EXTREME MILL MAKE OVER

by

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Abstract

This paper examines the operation and performance of a lumber mill. Generating positive cash flow and remaining profitable at coincident low points of the economic and seasonal cycle are major challenges. Mill metrics were benchmarked using industry data which revealed performance gaps in costs, production rate, quality and lumber recovery. Economies of scale were investigated for lumber manufacturing. Capacity utilization for the site empirically determined that the unit was operating at close to its minimum cost, and this was an optimum operating level under poor market conditions. Opportunities to improve efficiencies and decrease waste through organizational changes, technological upgrading, and techniques of lean manufacturing are outlined. These changes raise the mill to a first quartile level generating positive cash flow at the bottom of the lumber economic cycle.

Keywords: Lumber mill, economies of scale, capacity utilization, lean manufacturing.

Subject Terms: Value added, Industrial efficiency, Organizational effectiveness, Strategic Analysis.
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List of Abbreviations and Acronyms

2+BTR  Number Two and Better. A designation for a grade of lumber
AAC    Annual Allowable Cut. The volume of crown timber allocated by the ministry of forest for annual harvesting.
BDU    Bone Dry Unit. A volumetric measure for by-products such as chips, sawdust and hog
bf     Board Foot. A measure of volume equivalent to 1728 cubic inches or an area of one square foot, one inch thick.
C-frame A large log processor which produces a two sided cant and two or more side boards from a log.
Cant   A rectangular timber with either two or four flat faces
CNS    Chip' N Saw. A term used to describe a primary lumber breakdown machine usually consisting of a scanner, log turner, chipping and saw box module.
CNOL   Cost Net of Logs. All production costs excluding the cost of logs
COGS   Cost of Goods Sold
CQAA   Customer Quality Action Alert
CVD    Countervail Anti-dumping Duty
DEA    Data Envelopment Analysis
DT     Down Time
FTE    Full Time Equivalent. A term frequently used for a full time employee
HVP    High Value Product. A class of lumber grades usually including MSR and Prime appearance grades
J-grade Japanese Grade. An HVP product for export to Japan
JSP    Job Safety Plan
m      A unit of one thousand
2+BTR  Number Two and Better. A designation for a grade of lumber

m³  One cubic meter. Usually refers to a measure of raw material (logs)

mbf  One thousand board beet

MES  Minimum Efficient Scale

MPB  Mountain Pine Beetle

MSR  Machine Stress Rated. A grade of lumber which has been qualitatively evaluated for its strength characteristics

MTBF  Mean Time Between Failure

NVA  Non Value Added

OEM  Original Equipment Manufacturer

OSHA  Occupational Health and Safety Administration

PACE  Process to Achieve Capital Excellence. The Weyerhaeuser capital spending approval process

PIE  Purchasing Improvement Initiative. An economy of scale purchasing initiative to reduce costs.

QC  Quality Control

RIR  Recordable Incident Rate

ROCE  Return on Capital Employed

RONA  Return on Net Assets

SKU  Stock Keeping Unit.

SLB  Soft wood Lumber Business.

SMED  Single minute Exchange of Die

SPF  Spruce Pine Fir. A combined designation for three species of soft wood.

SUVPC  Safety, Utilization, Value, Productivity and Cost. A teaming concept intended to rapidly replicate improvements in the aforementioned areas.

TFL  Tree Farm License
1 Introduction

The Kamloops sawmill is a dimension lumber production facility within the Weyerhaeuser corporation. Founded in 1942, it is the oldest site amongst the company’s Canadian sawmills and underwent a succession of owners prior to its acquisition by Weyerhaeuser in 1970. The mill has been updated numerous times during its history with the last major upgrade occurring in 1989.

Relative to most of its competition and sister company mills in Canada and the USA, Kamloops is two generations behind in sawmilling equipment and process technology. Little, other than minor incremental improvements has been made to equipment and process flows. The site is highly conventional in its culture and plant layout. With its current work environment and equipment the mill is not profitable during the bottom of the lumber economic cycle, and not competitive with larger, high technology plants.

The aim of this paper is to propose productivity improvements, cost reductions, and quality enhancements which will enable the site to continue generating profit at the bottom of the lumber market economic cycle and become a top quartile performer in the lumber business. Specifically, productivity gains from economies of scale, organizational changes and capital equipment upgrades will be proposed. Cost reductions by identifying value added activities and eliminating waste using the principles of lean manufacturing will be considered as part of the means to achieve the project’s goals.
1.1 The Lumber Manufacturing Process

The Kamloops lumber mill’s corporate goal is to safely convert trees to profit. Lumber manufacturing is primarily a disassembly process where value is added by transforming cylindrical/conical wood forms (logs) into rectangular cross sections of varying dimension, length (lumber), and quality (grade). The process results in by-products of wood chips and sawdust which are used for pulp production and waste (bark & breakage) referred to as hog. Hog is used as biomass fuel in the pulp mill.

Lumber production is comprised of five main processes:

1. The log yard receives the raw material, measures its volume, and stores the logs;
2. The sawmill cuts the logs into preferred lengths, debarks them, and processes the logs in either the large or small primary breakdown units into rough lumber ranging in width from 2x4 to 2x12 and in lengths from 8’ to 20’;
3. This lumber is then dried in the five on-site kilns;
4. The planer puts a smooth surface finish onto the rough, dry, lumber. Graders assign a grade to the pieces. Lumber of the same grade is then stacked and wrapped into packages. This results in a total of slightly over 400 different stock keeping units (SKU) of two species with varying lengths, widths and grades;
5. Shipping loads the lumber onto railcars or trucks and sends them to the customer.

The mill’s customer base is 50 percent residential home construction, 30 percent home improvement warehouses and 20 percent a miscellaneous mix of secondary wood manufacturers and industrial users. Geographically 70 percent of the lumber is shipped to the USA, 22 percent is sold within Canada, and eight percent to the Japanese market.
1.2 Kamloops Site Operations and Production Tactics

The site runs three shifts for a total of 116 hours per week. The unit’s production goal for 2006 is 214,000,000 board feet (bf) of lumber. The sawmill processes approximately 40 thousand board feet per hour (mbf/hr). The kilns dry the wood at 33 mbf/hr. The planer finishes the lumber at 30 mbf/hr.

From the above information and as shown in Figure 1.1 it can be seen that the planer is the site’s process bottleneck, lagging the sawmill by 10, and the kilns by three mbf/hr. An additional weekend planer shift of 32 hrs is currently used to make up planer production and match the sawmill’s output.

Figure 1.1: Kamloops Site Lumber Production Process

![Diagram of Kamloops Site Lumber Production Process]

The major cause of the planermill’s lacklustre productivity is poor process reliability. This can be attributed to; bad equipment purchasing decisions in the past forced by capital constraints, poor equipment and material-flow design, inadequate maintenance and lack of worker motivation. Many of these issues are present in some of the other five main process areas of the site, but to a lesser degree.

The log yard, sawmill, planer and shipping employ 133 production workers supported by 44 maintenance employees. The leadership group, including front line supervisors, superintendents, managers, engineers and technologists comprise a further 24 personnel for total site population of 201 associates.
Operations are supported by engineering, quality control (QC), and a safety group. There is also a central sales group external to the mill that identifies customer requirements and arranges sales to preferred customers and the commodity market. The site’s organization is analyzed in more detail in chapter two.

1.3 Kamloops Site – Metrics and Goals

Dimension lumber production is a commodity business with a low cost producer strategy and little opportunity for product differentiation. Achieving top quartile performance in today’s market generally requires, up-to-date-technology, a very high level of process reliability, and mill capacity at least to a minimum efficient scale (MES) level.

As a corporate franchise requirement, the site commits to achieving a series of annual metrics. In the spirit of continuous improvement, mills are encouraged to set “stretch” goals that will always exceed the past years performance. Successfully achieving these goals does not ensure that the unit will be either profitable or not fall victim to the corporate “fix, sell or close” strategy for non-performers, since log and lumber market variables are beyond the mill’s control.

1.3.1 Safety Goals

The most important company goal is related to safety. Although numerous safety metrics are tracked, the most prominent one is the Recordable Incident Rate (RIR). The corporate goal is to run their operations with an RIR of less than one, although the target is zero. This is embedded in Weyerhaeuser’s corporate doctrine as outlined in their “Roadmap to Success” presented in Appendix A. RIR, a term originating from the US federal Occupational Safety and Health Administration (OSHA) is defined as the total number of recordable injury cases times 200,000 divided by the total site work-hours. The RIR is a 12 month rolling average. The site has met the
target of zero once in the past five years. The end September 2006 rate is 5.98 which is currently the second worst in the company’s softwood lumber business.

