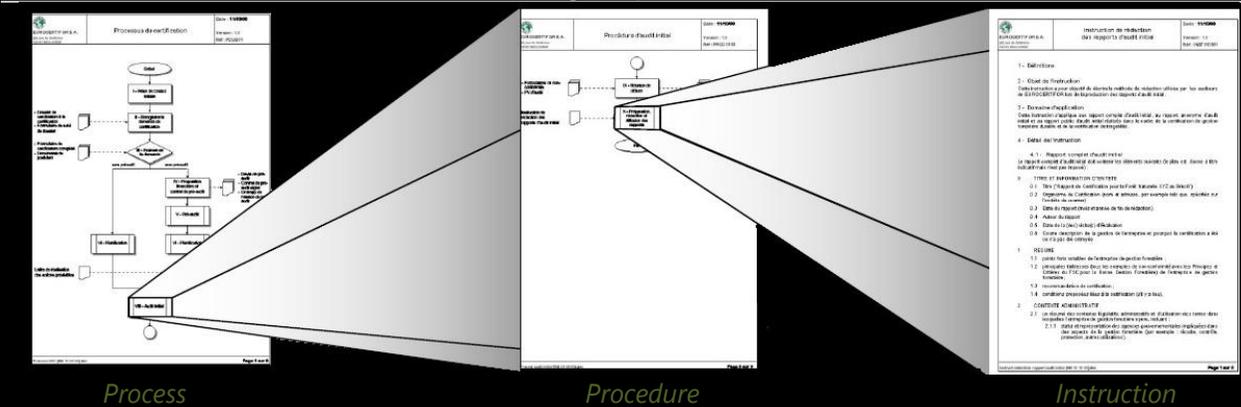


Figure 10: Link between process, procedures and instructions



To ensure that processes, needed for a wood residue management system, are established, implemented and maintained, management should appoint a member of the organisation having the responsibility and authority required⁶. The role, named shop manager in further procedures, consists of responsibility for developing, revising and implementing wood residue standards and policies in the organisation. This position is the link with management and mainspring of team motivation.

Just as shown in figure 10⁷ a wood residuals system is designed specific to MacDonald & Lawrence Timber Framing Ltd. In the following eight pages wood residuals process, procedures and instructions are shown. In order to read the system key from figure 11 is needed and for a clear overview the following process and procedures are shown on the following pages:

- ☼ Page 25 Figure 12: Wood residue process [general overview, most left in figure 11]
- ☼ Page 26 Figure 13: Timber intake procedure [first step in process requiring a procedure]
- ☼ Page 27 Figure 14: Log/pole procedure
- ☼ Page 28 Figure 15: Project returns procedure
- ☼ Page 29 Figure 16: Saw procedure
- ☼ Page 30 Figure 17: Wood residual procedure
- ☼ Page 31 Figure 18: Packaging, storing procedure
- ☼ Page 32 A quick overview of used documents and instructions