1.3.2 Production Goals

Meeting annual production goals is the company’s second most important metric. Production related metrics include net sawmill production (mbf of lumber), sawmill and planermill production rates (mbf/hr). Net production is based on the sawmill’s gross output minus trim loss. With the planermill being the constraint, this production metric results in conflict between improving a key metric and working on the site constraint. Improvement efforts which should be focused on the planermill are diluted when sawmill production falls behind the annual target. Over the past five years the site has not met its annual production goals, missing its target by five to eight percent. For 2006 June year-to-date (YTD) Kamloops is four percent ahead of its annual production target. The planermill is lagging its 2006 production rate goal by 5.1 mbf/hr. This is partially due to the lack of a new planer machine which was expected to have capital approval in early 2006. The sawmill is on plan with its net production rate of 36.9 Mbf/hr.

1.3.3 Recovery Goals

Lumber recovery is defined as the volume of lumber in mbf extracted from a cubic meter of log. Lumber recovery is behind plan of 0.281 mbf/m³ at 0.278. This is a particularly significant measure since each 0.001 or “point” of recovery is worth $150,000 of annual margin to the mill. A corollary metric to recovery is waste expressed as a percentage of total mill wood consumption. Waste is comprised of lumber trim loss, log yard breakage, kiln losses from drying degrade, and any other fibre that is not transformed into lumber. The mill is meeting its goal of seven percent waste June 2006 YTD.
1.3.4 Quality Goals

The quality metrics related to the grade of lumber produced are the percentages of high value product (HVP) and #2 and Better (2+Btr) grades. High value products are Machine Stress Rated (MSR), J-grade (Japanese export) and prime grade lumber. The 2+Btr classifications also include the volume of HVP. The site is doing relatively well in these metrics with a 2+Btr production of 82.2 percent of net production versus the unit goal of 85 percent and 42.1 percent HVP versus the target of 45 percent. Quality goals are also influenced by log quality which is beyond the mill’s control. Grading accuracy, machine induced lumber damage, drying de-grade and equipment setup are factors affecting lumber quality that are within the site’s purview.

1.3.5 Cost Goals

The cost of production is measured in terms of cost of goods sold (COGS) which includes all variable and fixed costs, and Cost Net of Logs (CNOL) which covers variable costs excluding the cost of the raw material. In terms of cost of goods sold, raw material presents the largest component of cost, in the order of 50 to 65 percent of total COGS depending on raw log costs (stumpage), logging and hauling rates. The site cannot control log costs. Stumpage is set by the provincial government, and usually lags the trend in lumber prices. Weyerhaeuser forest lands, a separate department not under the sawmill management, controls which areas are logged and arranges for logging and transport of logs. This organizational factor is discussed further in Chapter 2.

CNOL consists of labour, regular, overtime and salaried; energy, electricity and gas, maintenance supplies and production consumables. A percentage breakdown of the Kamloops site’s COGS is shown in Figure 1.2. The “other” category also includes the counter-vail and anti-dumping duty (CVD) which the site had to pay in the first three quarters of 2006. This situation will change with the recent soft wood lumber agreement which came into effect on October 12, 2006. With
the current low lumber prices this penalty will actually increase from an 11 percent duty to a 15 percent export tax on lumber sold into the USA.

Figure 1.2: Kamloops Sawmill Cost of Goods Sold June 2006 YTD

![Pie chart showing cost components: Log Costs 59%, Labor 19%, Supplies and Equipment 7%, Energy 6%, Depreciation 2%, Other (includes inventory costs) 7%]

Source: Author

Processing cost is a major factor in the lumber industry. While the site should be able to meet its commitments in 2006 in terms of production, it will be doing so at a cost that will be prohibitive given the forecast for lumber prices in the latter half of 2006 and 2007. There is very little spread in manufacturing costs between mills across the world when the cost of logs is excluded. A 2004 PriceWaterhouseCoopers Global Lumber/Sawnwood Benchmarking report using 2002 data showed that the global average cost for lumber processing was $US 49/m³. In 13 of 20 countries/regions profiled in this study, milling costs were within $US 5/m³ of the average in 2002.

CNOL is the principle cost variable measured and compared when considering lumber mill operations. The Kamloops site's target CNOL is $US 111.11/mbf. The mid year actual is $US 118.64/mbf. The percent overtime is another frequently tracked number in relation to the CNOL. The unit is now at 18 percent versus the 2006 goal of 11 percent.
The site goals, current metrics and the goals - performance gaps YTD Jun 2006 are presented in Table 1.1.

Table 1.1:  Kamloops Lumber Mill Performance Goals and Metrics June 2006 YTD

<table>
<thead>
<tr>
<th></th>
<th>Safety RIR</th>
<th>Net Production Mbf/a</th>
<th>Sawmill Production Rate Mbf/hr</th>
<th>Planermill Production Rate Mbf/hr</th>
<th>% Overtime</th>
<th>% High Value Product</th>
<th>% 2+Btr Grade</th>
<th>% Waste</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2006 Unit Goals</strong></td>
<td>1</td>
<td>92,639</td>
<td>36.8</td>
<td>35.3</td>
<td>11%</td>
<td>45%</td>
<td>85%</td>
<td>7%</td>
</tr>
<tr>
<td><strong>YTD Status End Jun 2006</strong></td>
<td>3.72</td>
<td>93,091</td>
<td>36.9</td>
<td>29.4</td>
<td>18%</td>
<td>43%</td>
<td>82%</td>
<td>7%</td>
</tr>
<tr>
<td><strong>GAP Site Goal YTD June 2006 Performance</strong></td>
<td>-2.72</td>
<td>452</td>
<td>0.1</td>
<td>-5.9</td>
<td>-7%</td>
<td>-2%</td>
<td>-3%</td>
<td>0</td>
</tr>
</tbody>
</table>

Source: Author

The site is close to meeting, or exceeding many of its unit goals. Some notable exceptions are the RIR, planer production rate, CNOL and overtime. With labour being the second highest expense, overtime is contributing considerably to the CNOL. The next aspect to consider is whether Kamloops goals are sufficient to place the site in a competitive position in relation to other forest products companies and Weyerhaeuser’s other mills.

1.4 Canadian Lumbermills – Kamloops 2004 Performance Comparison

A 2004 PriceWaterhouseCoopers benchmarking survey of 56 mills in Canada was commissioned by a number of forest products companies, one of which was Weyerhaeuser. Thirty one (31) of these mills were spruce-pine-fir (SPF) dimension lumber mills in the BC interior. This survey was heavily slanted towards cost and profit variables, however some metrics related to safety and productivity were also included. Although this data is somewhat dated, a comparison of YTD information would likely reveal the same trend with a few exceptions. Unfortunately, there was
no survey for 2005 since companies were not willing to reveal their detailed performance data reflecting increasing rivalry in a tight, oversupplied market.

This survey placed the Kamloops site primarily in the third and fourth quartiles of the 31 mill BC interior SPF producer set based on a number of performance variables. Safety has declined slightly over the past year and drastically from June to September 2006. CNOL has improved considerably, as has sawmill productivity. The competition has also improved, although no definitive benchmarking study has been done on lumber mills in 2005 or 2006. There has been consolidation in the industry with less efficient mills closing and other plants expanding to take advantage of economies of scale. The gaps between Kamloops and the mills of today would likely be similar to those in the 2004 survey.

To survive in the lumber oversupply scenario over the next three years will require the mill to close this gap to at least a bottom top quartile performance level. While some improvement has already begun by meeting year-to-date 2006 production goals, this alone will not be sufficient to ensure continued operations over the coming downturn in the industry.

Table 1.2 presents some of the metrics from this survey with an indication of the Kamloops mill's competitive positions relative to the average and top quartile units.
Table 1.2: 2004 Competitive Position Metrics
Kamloops versus BC Interior Dimension Mills

<table>
<thead>
<tr>
<th></th>
<th>Safety RIR</th>
<th>Net Production mbf</th>
<th>Production per Hour of Hourly Labor mbf/hr</th>
<th>Planer Rate mbf/hr</th>
<th>CNOL $/mbf</th>
<th>Net Recovery mbf/m$^3$</th>
<th>Return on Capital Employed (ROCE)</th>
<th>Net Sales Realization $/Mbf</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top Percentile</td>
<td>3.43</td>
<td>278,519</td>
<td>0.739</td>
<td>45.34</td>
<td>108</td>
<td>0.294</td>
<td>64%</td>
<td>498</td>
</tr>
<tr>
<td>Group Average</td>
<td>6.69</td>
<td>264,711</td>
<td>0.651</td>
<td>37.92</td>
<td>118</td>
<td>0.282</td>
<td>43%</td>
<td>482</td>
</tr>
<tr>
<td>Kamloops</td>
<td>3.5</td>
<td>189,664</td>
<td>0.529</td>
<td>29.14</td>
<td>139</td>
<td>0.264</td>
<td>36%</td>
<td>482</td>
</tr>
<tr>
<td>Kamloops Percentile Ranking</td>
<td>1st</td>
<td>4th</td>
<td>4th</td>
<td>4th</td>
<td>4th</td>
<td>3rd</td>
<td>2nd</td>
<td></td>
</tr>
<tr>
<td>Kamloops Top Percentile Gap</td>
<td>-0.07</td>
<td>88,855</td>
<td>0.21</td>
<td>16.2</td>
<td>-31</td>
<td>0.03</td>
<td>28%</td>
<td>16</td>
</tr>
<tr>
<td>Kamloops Group Average Gap</td>
<td>3.19</td>
<td>75,047</td>
<td>0.122</td>
<td>8.78</td>
<td>-21</td>
<td>0.018</td>
<td>7%</td>
<td>0</td>
</tr>
</tbody>
</table>

Source: Author

The most significant 2004 performance gaps were in the areas of productivity as measured by net production, planermill production rate, production per hour of hourly labour, recovery, and CNOL.

Net sales realization is a reflection of product grade, which was at the top of the second quartile. Kamloops relatively high ROCE is largely a function of low capital investment and “sweating” the mill’s assets over the past 15 years.

1.5 Weyerhaeuser Soft Wood Lumber mills – Kamloops June 2006 YTD Performance Comparison

A more recent assessment of the Kamloops site’s competitive position can be made by comparing its performance relative to the other 28 Weyerhaeuser softwood mills for the first six months of 2006. This data is presented in Table 1.3.
A large gap currently exists between the Kamloops mill and Weyerhaeuser benchmark performers. Comparing Kamloops to the top quartile mills yields a similar, although less dramatic trend. In the group of Weyerhaeuser softwood dimension mills, Kamloops production and HVP are at the second quartile performance level; all other metrics are at the third and fourth percentiles. Safety, cost, with its related metrics of waste and overtime, recovery and production rate all show significant performance gaps between Kamloops and top quartile performers.

Although the site is largely meeting its current goals, these will not be aggressive enough to raise it from its position in the rankings. This is of particular concern since the company’s strategy of “fix, sell, or close” is being applied to its bottom quartile performers.

There is an oversupply of lumber in the current North American market which the company forecasts to continue until 2008. The over supply is largely due to a decline in US housing starts which commenced in early 2006 and is likely to continue into late 2008. This oversupply has been exacerbated by the Western Mountain Pine Beetle (MPB) epidemic in British Columbia. The provincial government has placed a priority on harvesting MPB trees and has increased the Annual Allowable Cut (AAC) commensurate to the amount of surplus timber available. This
oversupply will continue to depress lumber prices. The recent depreciation of the United States dollar relative to Canadian currency has also hurt the site’s competitive structure. An over supply of chips and low pulp prices has resulted in declining sawmill revenues for this commodity. The increase in natural gas and diesel fuel over the past year has adversely affected energy expenses. With the implementation of the soft wood lumber accord on October 12, 2006, a sliding scale of export taxes will come into effect dependent upon lumber prices and the amount of lumber exported to the USA past quota limits. At current lumber prices ($US 236/mbf, October 5, 2006) the site would pay a 15 percent Government of Canada Export tax on its sales to the USA comprising 70 percent of its output. This new agreement, with its clause initiating increasing import duties when prices fall below a certain floor level, results in the mill paying more than under the past CVD/anti-dumping regime. Furthermore Canfor and West Fraser, two major competitors will likely continue exporting past the quota limits at which time an additional seven percent tax will be imposed for a total of 22 percent. The intent of these two companies is to drive weaker competition to exit the industry. All these factors will further squeeze an already narrow margin and make it difficult to maintain the positive cash flow necessary to keep the mill open.

There are avenues left for the mill to further reduce costs and keep the site in a positive cash flow situation. This paper will explore the potential of scale, capacity utilization, capital upgrades, and the implementation of a lean manufacturing strategy to further lower costs, improve productivity and increase lumber recovery.

1.6 Project Outline

Chapter 2 will discuss the corporate organization and the relationship of the site to the corporation. The corporate and site strategy and organization will be examined in detail and their effect on the unit’s future will be evaluated.
Chapter 3 will explore the opportunities for economies of scale in the Weyerhaeuser softwood lumber business. A literature survey of past work on economies of scale in sawmilling will be presented. Data from the Weyerhaeuser mill system including the Kamloops site will be analyzed to determine to what degree economies of scale are present. The economic capacity utilization for Kamloops lumber will be proposed, and the degree to which this influences costs will be explored. A future state with implications for economies of scale will be discussed.

Chapter 4 will review the seven areas of waste identified in lean manufacturing and relate these to situations within the Kamloops sawmill process. As part of the lean manufacturing assessment, value stream analysis of the Kamloops lumber production process will be presented in Chapter 4. The intent will be to uncover areas which are impediments to swift, even, material flow, quantify the costs of these losses and isolate the causes of these delays. A future state value stream will be proposed and potential improvements will be identified. The various cost reduction options from the previous analyses will be summarized and the interaction of their impacts on the operational structure, capital requirements and staffing costs will be presented.

In chapter 5, a schedule will be proposed to implement specific process and organizational changes.

Chapter 6 will summarize the project and present recommendations for the mill to achieve first quartile financial performance.
2 Kamloops Sawmill and the Weyerhaeuser Corporation – Strategic Context

2.1 Weyerhaeuser Overview

Weyerhaeuser is multifaceted forest products' company with operations in all major sectors of this industry as well as an interest in house construction and real estate. It is the second largest forest products company in the world as measured by net sales (PricewaterhouseCoopers Global Forest and Paper Industry Survey - 2005 results). With a presence on every continent, it is a global organization. The majority of its operations are located in the USA and Canada.

The interrelationships between the corporation, iLevel (described below), Softwood Lumber Business (SLB), the BC area and the Kamloops mill are important determinants to the future success of the unit. All sectors compete for corporate resources. This competition cascades through the businesses down to the mill level. Kamloops vies for annual funding, capital, market share, personnel, and raw material with the other BC mills. The BC region is assessed by the SLB in relation to the seven other geographic regions. Resource allocation within a business is typically based on past performance and future potential. For Kamloops to become a first quartile performer will depend on how well it can thread its way through the corporate labyrinth via improving its metrics, justifying its requirement for future resources, and positively influencing senior corporate VPs. To achieve this will require a good knowledge of the corporate strategy, the “fit” of the Kamloops site within the corporate, business and area organizations, and the capital allocation process. The site currently has issues with the unit culture, span of control, human resources (HR), and its position in the overall lumber value chain that would keep it from progressing to the first quartile performance bracket.
2.2 Weyerhaeuser Business Sectors

The company has five main divisions: Timberlands; Wood Products, consisting of lumber, panels, and engineered wood; Pulp and Paper; Containerboard Packaging and Recycling; and Real Estate. Kamloops is part of the Wood Products organization.

Revenue and Earnings before Interest, Taxes and Accounting charges (EBIT) for all divisions are shown in Table 2.1.