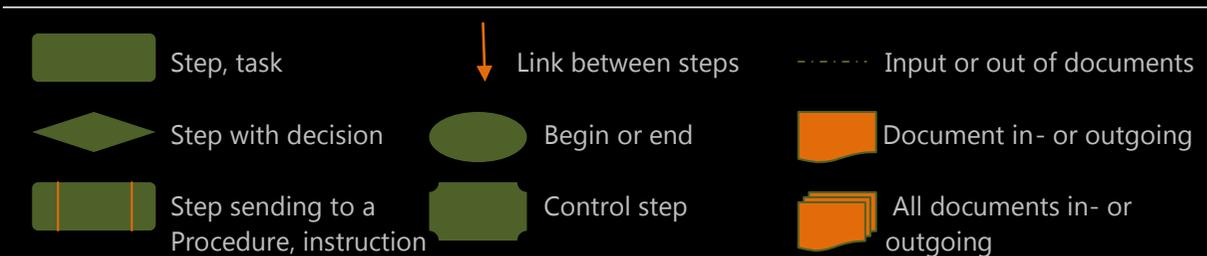


Figure 11: Key

⁶ See ISO 9001:2008 [Quality Management] *Indicator 5.2.2*

⁷ Link between process, procedures and instructions

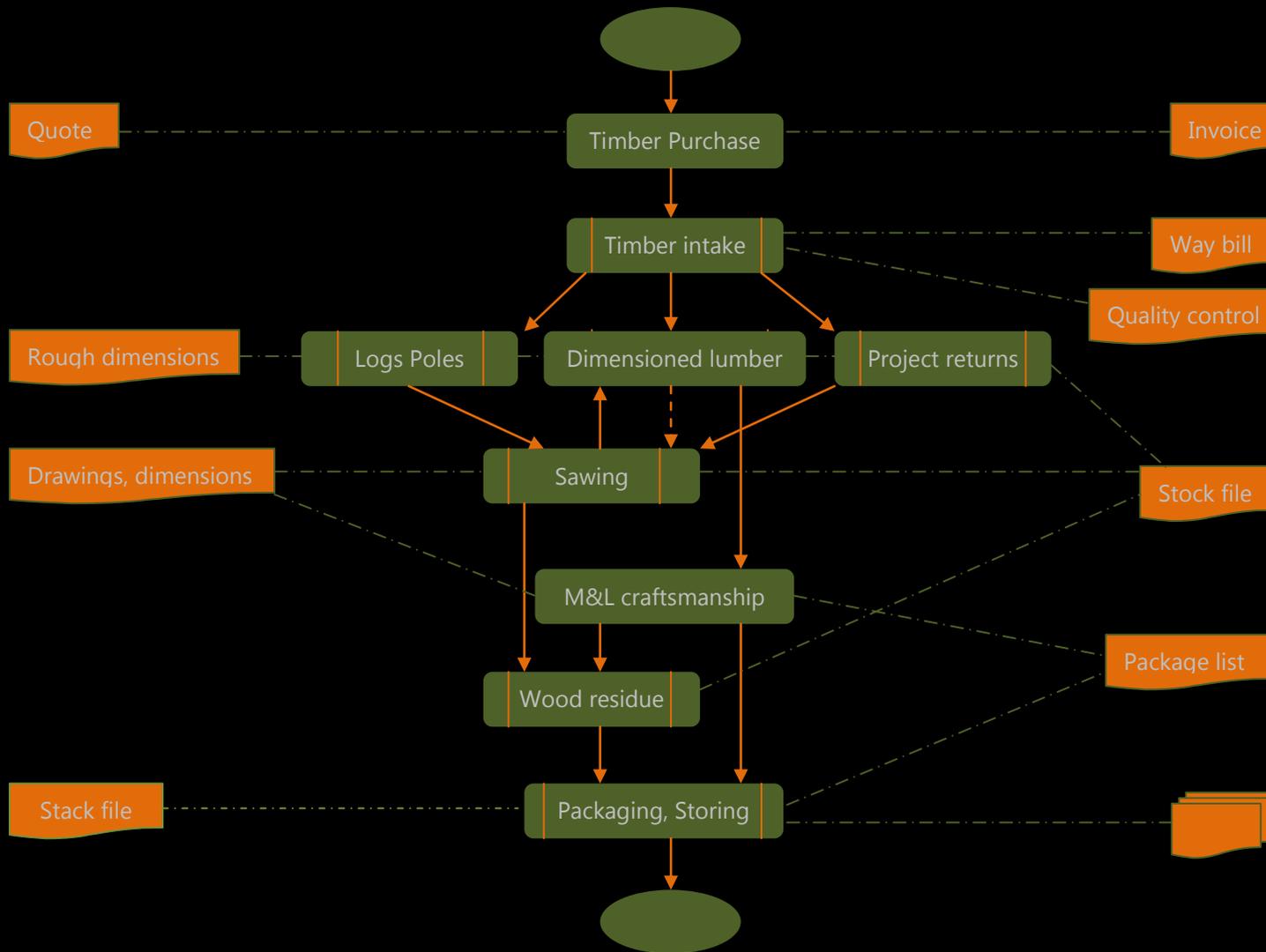


Figure 12: Wood residue process

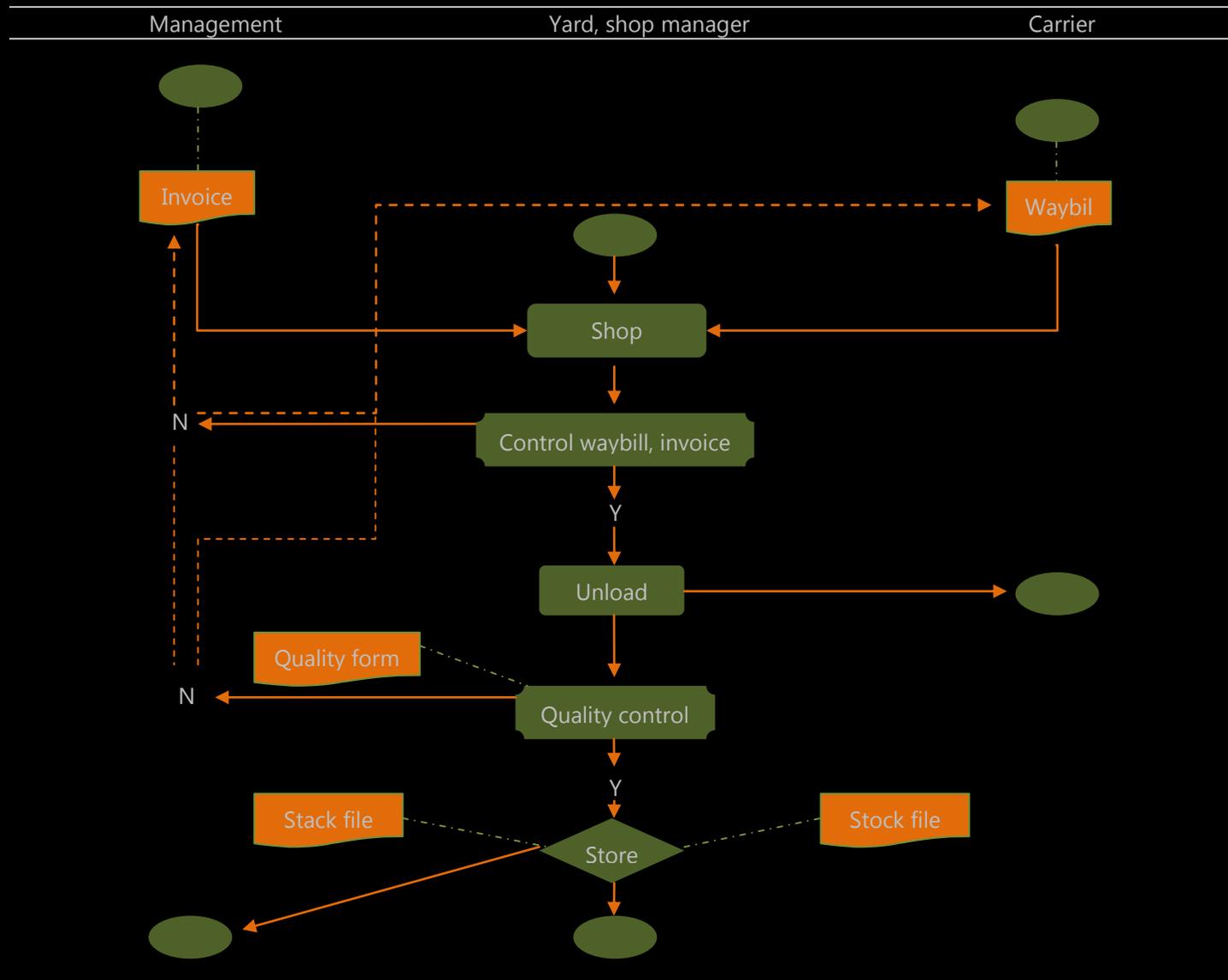


Figure 13: Timber intake procedure

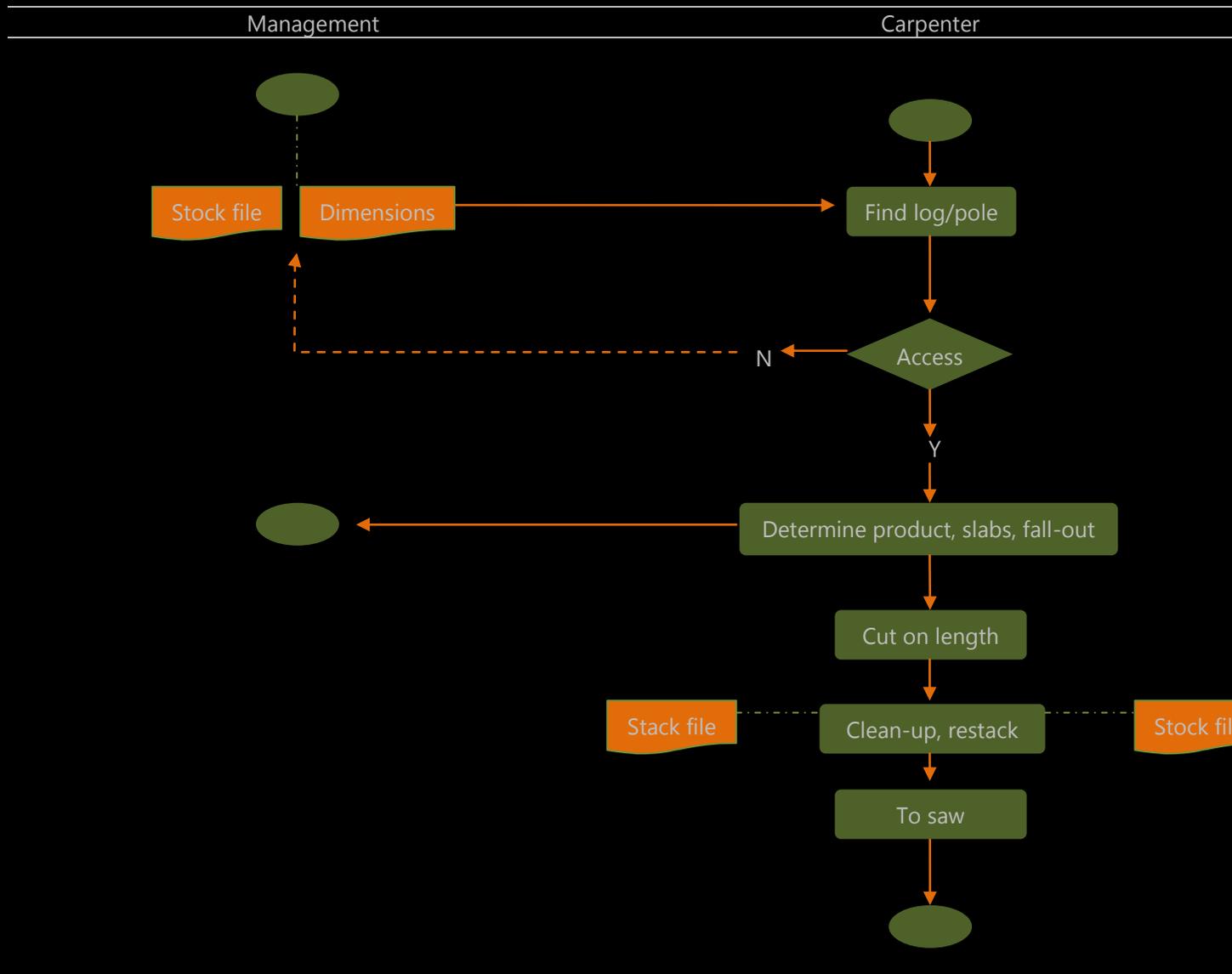


Figure 14: Log/pole procedure

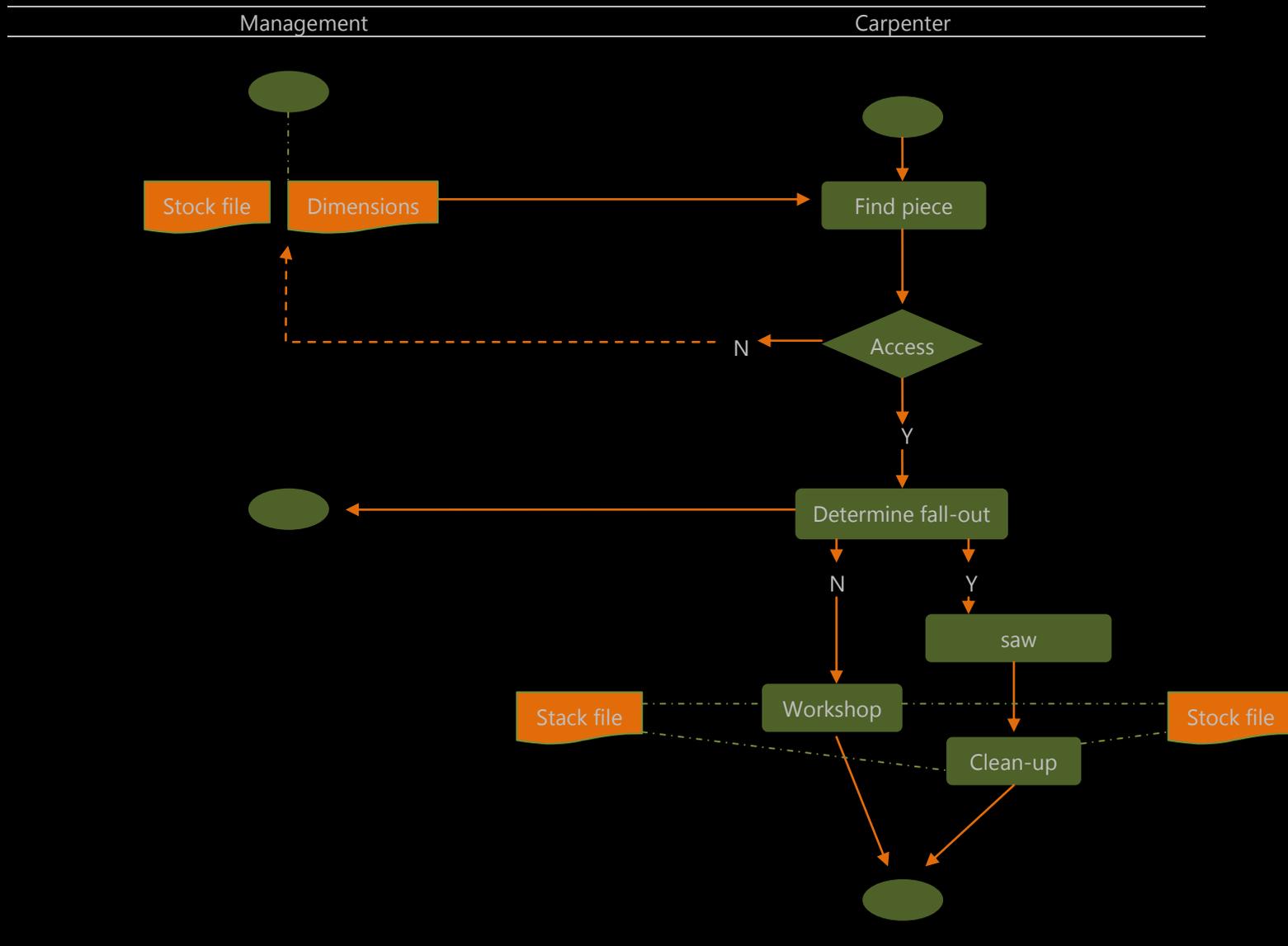


Figure 15: Project returns procedure

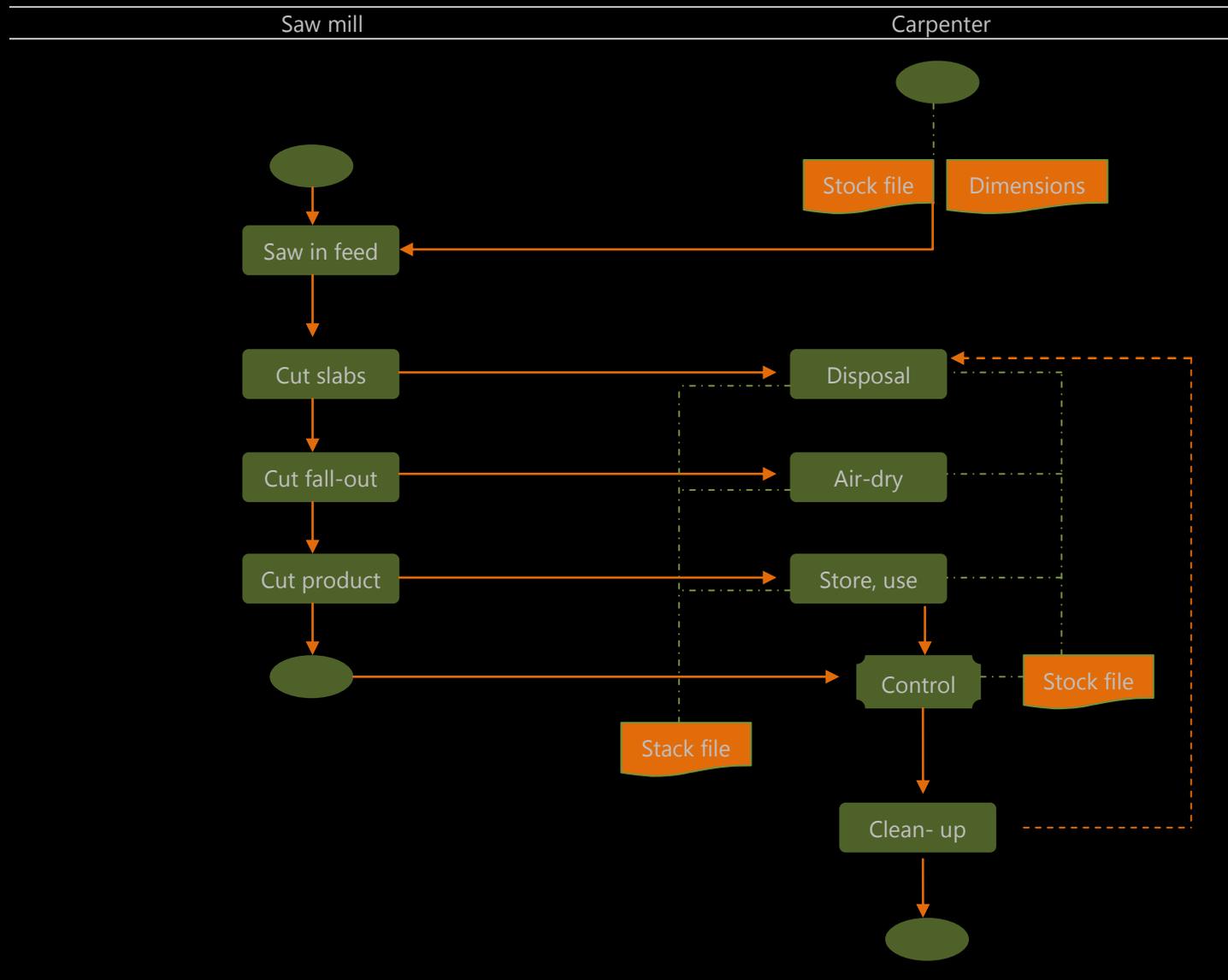


Figure 16: Saw procedure

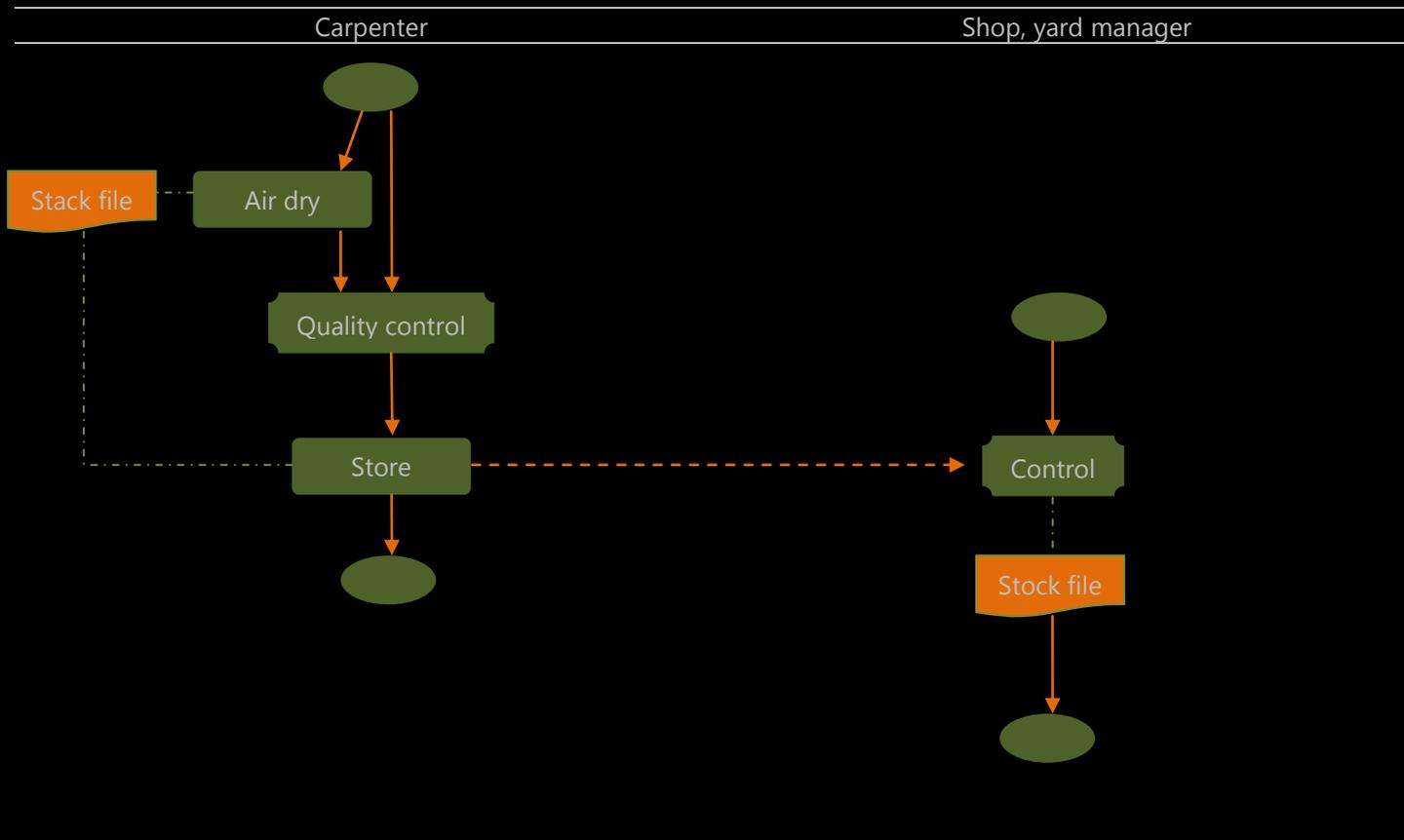


Figure 17: Wood residuals procedure

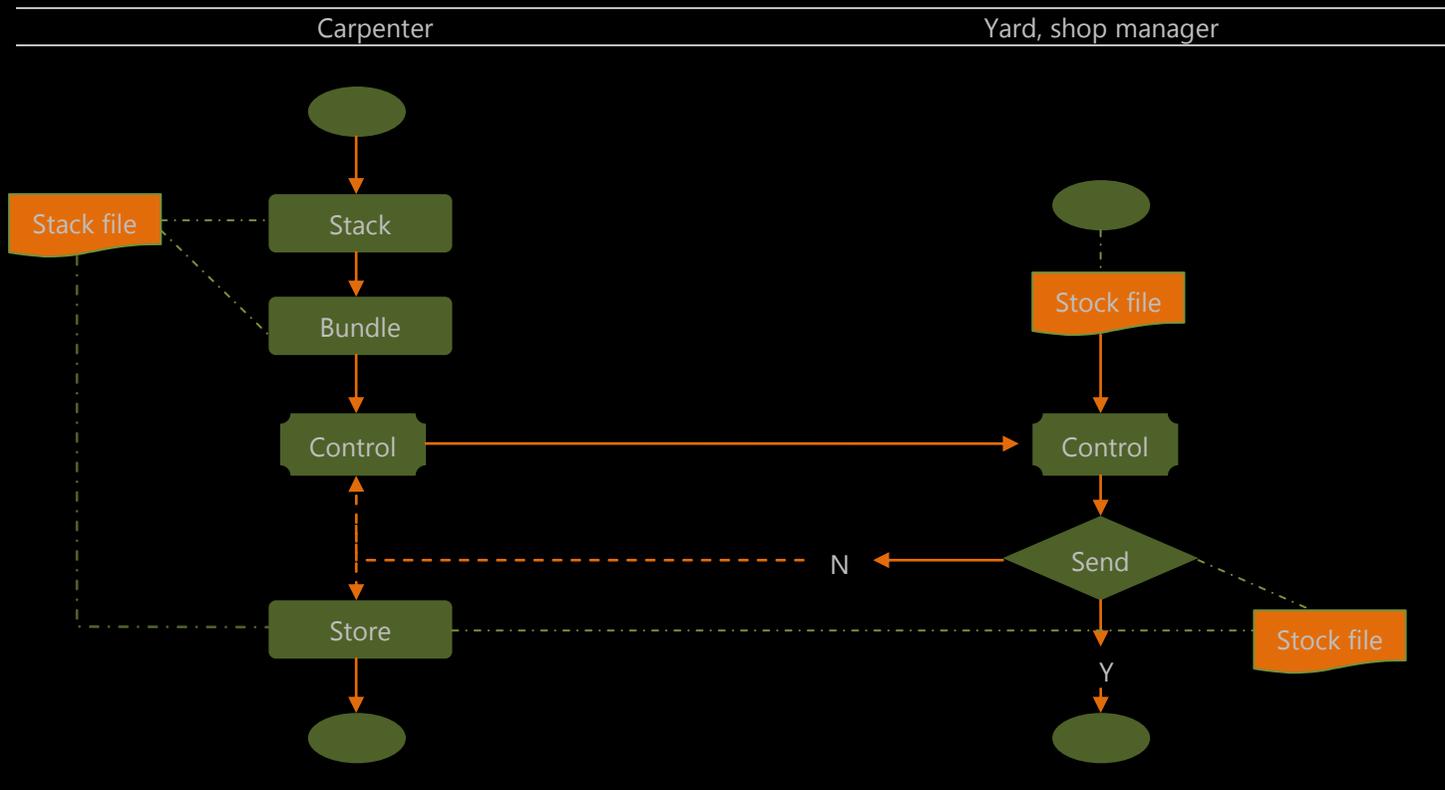


Figure 18: Packaging, Storing procedure



Inside-out: wood residual records?

- ⊗ **Existing external documents:** quotation, invoice, way bill.
- ⊗ **Internal existing documents:** Rough sawing dimensions, frame drawings, finished dimensions, package list.
- ⊗ **Internal revised documents:**

One sheet with the possibly to comment on inbound timber which consists of 3 sections:

1. Quality control: remarks about the timber quality focus on colour, producing defects and packaging.
2. Stack file: instruction on how, where and what to stack properly preventing later timber distortion.
3. Stock file: section to show before use, where certain pieces are and after use, in which parts timber has been divided and where these 'fall-out' parts are.