### Table 2.1: Weyerhaeuser Corporation 2005 Revenues and EBIT by Sector

<table>
<thead>
<tr>
<th>2005 All Figures US million $</th>
<th>Timberlands</th>
<th>Wood Products</th>
<th>Pulp &amp; Paper</th>
<th>Container-Board, Packaging &amp; Recycling</th>
<th>Real Estate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net Sales</td>
<td>2,841</td>
<td>9,721</td>
<td>4,383</td>
<td>4,768</td>
<td>2,915</td>
</tr>
<tr>
<td>% Total Sales</td>
<td>11.5%</td>
<td>39.4%</td>
<td>17.8%</td>
<td>19.4%</td>
<td>11.8%</td>
</tr>
<tr>
<td>EBIT</td>
<td>784</td>
<td>485</td>
<td>-444</td>
<td>-5</td>
<td>743</td>
</tr>
<tr>
<td>% Total EBIT</td>
<td>50.2%</td>
<td>31.0%</td>
<td>-28.4%</td>
<td>-0.3%</td>
<td>47.5%</td>
</tr>
</tbody>
</table>

Source: Author

Table 2.1 reveals that revenues from the different sectors do not correlate well with positive earnings. The sector with the lowest revenues, timberlands, accounted for over half the company’s earnings in 2005. Both Pulp and Paper and the Containerboard Packaging and Recycling sectors lost money in 2005. Real Estate, a complementary business to Wood Products was second in ranking for EBIT. Wood Products, comprised of a business serving the residential housing market (now called iLevel), and an industrial and international business segment ranked third in 2005 earnings. Weyerhaeuser operates in markets which are affected by both seasonal and business related cycles. For example, when the housing market was extremely active in 2004, Wood Products led the company with a US $1,055,000,000 EBIT. Earnings decreased in 2005 with the cooling housing sector and are forecast to drop even further in 2006 and 2007. The different forest products sectors within the company have tended to be counter cyclical in the
past. Unfortunately this has not been the case over the last five years with the pulp and paper and containerboard and packaging showing a continuing downward trend in earnings.

Asset base values and capital spending in 2005 for the major sectors are presented in Table 2.2.

| Table 2.2: Weyerhaeuser Corporations 2005 Assets and Capital Expenditures by Sector |
|---------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| 2005 All Figures US million $   | Timberlands     | Wood Products   | Pulp & Paper    | Container-Board, Packaging & Recycling | Real Estate     |
| Consolidated Assets             | 4,169           | 4,319           | 7,216           | 5,309           | 2,907           |
| Capital Expenditures            | 59              | 161             | 317             | 221             | 18              |
| Capital Expenditure to Consolidated Asset ratio (percent) | 1.4 % | 3.7 % | 4.4 % | 4.2% | 0.6% |

Source: Author

As shown in Table 2.2, the majority of the firm’s asset base and capital spending is in the two sectors producing the lowest rents in 2005. Timberland asset valuation is based on historical cost which is does not recognize the escalation in land values.

The company’s capital allocation process is a function of numerous inputs, one of which is the size of the asset base. Pulp and paper and containerboard/packaging have the two largest capital asset bases and typically require large sums for environmental, technology and energy efficiency upgrades. The distribution of capital noted in Table 2.2 will change in the near future. On August 23, 2006, Weyerhaeuser announced its divestiture from fine paper production and associated pulp production facilities by spinning off its paper and related pulp mills to Domtar. This transaction is scheduled to be completed by February 2007 and is still subject to regulatory approvals. The company also stated that Wood Products would now become a greater focus as a core business with the iLevel brand. This will have a direct bearing on the capital available to Wood Products.
and in turn the Kamloops site. Capital formerly intended for pulp and paper mills will be available for the other businesses, Wood Products being a likely major recipient. In 2005 the entire softwood lumber business of 31 mills received only $US 40 mm of capital. This should more than triple in 2006 due to a higher company emphasis on lumber production. Kamloops should be laying out the ground work now to acquire a major portion of Wood Products capital in the years 2007 – 2009. This will be essential to raise its performance into the first quartile and maintain it at that level.

2.3 Weyerhaeuser Corporate Vision and Goals

The company’s vision is to be “The best forest products company in the world”. In 2001, a “Roadmap for Success” provided some metrics for “best” as well as outlining the company’s values and goals.

The phrase “less than 1 (referring to the RIR), and greater than 17 (referring to a RONA of 17 percent)” became the company catch phrase for two of its definitive metrics. Both of these are ambitious goals. Additional financial commitments mentioned in Weyerhaeuser’s 2005 Guide to Investors are to: maintain an investment-grade rating; minimize liquidity and interest rate risk; to return 20 to 30 percent of operating cash flow in dividends, and, to manage the capital structure to maintain a 30 to 40 percent debt to total capital ratio.

In terms of capital management the Guide purports that Weyerhaeuser has high quality assets that are efficient and relatively modern. Underperforming or non-strategic assets are removed; and operating systems are continually optimized to improve productivity. This can be summed up in the company’s “fix, sell, or close” dictum for underperforming and non-core assets. This last aspect of Weyerhaeuser’s core doctrine is particularly germane to the Kamloops site. As one of the lower quartile performers, albeit an improving one, the site is particularly exposed to the
possibility of closure or sale. The preferred course of action for the mill is obviously to be in the "fix" category. Referring back to the "Road Map for Success", the unit should emphasize to the corporate seniors that it has achieved an average RONA of 31.2 percent over the past 10 years, well above the roadmap's goal. Kamloops has also contributed to annual positive cash flow and generated $81,000,000 in profit over the past 10 years. Continuing to demonstrate improvement in the critical metrics will provide the justification to allot the required capital for the mill become competitive in today's market.

2.4 Weyerhaeuser Organizational Structure

2.4.1 Weyerhaeuser Corporate Structure

Weyerhaeuser is organized on a product-based divisional structure from the corporate headquarters to the business level. At this point, the organization is regional, based on geographical areas. This is presented diagrammatically in Figure 2.1. At present Kamloops has elevated itself somewhat negatively to the forefront of the corporate structure. The CEO himself is aware of the site's poor labour relations and safety record. To amend this image will take effort by all the leaders from the BC area manager to the senior VP of iLevel. A knowledge of the organization, and who to influence is important to achieve this end.
The CEO and the senior VPs exert influence over all the business sectors and set the overall high-level strategy for the company. They have ultimate fiduciary responsibility. The investment direction strategy (IDS) is determined annually by the senior VPs. This involves decisions regarding mergers and acquisitions, site closures, business divestments and broad capital spending guidelines. Numerous company-wide processes are also managed from this level. Some critically important senior directors at this level are Safety and Environmental, iLevel, HR, COO, and the CFO. These individuals should be encouraged to visit the site to experience the improving culture and safety which would positively influence future decisions concerning Kamloops.
2.4.2 Wood Products Business Structure

The Wood Products division is composed of two main businesses; industrial products and international operations, and, iLevel.

iLevel is a relatively new organization which was activated in April 2006. It was developed to improve customer service to the residential wood frame construction market. The name was chosen as a branding initiative to provide customers with an easily identifiable trademark. It encompasses softwood lumber, panels (plywood and oriented strand board (OSB)), and Engineered Wood Products (EWP) consisting of trusses, joists, Parallam, laminated veneer lumber (LVL), and oriented strand lumber. The iLevel business was formed as a response to the most common customer complaint that Weyerhaeuser was too difficult to deal with from a buyer’s perspective. iLevel was created to resolve this point of customer dissatisfaction by providing a single point of contact for all the needs of residential wood products customers. The senior VP of iLevel reports directly to the CEO.

The iLevel VP has instituted an SUVPC (Safety, Utilization, Value, Productivity and Cost) teaming concept across the business. The intent is to replicate best practices and provide common SUVPC metrics across all sites. Elements of the sites’ goals are imbedded in many of the SUVPC strategies and are reflected in the metrics.

The softwood lumber business component of iLevel consists of 28 sawmills in seven geographical regions. The mills process all North American softwood species, with Spruce, Pine, Balsam Fir (SPF), Douglas Fir, and Southern Yellow Pine (SYP) being the dominant ones. The VP of Softwood lumber is responsible for the synergies and profitability of the business. He reports to the iLevel VP.

The BC area manager is responsible for the combined performance of three mills, Kamloops, Okanogan Falls, and Princeton. He reports to the VP of Softwood Lumber.
The Kamloops mill manager has some autonomy in managing the site which is reduced with an increasing level of oversight and formula driven budgetary processes. He is limited by the numerous corporate “franchise” requirements and policies. Any significant changes at the unit are usually coordinated through the BC area manager. Although limiting, this close supervision and micro management can be made to work to the unit’s advantage. As a safety and/or reliability improvement site, progress on these fronts is highlighted at the senior management levels.

Kamloops needs to create a “stream of advocacy” up the chain of command to the CEO. The Senior VP of iLevel perception of the mill will be particularly difficult to change since he has a fairly negative impression of the site from past visits.