When completed and -/ or fully updated the document should be handed in to shop, yard manager to be uploaded in order for the design department/management to know what pieces are available for concept drawings.

Inside-out: Cost-benefits relationships

- ⊗ **Less waste disposal service costs;** by [re] using wood residuals paid disposal could be reduced to virtual zero. For example following cutting 38 octagon spars for Wild Play Kelowna⁸ resulted in a full 10 yard container which costs the company \$500 a month for pick-up, disposal and renting an empty one. All neighbouring companies sell their fir saw dust for \$250 to \$350 per container. A simple calculation: instead of a \$6000, - disposal bill an extra \$3000, - receiving's could be made.
- ⊗ **'Wasted' labour & production costs;** in interviews and observations personnel 'waste' time to find 'tally' to frame or move existing stock around to create framing space. For example; a group of 5 carpenters work average 4 months per project is 3 project a year. Having 30 employed carpenters makes a total 18 projects. 2 full days 2 carpenters of tally search or rearranging the yard per project at \$25 per hour 10 hour days makes \$18,000 bill which could be saved on a yearly basis. Of this total bill a significant share could be saved.
- ⊗ **'Soft' benefits:** *Improved workplace safety:* employees are less likely to trip, fall or cause machine malfunction. *Possible extra revenue:* if products sold extra turnover is realised. *Improve work efficiency and productivity:* Employees are less likely to be moving stock, wood residuals or waste.

Inside-out: product group framework?

A specific product group framework is made in paragraph 2, table 8. Identified suitable end-uses are defined with grade and 'rough' dimensions. A special interest should be reclaimed timber, 'Weyerhaeuser expands into reclaimed wood market'⁹, from restoration, heritage project read in Timber.

Outside-in: customer benefits?

- ⊗ **Green, environmental and ecological marketing:** opportunities to differentiate from existing marketing seeking, and challenge, to provide a substantially different perspective. Address in a green, environmental way the ecological and social realities in the current market environment. In addition of the 4p's, the 3p's of Public, Partnership and Policy should be added to the marketing mix. Describing 'green' affiliated people/groups, initiatives and corporate policies.
- ⊗ **Positive community relations, image and goodwill:** By waste reducing policies or compliance to local waste challenges companies accepts civic responsibility and takes active interest in the well-being of its community. Community involvement builds public image, employee morel and good which contribute to long-term success

⁸ Also see §1, products produced? Waste flow quantities?

⁹ Source: Trade Journal of June 28th 2012



Outside-in: customer requirements?

- ⊗ **Labelling:** Marketing claims call for caution; misleading or overstated statements can have a negative effect on attitude towards a brand. To overcome scepticism guaranteeing messages by labelling systems such as FSC, Timber Framers Guild or an internal wood residual label is desirable.