2.4.3 Kamloops Sawmill Organizational Structure

The Kamloops site is formally organized in a classical functional hierarchy based on processing functions and supporting activities as presented in Figure 2.2.

Figure 2.2: Kamloops Sawmill Current Organizational Structure – October 2006

Source: Author
Figure 2.2 only shows the leadership positions excluding the functional line workers. There are from one to three levels of hierarchy from the hourly mill operators to the mill manager. A further four levels of hierarchy separate the mill manager from the company CEO. The total number of five to eight hierarchical levels from worker to CEO in the case of the Kamloops mill is slightly less than the average of 10 for a company of 40,000+ employees. The formal mill hierarchy varies from a relatively tall number of three levels to a minimum of one. Jones et al, 2006 recommended a span of control of 15:1 for first line supervisors and an 8:1 ratio of manager to non-managers for a continuous process. Kamloops meets this prescription quite well.

The mill has a mixture of salaried and hourly leadership personnel. The vertical integration of the structure varies with each department. Since this is a unionized mill, hourly lead hands are somewhat restricted in the direction they can provide and they cannot perform any disciplinary activities. This places a limitation on their effectiveness and the degree of formal vertical integration achievable within the structure. On the salaried side, there is a high degree of vertical integration. Superintendents on occasion fill in for supervisors during absences and vice versa. There are daily meetings with all leadership personnel including lead hands to review past performance, coordinate upcoming events and resolve issues.

Eight department heads report directly to the mill manager and form what is known as the core management group within the mill. The eight departments are as follows: Log yard and Product Supply, Quality Control, Planermill, Sawmill, Reliability, Engineering, Safety, and Maintenance.

This is an extremely wide span of control for the unit manager and makes it difficult for him to focus his attention on his functions of ensuring capacity and capability. Fortunately, there is a relatively low degree of horizontal differentiation at this level. Department heads interact extensively and able to fill in for each other during absences. At the core group level there is a good “flow to work” with the different departments supporting one another when they see an
outage. This level of cooperation is dependant upon the existing personalities in the positions. With a change in the individuals the current broad span of control on the mill manager could become an onerous burden.

There is a greater degree of horizontal differentiation at the supervisory level. Maintenance, production, reliability and shipping are relatively dedicated to their specific support functions with fairly well defined roles and relationships to the other departments. At the workforce level there is a high degree of horizontal integration within each department. Production workers are encouraged to learn a wide variety of jobs so they can be flexibility employed throughout the mill although this increases training costs. Maintenance workers are somewhat more restricted because of trade lines and the union insistence of a “one trade per job” policy. There is an opportunity for improvement by a closer integration between maintenance and operations. This will require a major culture shift leading to the implementation of a Total Productive Maintenance concept where production workers assume some limited maintenance duties.

Each department head has between four and zero salaried direct reports. Authority is fairly decentralized but well defined. Supervisors have considerable latitude to make decisions, but are limited in their spending authority. Matters of discipline are resolved at the lowest levels possible, although these often proceed to the mill manager and beyond through the formal labour management grievance process.

All the department heads have a primary responsibility, but they are also required to perform secondary duties. Prior to 2003, mills had their own HR and financial services group. Process re-engineering devolved these groups from the mill structure and centralized these activities. Financial inputs, inventory control, and numerous HR actions must be done at the site level considerably increasing the workload of mill leadership in these areas. Rules of conduct, performance expectations, and policies on ethics, harassment and diversity to name a few, are
reviewed annually. In addition, there are numerous documented safe reliable methods, a standard safety processes, and annual company/divisional standard audits for safety, reliability, quality, financials, and kiln operations. All of the aforementioned require leadership time in crew briefings, reviews and updating, numerous plans and inspections.

Whether or not such extensive bureaucracy, in the form of documentation and regimentation, adds value from a company and customer perspective can be questioned. The secondary duties mentioned distract from the leaderships primary goal of safely producing quality lumber. Senior leadership reinforces this dichotomy by stressing the importance of direct process and performance observation through “time on the floor.” At the same time an ever increasing myriad of documented procedures, audit responses, plans, and reports are demanded from the same individuals. Redundant upwards reporting through two or more separate channels (rather than going through a single point of contact) wastes even more time. To rectify these outages will require harmonization and less horizontal differentiation at the business and corporate levels.

Coordination and cooperation between operations and maintenance and the log yard needs to improve. Conflicts between the planermill and sawmill also take place but are not as chronic as the aforementioned.

2.4.4 Site Culture

Kamloops has undergone several transformations in terms of site culture. Currently the unit’s culture could best be described as fragmented “low on sociability, low on solidarity” (Langton and Robbins, 2007 p. 368). Associates are committed to their tasks but not necessarily to the corporation. There is concern over the long term prospects for the mill by younger workers but not to the extent that they are willing to change the existing culture.
There is a considerable diversity in the mill in terms of age, ethnic groups, and gender. Weyerhaeuser refers to all their personnel as associates in an effort to have individuals identify more closely with the company.

The union plant committee has exerted considerable control over the workforce, which has had an effect on the safety and productivity of the unit. Over the years there have been a number of local agreements which have somewhat circumvented the master union/company agreement. Some of these local agreements have benefited the site whereas others have increased costs and reduced flexibility. The plant committee as a whole has not resisted change when they see it as inevitable, but successfully negotiated some quid pro quo for themselves when a change occurs. This has generated a feeling of entitlement in the workforce.

Labour relations were more or less amicable until 2004 with the succession of a new mill manager. Over the past two years, there has been a steady decline in plant committee – management relationships. The new manager has not been willing to go outside the master contract and has rescinded many of the previous local agreements which emphasized workers’ seniority. The plant committee chairman has not had the direct line of access to the mill manager he previously enjoyed and is being forced to work issues through the relevant superintendents. This resulted in acrimonious labour relations culminating the resignation of the plant committee in October 2006.

The organized labour attitude at present is one of guarded optimism. Until a new plant committee is selected, any proposed changes in worker flexibility will be difficult to implement. The corporation is particularly sensitive to poor labour relations. Several sites in the past have been closed due to bad safety records and an uncooperative plant committee despite the company having invested considerable capital in these mills. For the mill to succeed in the future, leadership and the hourly workforce have to re-establish a condition of mutual trust and a culture
of co-operation instead of confrontation. This would evolve into “communal” culture typified by high sociability and high solidarity (Langton and Robbins, 2007, p. 368).

### 2.5 Kamloops Future State Organization

The future state for the site organization envisages a leaner structure with a reduced span of control for the mill manager. The rebuild of the planer mill will enable this department to run on two shifts. This will eliminate the need for two current supervisors and the planermill superintendent. The timeframe for the rebuild is not yet certain. Over the next five months, the objective will be to match the planer and sawmill production rates with process changes and equipment modifications. This will enable the elimination of one planer shift and one supervisory position. In the longer term future state (three to four years) sawmill, planermill, and kilns would be under the leadership of a production superintendent. The log yard would be under the guidance of the production superintendent or become a contracted-out function. The engineering manager would assume a greater leadership role with the reliability manager being an additional direct report.

The quality control manager would also have an increased leadership role with the product supply manager and the saw filing department lead hand being direct reports.

The organization of the maintenance department would shift towards mechanical maintenance. One of the shortages in the current organization is the lack of a dedicated weekend maintenance supervisor. This is a particularly critical role since majority of planned maintenance is done on the weekend when there is a 12 hour window for downtime. The proposed future leadership group organization is shown in Figure 2.3.

The future state would see a reduction of four senior leadership positions from the core group (from eight to four), and the elimination of three leadership positions. This will reduce the
effective span of control of the mill manager and provide him with more time to focus on his primary functions of increasing capacity and capability. Some of the secondary duties described in 2.4.3 will have to be rationalized and redistributed. Several positions would have a reduced level of responsibility with correspondingly lower salaries. These changes are estimated to save the site approximately $400m/annum and reduce the CNOL by 1.88 $/mbf or 1.3 percent. The proposed restructuring will contribute to improving the site’s competitive posture through a better organizational structure and by reducing overhead costs.