- ⊗ **Just-In-Time:** More and more businesses strive for JIT management in stock, by reducing inventory and associated handling costs stock improving efficiency, quality and ultimately returns on investment.
- ⊗ **Quality:** Products need to be produced correctly, reliable, maintainable and sustainable. Costs of products need to be according to its quality.

What is the SPT (Segmentation, Positioning and Targeting) strategy per product group?

	Segmentation	Positioning	Targeting
Community	Purchase power Need of wood Distance to Bamberton	Low price, 'cost' price compared to DIY shops. 'Lure' potential clients on yard, increasing goodwill, image and brand awareness.	Volunteers, Neighbourhoods, communities, public gardens/institutions, sole proprietors
Decorative frames	Home owners Garden Social Class Countryside	Mid range pricing must be seen as 'additional' sales opportunities to existing clients (Homes)	Current business model
Frame Logs	Current business model Same as 'Community'	Current business model. Same as 'Community' with a higher price for special, bigger dimensions.	Current business model
Wild Play Furniture	Current business model Need of wood Occupation Quality Specialty	Current business model. Mid-high price range, the use of special pieces for	Current business model Cabinet makers, sole proprietors, artist, carvers, furniture makers

Table 10: SPT Matrix



How does M&L implement, evaluate and monitor the wood residual management system?

The successful implementation of revised strategies or business policies requires four critical steps;

1. Integrate the new strategy in the current business processes.

To achieve this, time and training investments in the systems, corresponding to the previously designed in paragraph 6.3 inside-out: residue process described waste process, procedures and instructions, are necessary. A *top-bottom* approach should be sufficient, where management shows and appoints wood residuals system to the shop manager who in turn briefly instructs the working carpenters.

2. Execute the new policies suitable to the organisation.

The company's strong heterogeneous, unique and 'tailor made' approach conflicts with a homogeneous, commodity production way of thinking. To be able to execute the procedures right, MacDonald & Lawrence should approach product development/production as *project*. Inbound timber should be assessed and out of this timber a certain amount of products are manufactured. Time, tools and carpenters should be allocated to this project exactly as current business procedures.

3. Actual execution needs to lead to customer- or added value.

In order to lead to customer- or added value products produced need that typical 'tailor made', handmade and craftsmanship character. This requires a solid base, for working with 'waste' [implying more handling, 'dirty' lumber, misfit dimensions etc] among employees. Brainstorming with- or appointing a single member to craft certain products, close to their speciality, increases willingness, motivation and triggering [- or appeal to] the sense of creativity.

4. Evaluate and control the executed activities.

To be able to evaluate and control the progress again four steps should be taken into account:

1. Formulate performance criteria [for later benchmark]
2. Information collection [per criterion]
3. Analyse found information [identify results]
4. Evaluation audit

A simple but fast and easy to use instrument to control and evaluate is a *balanced scorecard*¹⁰, an example could be found in Appendix III.

¹⁰ Kaplan, R.S., en D.P. Norton, Translating strategy into action: the balanced scorecard, Harvard Business School Press, 1996



7. Conclusions & discussion

§7.1 Conclusions

“What are the current input, processing and output capabilities?”

The use of Coastal Douglas-fir makes a wide range of end-uses possible. But due to the construction grade, appearance- or fine carpentry are ruled out. Uses that do not require direct engineering and a more rustic appearance seem likely. 65% of the timber intake has been dimensioned to size and thus waste timber components could be made from the 35% logs, pole intake, with special attention for Wild Play entertainment parks.

Most valuable, in the form of solid wood, ‘waste’ is handled by an experienced saw miller who is able to push the mills to their maximum abilities. His decision making and the octagon shaped beams, demanded by Wild Play, leave ‘space’ for extra cuts and thus possible timber waste components.

Shavings, sawdust and trim-ends are not automatically dissolved resulting in a [paid] mixed waste dump. The same occurs with ‘waste’ which represents the highest possible customer value; ‘nice’ cut-offs, project returns and valuable heritage timbers. Timber pieces are randomly set- or laid aside without proper preserving methods.

“What could be possibilities for added value from M&L’s wood residue?”

As mentioned earlier Douglas fir and Western Red Cedar are multi purposes wood species but current purchase specifications limits possible end-uses to ‘low grade’ outside use. This in order to reduce handling costs, maintain margins and customer value.

Employees are enthusiastic about re using or re manufacturing the companies’ wood residue. The practical side is that employee’s are tripping over and have no clue what to do with wood residue due to a lack of protocol. This problem could be dissolved by using the space surrounding and in the workshop more effectively. Framing requires vast amounts of space which is available if there was a ground plan for stocking, properly stacked wood residue.

Current wood residue does not represent significant value or continuous material flows resulting in added value. To reduce the impact of these factors to a minimum, creating a stock is desired. Because the value of wood residue is hard to measure by economical methodology focus should be on the ethical, philosophical client benefits rather than direct impact on business profitability.

“How could M&L organise wood residue use, if customer- or value added products are found?”

In order for MacDonald & Lawrence to organise its wood residuals leading towards customer- or added value, results from the confrontation between §6.1 and §6.2 [organisational issues] need to be overcome. Assessments of the waste structure and current workshop arrangements required specific use of the limited available space, as shown in appendix I, II. Due to the lack of wood residual protocols a wood residual system, a framework of process, procedures and instructions, must be designed to lead to added- or customer value.

If MacDonald & Lawrence implements [and evaluates!] this previously mentioned wood residuals system, as designed in tables 11 until 17, in combination with their key strength [project based, tailor made] and taken customer requirements in account, the given possible products produced should result in short-term decrease waste disposal, labour and production costs. In the long run results are increasing safety, extra revenue, and efficiency benefits specific to MacDonald & Lawrence and on the other hand creating ‘green’ marketing, enhancing image and goodwill opportunities for all relationships.



"What could be suitable end-uses for MacDonald & Lawrence timber framing Ltd. industrial wood residuals, organised benefiting its relationships?"

Suitable end-uses for MacDonald & Lawrence timber framing Ltd. wood residuals are:

- ❁ **Community:** A product which possesses abstract values rather than its tangible product. It is the combination of all MacDonald & Lawrence's wood residuals for 'community' or 'privates'. Being able to sell local people firewood, [un] edged boards for their garden or other do-it-yourself jobs for instance or helping out the local community organising a fair. Rooted into the community, enhancing brand awareness and getting rid of wood residuals at the same time.
- ❁ **Decorative frames:** Examples are arbors, garden lattice sheets, grow stacks for plants, entrances etc. Small wooden structures which enhance the ecstatic values but do not require construction grade timbers or other building regulation codes.
- ❁ **Logs:** or large dimension beams- or blocks to use in public spaces such as parks for decoration, in retail shops as window dressing, art galleries as pillar or just as a stool.

- ❁ **Wild Play:** this client, who represents a significant part of MacDonald & Lawrence turnover, is enthusiastic about waste remanufacturing and pioneer in 'green' marketing and moreover interested in every octagon shaped piece of wood residual.
- ❁ **Furniture:** Every once in a while a magnificent piece of wood passes along, when cutting a custom beam, shaping a timber frame or replacing lumber in conservation projects. Throwing pieces with beautiful grain- or an extraordinary pattern in the trash is a waste in both ways. These pieces deserve to be transformed into doors, tables or counters for example, products which catch the eye.
- ❁ **Maintenance & Packaging:** When timber framing timbers need to be lifted to level out, frames need bundling to be sent to the site of erection and wood residuals need stacking. There is a need for jigs, sawhorses, stackers and covers for internal use.

In order to lead to added- or customer value these products need the following organisation:

- ❁ **Project based working:** None of MacDonald & Lawrence customers required a standard product, all wanted that specific, tailor made and unique solution for their needs. Refurbishing wooden bridges, building high-end houses and canopy entertainment parks all need that bespoke fit, allocating the right people, tools and time to each stand alone project. Within this business model standardises production lines do not fit in, not in the workshop [as in space and set-up], not in the mind-set of its employees. When wood residuals are identified certain, specific end-uses need to be linked to this particular timber and small range and bespoke products could be manufactured.
- ❁ **Waste management system:** Wherever there is no waste protocol in effect, lumber is all over the place and trim-ends end up in the same bin as sawdust and possible valuable timber piece deteriorate poorly stacked. Setting up a waste management system for wood residuals results in cost reduction, efficiency and work place safety benefits for MacDonald & Lawrence and 'green' marketing, image and goodwill opportunities for its relationships. The waste management system shows wood residual structures, procedures and clear instructions and responsibilities for management, shop managers and carpenters. So shavings & sawdust end up in the waste bin, sold to soil enhance firms, whereas value grain pieces transform into table tops, beams into wild play octagons and log trim ends as window dressing at the local retail store.