**Figure 2.3: Kamloops Lumber Future State Proposed Organization**

![Kamloops Organization - Future State](image)

Source: Author

### 2.6 Lumber Business Value Chain

The role of the Kamloops sawmill in the lumber production value chain shall be examined using the concepts proposed by Michael Porter in “Competitive Advantage” (1985). These activities are viewed with the potential of promoting the mill’s advancement to a top quartile performer. Value chain activities in the lumber business can be defined by (Porter, “Competitive Advantage”, 1985):
a. **Inbound Logistics:** The timber allocation process: log harvesting; log transportation; and log storage

b. **Operations:** The transformation of logs into finished lumber as described in 1.1 and further discussed in Chapter 5.

c. **Outbound Logistics:** The storage and distribution of outbound lumber by truck, rail, and ship. The physical distribution is done from the mill site as directed by the iLevel sales group through the product supply manager.

d. **Marketing and Sales:** The integrated iLevel marketing and sales group provides the single point of contact for the mills for this function. Marketing and sales is centralized for the BC group in the Kamloops head office. This organization is further integrated into the iLevel sales and marketing group operating out of Tacoma WA. iLevel serves as the single point of contact for all lumber sales and marketing. The mill assists marketing on occasion by providing mill tours to customers and participating in customer visits along with marketing personnel.

e. **Service:** The iLevel organization provides numerous services to the customer including building materials optimization and co-ordination of all wood products requirements for residential wood frame construction. The mill responds to customer quality action alerts (CQAAs) though the iLevel group. On occasion the mill quality control manager may visit customers to view quality issues and authorize corrective actions.

The value chain as briefly described above is supported by the company infrastructure and organization. Financial controls, policies, and numerous additional “franchise requirements” such as the Process to Achieve Capital Excellence (PACE), Purchasing Improvement Effort (PIE), Lumber Track (an automated finished lumber inventory tracking system), and the SUVPC teams are dictated from the corporate and business levels to the mills. A centralized
human resources and procurement group manages staffing, training, personnel development and compensation issues.

Most innovations in the lumber business are related to the production process versus product improvements. Major process machinery improvements usually come from lumber milling equipment manufacturers. This is in response to the competitive nature of their business and demand from lumber producers for ever increasing recovery, processing speed, and higher productivity. There are few proprietary technologies in lumber production since sawmilling equipment manufacturers are willing to sell their wares to any company. The lumber industry tends to be rather conservative. Often the biggest challenge faced by a machine supplier with a new technology is finding a forest products company willing to be the first to install the equipment in their mill.

2.6.1 Kamloops Lumber Mill Value Adding Activities

The lumber mill itself can add value primarily in three ways.

a. Optimizing recovery of lumber from logs is the greatest value creator. There is also a value aspect to recovery which is a function of the final grade of lumber sold to the customer. Although longer and wider lumber typically has a higher market value, more desirable grades of lumber in smaller dimensions can often yield greater margins. Grade and volume recovery often work in opposition. The objective is to achieve the highest margin using a combination of value and volume recovery. Under current market conditions, value recovery has the higher priority.

b. Improving productivity through increased capacity utilization is the second of the three sawmill value drivers. By producing more lumber with the same fixed resources and labour, the mill will decrease its cost net of logs (CNOL) per mbf. This is one area where the Kamloops site has perhaps its greatest opportunity for improvement. There is at least
a 35 percent utilization gap between the Kamloops planermill and world class performance.

c. The final aspect of value improvement is cost reduction. There are some mill opportunities in this arena primarily via waste reduction. Some cost reduction efforts have already been implemented through corporate purchasing programs.

The lumber value chain is presented diagrammatically in Figure 2.4.

Figure 2.4: Lumber Value Chain

<table>
<thead>
<tr>
<th>Timberlands</th>
<th>Operations</th>
<th>Shipping &amp; Distribution</th>
<th>Marketing &amp; Sales</th>
<th>Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crown - TFL timber</td>
<td>Log Yard</td>
<td>Order generation</td>
<td>iLevel</td>
<td>Customer design</td>
</tr>
<tr>
<td>Private Purchase logs</td>
<td>Sawmill -log</td>
<td>Rail car</td>
<td>customer base</td>
<td>service</td>
</tr>
<tr>
<td>Company Timber</td>
<td>-log bucking</td>
<td>Truck</td>
<td>New</td>
<td>Complaint response</td>
</tr>
<tr>
<td>Contract Logging &amp; Hauline</td>
<td>- primary break down</td>
<td>Ship</td>
<td>Markets</td>
<td>Customer logistics support</td>
</tr>
<tr>
<td></td>
<td>-secondary trimming</td>
<td>Distribution centers</td>
<td>Sales</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Planermill -planing</td>
<td>Builders &amp; Manufacture</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-grading packaging</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Weyerhaeuser Infrastructure – Corporate policies, Culture, Ethics,

Human resources – Staffing, Training, Compensation

Technology Development – New products, Process Improvements

Procurement – Corporate Purchasing Initiative (PIE), Capital Procurement (PACE)

Source: Adapted from M. Porter, "Competitive Advantage", p.37, 1985.

The margin the mill/company can earn from the value chain depends on the how well they execute the value adding activities such that the margin between their costs and what the customer is willing to pay for the product is maximized. The value chain must be configured to
provide either the lowest cost of production or a means to differentiate the product from the competition.

There are few real opportunities to differentiate lumber in a commodity market. Quality standards are set by the National Lumber Grading Association (NLGA). All competitors must meet these minimum grade levels. Customers buy primarily on the basis of price, delivery, and other service attributes which should be enhanced with the new iLevel strategy. Prices for the various lumber grades depend on whether it is purchased on the spot market or through a longer term contract established between a supplier and a customer. With price being the main driver in purchasing decisions, the low cost producer has the competitive advantage, all other factors being equal. Prosperity in the commodity lumber business requires a strategy based on minimizing costs and maximizing the value that can be extracted from the raw material. This is the site strategy which must be better executed in the future than at present if the site is to survive. To boost its performance into the top quartile, Kamloops can upset this equation to some degree by benefiting from the differentiating efforts of iLevel.

### 2.7 Lumber Business Cost Drivers

Porter, in “Competitive Advantage” (1985) identified the following cost drivers which are present in many links of the value chain. Most of these are unit controllable, while a few are primarily external influences.

a. **Economies of scale.** Scale has been shown to have some influence on cost of production in the sawmill industry and will be explored thoroughly in Chapter 3. The greatest benefits from economies of scale in the lumber business reside in improved productivity and reducing infrastructure/support costs such as sales and marketing, procurement, and human resources.
b. **Learning.** There is a learning curve for sawmill operations. Experiences within Weyerhaeuser have demonstrated this range extends between one to two years for a new mill start-up to full production. Sawmilling process improvements generally tend to be incremental as a result of longer term learning in the industry rather than transfers from other industries or breakthroughs in technology. There will be a learning curve associated with the new mill equipment after the proposed major Kamloops upgrade. The critical point will be acknowledging the degree of difficulty in learning to operate, and particularly maintaining the new technology.

c. **Capacity Utilization.** This is a controllable cost driver which most mills exploit fully during periods of high prices and short supply. Mills often reduce capacity utilization during periods of low demand to reduce variable costs of production. An adverse effect of high utilization is a lack of maintenance time which eventually tends to counter 24/7 operations by increasing downtime. High utilization can also lead to inventory accumulating if process variability is high and not well synchronized. Capacity utilization at Kamloops will be more thoroughly discussed in Chapter 3.

d. **Linkages among activities.** Linkages within the value chain affecting costs are numerous in the lumber business. The actions of quality control (QC) are closely linked to marketing and sales through customer complaints from sales and corrective actions taken at the site. Further value chain linkage between sales and production have the opportunity to reduce inventory by accurately forecasting sales such that the sawmill can produce the appropriate dimensions, species and grades. This linkage could extend even further to timberlands purchasing and/or harvesting the proper diameter mix of logs to yield the desired end products. Weyerhaeuser has numerous linkages to equipment spare parts suppliers through its PIE initiative. These suppliers act on behalf of the company to ensure that mills remain adequately stocked with consumables and critical spares.
e. **Interrelationships between business units.** Timberlands form the most important internal company relationship with lumber in supplying raw material to the mills. The lumber mill and pulp mill are closely tied together since the pulp business uses all the by-products from the lumber mill. There is additional opportunity for cost reduction at Kamloops by enhancing this interrelationship between the pulp and saw mill. The pulp mill produces steam and electrical power excess to its requirements. The steam could be used to kiln dry lumber, thus avoiding the current use of expensive natural gas. Electricity from the pulp mill generators could be used to partially power the sawmilling process. This synergy would have been more easily implemented when the pulp mill was part of Weyerhaeuser. The other critical internal relationship is with the iLevel sales group. The sales manager provides direction on the volume and product mix, arranges customer visits, and is the liaison between shipping and the transportation group. Most importantly, the sales group negotiates price premiums for high value products and arranges longer term lumber contracts with high volume buyers. All these inter-relationships affect mill margins and the long term viability of the site.