§7.2 Discussion

After drawing conclusions, found results were discussed with Gordon MacDonald and Steve Lawrence. Aim of the discussion: was information found sufficient to answer the research questions.

The feeling arouse if research was too far off regarding our first primary objective to find 'extra' products specific to Wild Play entertainment parks. The same feeling, being slightly off target, was applicable to the *organisation* of products rather than the *creation* of products. It takes some courage to change the direction but the results are definitely a leap forward, for example we normally unload the purchased timbers somewhere and find out, in a later stage, there is a piece missing. So showing seemingly simple procedures to our responsible employees helps.

The discussion took place in a critical pleasant atmosphere, comments and solutions as in extra 'weight' in certain assessments, narrow product groups definitions and specific considerations were needed and welcomed. Overall there is a positive attitude towards the results and assessed 'problems' are surmountable, making it able to implementing recommendations.

Doubts about work hour rates and lumber value, because fall outs are paid by other projects, make the *cost effectiveness* indecisive. Thus handling time is crucial and so streamlining and organisation of processes is tremendously appealing. MacDonald & Lawrence definitely see the positive sides and benefits on short and long term. Project based implementation of product development is particular interesting, well found as we do not see 'mass' production strengths.

Last but not least, to make the thesis compelling M&L suggest adjusting, [re] focus and adding the following [on standalone base];

- ⊗ More samples product rating [table 5].
- ⊗ Razor-sharp work hour rates.
- ⊗ Training manual timber stacking.
- ⊗ 3 business cases, determined products.
 1. Wild Play products
 2. Knee braces
 3. Decking/flooring



8. Evaluation, recommendations & continuing research

§8.1 Evaluation

When arriving to Vancouver Island impressions were overwhelming. Different culture, business model and timber dimensions than in the Netherlands.

After settling down and the fresh start research life was good. Visiting neighbouring companies, interviewing employees and having 'management' meetings resulted in vast amounts of information. The difficulty in this phase was pin pointing the right person and getting the information needed, in cases exact data was not present. Exploring certain leads resulted in work done which was not directly usable.

Biggest problem faced was the decision I had to make to shift my research from the commercial product development to the organisation of wood residuals structure. When tracking wood residual flows many problems had to be overcome, in my experience, before actual product development was even possible. Because I believe that it is much better to have an eclectic model to help management decisions than having no model at all, or to wait for the perfect data and perfect model.

§8.2 Recommendations

Rather than implementing the designed waste management system, and corresponding actions, no direct other significant recommendations based on the research results come to mind.

§8.3 Suggestions for continuing research

Due to the changing of direction from the initial thesis subject, a feasibility study or business case to certain, specific and determined products could not be done due to lack of time. Individual business cases should determine products feasibility.



List of abbreviations

3/8	Three eights
0.27	Nought point seven
1992	The year nineteen ninety two
6th June	The sixth of June
6.30 p.m.	Six thirty or half past six in the evening
13%	Thirteen percent
3cm x 8cm	Three centimetres by eight centimetres
3m ²	Three square metres
2kg	Two kilos
7m ³	Seven cubic metres
Ø 18cm	Eighteen centimetre diameter
e.g.	For example (exempli gratia)
i.e.	Which means (id est)
et al.	And others (ett alii)
Avg.	Average
VAT	Value Added Tax
EU	European Union

Table 11: List of abbreviations



List of tables & figures

Table 1: Delivered lumber, grade and purchase price	11
Table 2: Machinery and with waste output	11
Table 3: Overview blade width, kerf, equipment state and cutting method	11
Table 4: Example lumber specification Wild Play, Kelowna BC	12
Table 5: Rating suitable end-uses	18
Table 6: Producing end-uses	19
Table 7: Estimated costs	19
Table 8: product group, grade & dimensions	20
Table 9: Production process & waste structure	22
Table 10: SPT Matrix	33
Table 11: List of abbreviations	39

Figure 1: An example of a timber frame home, community square commercial timber frame and a restoration & conservation timber frame project	6
Figure 2: Conceptual model	8
Figure 3: Douglas	11
Figure 4: Red Cedar	11
Figure 5: Cruck timber frame example	12
Figure 6: NLGA Construction timber No1. & Btr	13
Figure 7: Yard lay-out	14
Figure 8: Workshop lay-out	15
Figure 9: Mind-map possible end-uses	17
Figure 10: Link between process, procedures and instructions	23
Figure 11: Key	24
Figure 12: Wood residue process	25
Figure 13: Timber intake procedure	26
Figure 14: Log/pole procedure	27
Figure 15: Project returns procedure	28
Figure 16: Saw procedure	29
Figure 17: Wood residuals procedure	30
Figure 18: Packaging, Storing procedure	31



Bibliography

Literature:

- ⊗ Prof. dr. R.T. Frambach & prof. dr. Ed. J. Nijssen, Marketingstrategie, Stenfert Kroese, Groningen, 2005
- ⊗ Dr. C.J. Gelderman & prof. Dr. H.W.C. van der Hart, Business marketing, Wolters-Noordhoff, Groningen, 2007
- ⊗ Centrum Hout, Houtvademecum, Sdu Uitgevers, Almere, 2010
- ⊗ Baarda, B & de Goede, M.P, Basisboek Methoden en Technieken, Wolters-Noordhoff, Groningen, 2001
- ⊗ Tsoumis, G, Science and Technology of Wood structure, properties, utilization, New York, 1991

Reports:

- ⊗ Probos, het juiste hout op de juiste plaats, Wageningen, 2009
- ⊗ Wade, W, Bullard, S, Steele, P, Araman, P, Estimating hardwood sawmills conversion efficiency based on sawing machine and log characteristics, Forest products Journal 1992
- ⊗ Steele, P, Factors determining lumber recovery in sawmilling, US Forest service, 1984

Contact persons:

- | | |
|--------------------------------------|-----------------------|
| ⊗ Vincent Bunnik | ⊗ S&A wood processing |
| ⊗ Gordon MacDonald | ⊗ Creative woodcraft |
| ⊗ Steve Lawrence | ⊗ Victoria Truss |
| ⊗ Chris Tucker | ⊗ Cowichan Millworks |
| ⊗ All MacDonald & Lawrence employees | ⊗ Millenear Lumber |

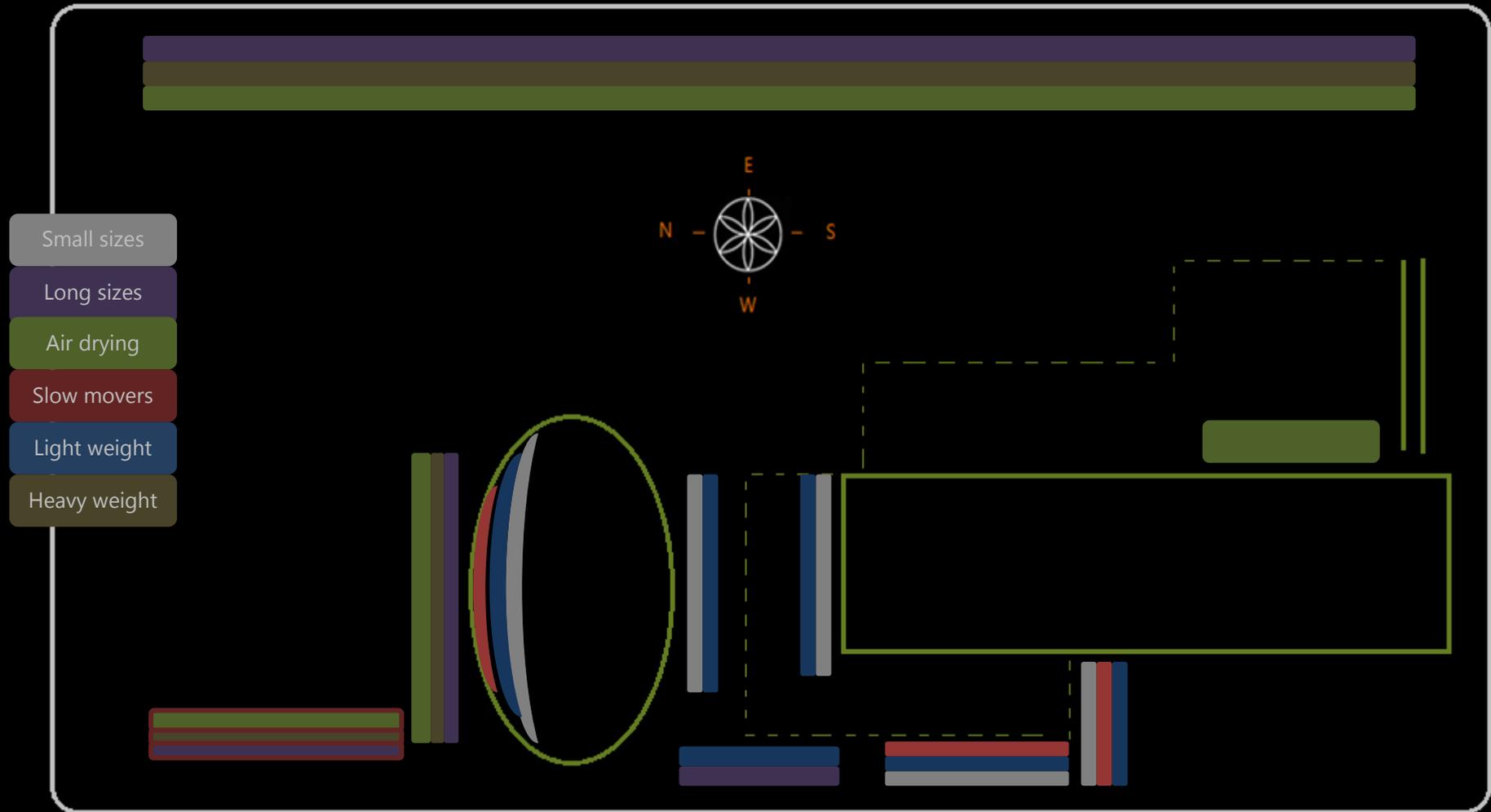
World Wide Web:

- ⊗ FPInnovations Forintek Canada
- ⊗ Timber frame guild
- ⊗ Canfor Corporation
- ⊗ Western Forest Products
- ⊗ Millar Western Forest Products
- ⊗ MacDonald & Lawrence Timber Framing Ltd.



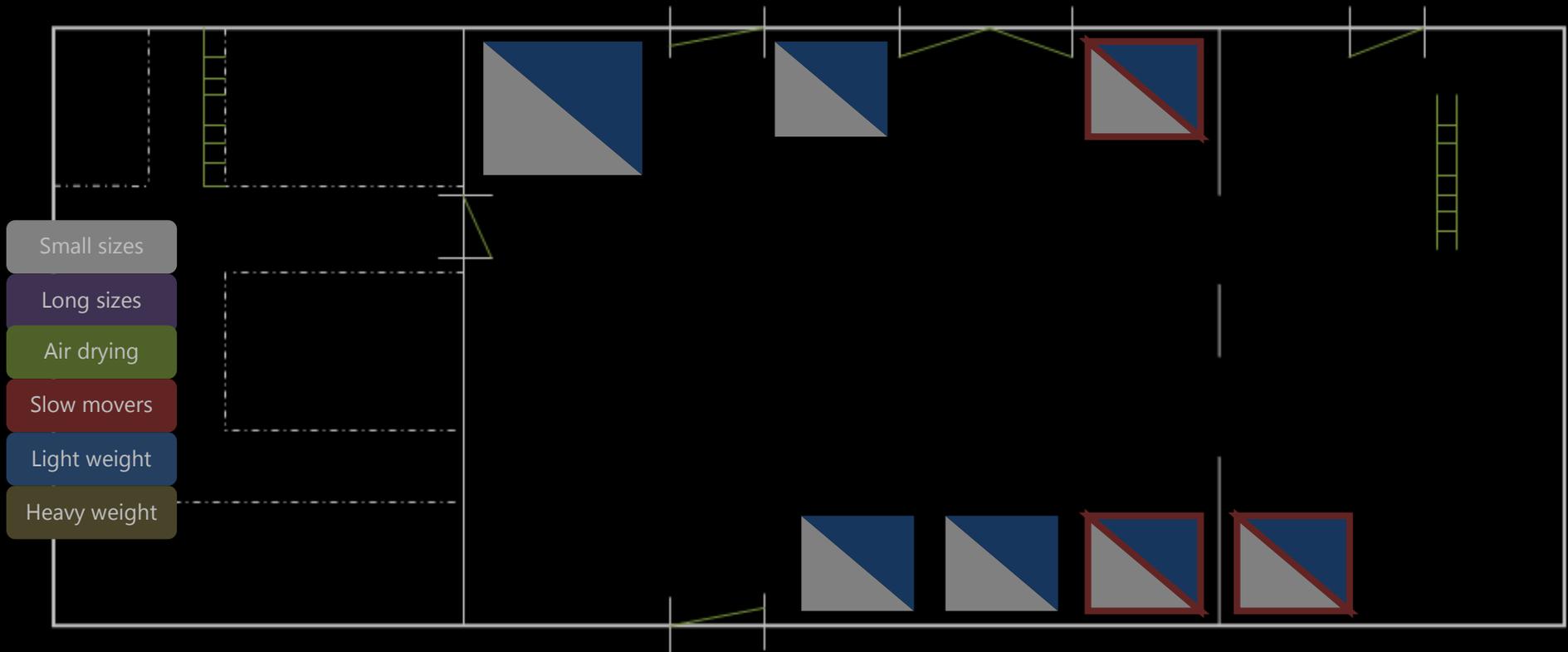
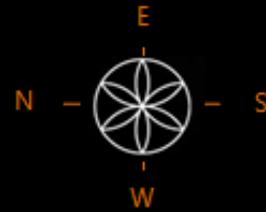
Appendix

Appendix I: Yard lay-out





Appendix II: Workshop lay-out





Appendix III: Balanced scorecard