f. **Degree of Vertical Integration.** There is a high degree of vertical integration in Weyerhaeuser. The company owns much of its own timber in the USA and controls a large number of forest licenses and tree farm licenses in Canada. This effectively freezes out competition in certain geographical areas creating a raw material competitive advantage as well as avoiding a potential hold up situation should timber supplies become restricted. This degree of vertical integration will become particularly important in the aftermath of the Mountain Pine Beetle (MPB) epidemic in BC when pine timber will be in short supply. The Kamloops site will be in a relatively good position since only 20 percent of its timber supply will be affected by the MPB. Forest lands have also consolidated their log supply in the BC interior with Kamloops as the epicentre. Existing log supplies would support a sustainable production of 350 mmbf. There is also some
degree of forwards vertical integration with company-owned building material
distribution centres and house construction companies that provide an outlet for finished
goods. The company should use its internal leverage in this area to sell more lumber
milled in Canada within the country thus avoiding export taxes when lumber prices are
low.

g. Timing of Market Entry. There is little the company can do to drive costs down in this
area. The only means of affecting market prices would be to withhold or increase
production in times of excess or decreased supply respectively. The company does
upgrade its sites and build new mills during market lows to take advantage of better
buyer power with equipment suppliers and to be ready for the next market up-swing.
With the market currently at its cyclic low, this is a factor which favours a Kamloops refit
in the near future. Recently there has been a tendency for forest product companies to
purchase mills rather than build new ones. These purchases are usually timed with poor
market conditions to take advantage of depressed prices for these assets. There are two
mills in the Kamloops area which could probably be purchased and are capable of
processing the timber from the Kamloops site. This option presents a threat to the
continued operation of the existing mill.

h. Discretionary Policies Independent of Other Drivers. Weyerhaeuser competes in the
commodity market for lumber. Low production cost is the primary driver in this industry.
The firm has made some attempts at product differentiation by producing proprietary
grades. The iLevel brand is an attempt to differentiate Weyerhaeuser lumber on a basis of
superior service and delivery. It remains to be seen if this will prove successful.
Weyerhaeuser has chosen to embark on several advertising campaigns. One of these
stresses involvement in the environment. Although this is an additional cost, the firm
considers the value and prestige from its environmental forestry practices a competitive
advantage which it must advertise to consumers to gain full advantage. A more recent
iLevel advertisement emphasizes house construction waste reduction through the use of iLevel consultants. All of these initiatives serve to enhance lumber sales.

i. **Geographic location.** The company's production facilities are primarily located at the centres of their respective “wood baskets”. Close proximity of the mills to their raw material minimizes transportation costs and prevents extended log storage in the bush which would result in their degrading. Some mills are also located close to major population centres. This minimizes transportation costs of finished goods to the final customers. Kamloops is in an excellent location considering both of these variables. As already mentioned, the Thompson Valley wood basket can support increased production. The town is located at the confluence of two transcontinental railways and is on the Trans-Canada highway. Location also affects the availability and cost of labour. With changing demographics, labour availability is becoming an increasing critical factor. Most lumber mills in BC are unionized which tends to level the wages playing field. Being a major population centre in the area, Kamloops has had no difficulty in attracting skilled trades and drawing on the local population to fill its workforce.

j. **Institutional Factors.** Weyerhaeuser has no control over legislated tariffs such as the Canada – US countervail and anti-dumping duty which has negatively affected the costs of the Canadian operations for the past five years. Exchange rates have recently had an extremely deleterious affect on costs. Union contracts have progressively edged labour cost higher. Environmental regulations and public expectations of sustainable forestry have forced chain-of-custody tracking expenses on the industry. There have been no instances where institutional factors have actually reduced costs. These have steadily eroded an already thin margin for lumber manufacturing and are particularly egregious when the lumber market is at a cyclical low. All the aforementioned factors have adversely affected the viability of the Kamloops operation.
2.8 Summary - Organizational and Strategic Impacts on Mill Competitive Posture

The current organizational structure and division of leadership labour is not conducive to enhancing the unit's competitive position. The mill manager is too involved in a wide area of activities and does not have the time to focus on the critical few. There are too many competing priorities from corporate, business, and site level initiatives. While many of these are mutually re-enforcing and beneficial, some have no value-added. The proposed future state streamlines the organizational structure and is more in line with what is considered ideal for a continuous process plant.

The site culture requires a major paradigm shift from a fragmented one of entitlement to one of mutual trust and cooperation. Senior company leadership views good labour relations as a critical component when considering capital investments.

The site has a well defined position in the company value chain. There are considerable opportunities for site improvement in the three value-adding activities of lumber recovery, capacity utilization and cost reduction. Kamloops is in a good position to improve its competitive position by exploiting nine of the 10 identified cost drivers.

The impact of corporate strategies and organizational factors on Kamloops is presented in the strengths, weaknesses, opportunities, and threats (SWOT) summary in Table 2.3. The unit has to focus on building on its strengths, alleviating its weaknesses, capitalizing on the opportunities and try to mitigate the threats. Recommendations and proposed actions in this chapter have addressed several of the strategic and organizational outages identified in the SWOT.
### Table 2.3: Strategic and Organizational SWOT – Kamloops Lumber October 2006

<table>
<thead>
<tr>
<th><strong>Strengths</strong></th>
<th><strong>Weaknesses</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1.</strong> Location – Transportation links and population centre</td>
<td><strong>1.</strong> Poor recent safety record</td>
</tr>
<tr>
<td><strong>2.</strong> Raw Material Supply – Good for sustainable production of 350 mmbf/annum, not as affected by MPB as other regions</td>
<td><strong>2.</strong> Labour relations</td>
</tr>
<tr>
<td><strong>3.</strong> Corporate Leverage in purchasing and sales</td>
<td><strong>3.</strong> CNOL – high labour, inventory and energy costs</td>
</tr>
<tr>
<td><strong>4.</strong> Branding – iLevel</td>
<td><strong>4.</strong> Shaky relationships with senior VPs</td>
</tr>
<tr>
<td><strong>5.</strong> Corporate vertical integration</td>
<td><strong>5.</strong> Site culture of entitlement</td>
</tr>
<tr>
<td><strong>6.</strong> Low level horizontal leadership differentiation</td>
<td><strong>6.</strong> Site organization – wide span of control, maintenance/operations disharmony</td>
</tr>
<tr>
<td><strong>7.</strong> Past history of high RONA and profits</td>
<td><strong>7.</strong> Poor process reliability</td>
</tr>
<tr>
<td><strong>8.</strong> Experienced workforce</td>
<td><strong>8.</strong> Antiquated equipment</td>
</tr>
<tr>
<td><strong>9.</strong> ISO 14001 environmental certification</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Opportunities</strong></th>
<th><strong>Threats</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1.</strong> Improve Safety and Reliability. Shine if designated a focus mill.</td>
<td><strong>1.</strong> Internal competition from other company sectors and sister mills for raw material, capital and talent.</td>
</tr>
<tr>
<td><strong>2.</strong> Reduce waste by improving recovery, lowering costs, and increasing productivity.</td>
<td><strong>2.</strong> Corporate fix, sell or close policy</td>
</tr>
<tr>
<td><strong>3.</strong> Reorganize mill leadership by rationalizing and streamlining reporting relationships</td>
<td><strong>3.</strong> External competition for talent and raw material</td>
</tr>
<tr>
<td><strong>4.</strong> Expand production and reduce unit costs through economy of scale technological upgrades</td>
<td><strong>4.</strong> Low cost lumber producers</td>
</tr>
<tr>
<td><strong>5.</strong> Market timing opportune for capital improvements and labour relations changes</td>
<td><strong>5.</strong> Loss or lowering of by product income with Domtar</td>
</tr>
<tr>
<td><strong>6.</strong> Prepare site early for capital upgrade – by benchmarking and training</td>
<td><strong>6.</strong> Institutional factors – export tax, high Canadian dollar, labour rates</td>
</tr>
<tr>
<td><strong>7.</strong> Lower energy costs by tying into steam and power from pulp mill. (Will be more difficult after sale to Domtar.)</td>
<td><strong>7.</strong> Loss of some fibre supply from MPB</td>
</tr>
<tr>
<td><strong>8.</strong> Harmonize reporting and data gathering for upper level management.</td>
<td><strong>8.</strong> Lumber market is at, or approaching historic cyclic low prices</td>
</tr>
</tbody>
</table>

Source: Author
3 Economies of Scale and Capacity Utilization

Economies of scale and the minimum efficient scale is an important factor in determining unit costs of production. High lumber prices in the past have concealed potential diseconomies of scale and permitted mills to operate profitably at sub-MES levels. With the lumber market approaching its five to seven year cyclical low, mills cannot afford to operate at either a sub-MES level or at higher production rates that would produce significant diseconomies of scale.

To reach top quartile performance levels and improve its cost structure Kamloops has the potential to benefit from both internal and external economies of scale effects.

Achieving greater productivity through increased production with the same size or smaller labour force, is possible through some relatively minor machinery improvements, and greater labour flexibility. There are also potential cost savings from higher raw material volume, different fibre quality, and species selection. Although energy is one of the growing costs of production, increasing productivity in lumber processing machinery does not usually incur a proportionate increase in power consumption. The distribution of fixed overhead costs (marketing, sales, purchasing, legal, and accounting, HR, and central manufacturing support) over a larger production volume would also serve to lower the mill-distributed costs.

3.1 Internal and External Economies of Scale

Kamloops benefits from internal company economies of scale in raising capital, advertising, and through national contracts for purchasing. Lumber distribution and transportation costs also profit from agreements with railroads and trucking firms based on corporate, business and regional scale; i.e., the BC region in the case of Kamloops.
Externally, Weyerhaeuser Kamloops has benefited from the scale of the economic impact of the company on the local economy by having its municipal taxes frozen at the 2005 rate. The whole lumber industry has benefited from the increasing scale of operations by being able to support numerous forest products machinery fabricators who have produced innovative solutions to reduce costs and improve productivity.

Two recent examples of this are the small log line chipping saw and fully automated lumber grading machines. The former has enabled the automated processing of small diameter (down to 4" top diameter) logs and the latter has lowered operating costs, improved value added, and increased production rates. Kamloops can benefit from both of these innovations.

### 3.2 Lumbermill Minimum Efficient Scale

Mills which cannot sustain operations at their MES will likely be the first to shut down.

While there are few definitive studies of what constitutes a MES for a lumber mill, Canfor has set a standard of 400 mmbf/annum as a mill’s viable production level for their lumber producing units. Although the trend is towards more “mega mills”, there does not appear to be a very good understanding at which point diseconomies of scale begin to take effect in lumber mills. In 2004 Canfor opened the largest sawmill in the world at Huston, BC producing 600 mmbf/annum. On July 2006, Canfor announced that they were going to curb production at this mill by reducing a shift due to “market conditions”. If this mill was truly achieving economy of scale benefits, it should have been the last in the Canfor mill set to take downtime. Perhaps the 600mmbf/annum mill is reaching into the diseconomy of scale effect.

Weyerhaeuser shut down three of their six mills in British Columbia from 1999 to 2003. The six mills were each producing approximately 120 to 150 mmbf/annum. The production of the remaining three mills was increased by improved asset utilization through adding shifts and some
technical upgrades. These mills, one of which is Kamloops, are now yielding from 213 to 260 mmbf/ annum. Whether these current production levels are at or beyond the MES have not been determined.

3.3 Economies of Scale in the Sawmilling Industry – Literature Survey

The most recent study of performance in the British Columbia primary forest industry evaluated the operational efficiencies of 82 sawmills in six geographical regions of the province (Salehirad and Sowlati, 2005). Log consumption and labour utilization were inputs to a Data Envelopment Analysis (DEA) model with chip and lumber production being outputs. Both scale and technical efficiencies were calculated and an aggregate of the two was used as a measure of overall efficiency. Their findings based on 2002 data showed high economies of scale efficiencies of between 90 – 100 percent for most of the mills. Technical efficiency, a measure of how effectively a mill was able to use its raw material and labour was much lower, with an average of 83 percent. On an aggregate basis, 81 percent of the mills studied were considered inefficient relative to their best peers. A 27 percent improvement in their production, using the same level of inputs (logs and labour) would be required to raise them to benchmark performance efficiencies.

An older study by Martinello in 1987 estimated factor substitution, technical change and returns to scale for four British Columbia wood products industries, one of which was interior sawmills. Cross section time-series pooled data from 1963 – 1979 was used in the analysis. Cost functions showed all inputs of capital, material and labour behaving as substitutes with deteriorating fibre quality being compensated for primarily by increased capital. Interior sawmills showed constant returns to scale and decreasing total factor productivity. This is in contrast to an earlier study (1985) by Martinello of Canadian sawmills where he showed a scale elasticity of 1.11.
In a study of sawmill scale effects in Tasmania, Campbell and Jennings (1990) found a scale elasticity of 1.49.

A study of economies of scale in the Ontario hardwood sawmilling industry showed a classical U shaped average cost curve with an MES of 16 mmbf (Puttock & Prescott 1992) with 85 percent of mills producing at a sub-MES level. Since hardwood mills typically have far lower annual production than softwood plants, the MES would not be applicable for softwood species, although the general shape of the average cost/quantity curve could be expected to be similar.

The influence of economies of scale on the Swedish sawmill industry was investigated by Manson in 2003 using 1995 data from 238 mills. Scale elasticity varied from 0.9 to 1.36 with a mean of 1.1. The optimal size of a mill for the Swedish sawmilling industry was also calculated, with the optimum being a mill processing 166,920 m$^3$ yielding 90,000 m$^3$ of lumber. Most Swedish mills had not achieved this level of production at the time, although some had significantly exceeded the optimum and were seeing diseconomies of scale.

In terms of scale sawmills now operating in British Columbia, a 170,000 m$^3$ operation would be considered generally too small to be viable.

A general consensus of the literature on economies of scale in the sawmilling industry indicates that there is a beneficial effect on cost and efficiency by increased production, albeit not as great as in many other industries. There is also evidence of potential diseconomies of scale when operations become too large.
3.4 Economies of Scale – Weyerhaeuser Sawmills

Average total costs of production for 31 sawmills in the Weyerhaeuser softwood lumber business for the first six months of 2006 are plotted against the total output from these mills for this time period. This data is presented in Figure 3.1.

Figure 3.1: Weyerhaeuser Softwood Lumber: Average Costs of Production for 31 Mills versus Total Net production for Each Mill – June 2006 YTD

The MES was determined by defining the minimum COGS/mbf on a plot of unit costs versus net production. The data reveals a typical U shaped curve with an MES of 161 mmbf for a six month period. On an annualized production basis, the MES for the Weyerhaeuser softwood mills would be 322 mmbf/annum. This is slightly less than the Canfor assumption of 400 mmbf for a viable mill size. Of the 31 mills, 11 are operating at or above the MES with 20 operating below. Only three mills appear to be running in the area where diseconomies of scale may be starting to take effect. The Kamloops site is on plan to produce 220 mmbf in 2006, well below the MES for the Weyerhaeuser mill group.
The economies of scale presented for the Weyerhaeuser group considered an average total cost of production for different sites. The same input prices and levels of technology were assumed.

This is not truly a fair comparison since there are numerous external variables which would influence this cost and make it far more difficult for sites to compete based on an equal footing. For example, the mills in the USA were not required to pay the CVD which added 11 percent to the COGS for the Canadian mills. There are also variations in wood costs between geographic areas and within countries. The cost of fibre is for example $10 - $12 less per m³ in Alberta than British Columbia and often more expensive in the USA than in Canada. This has perhaps the greatest effect on COGS between regions.

Sites with the latest equipment have a higher production rate and a productivity advantage, although this is not always the case when culture clashes with technology. This was most evident in the Weyerhaeuser Big River Saskatchewan site. Despite having an advanced technology mill, economies of scale were never achieved because of poor labour relations and an inadequate level of training on the new equipment. Although there are many similarities between the Weyerhaeuser mills, the disparities are significant enough that the estimated MES may not be applicable to the entire mill set.

### 3.5 Capacity Utilization – Kamloops Site

The Kamloops site has not changed to any great extent over the past six years. Production increases have generally occurred from additional shifts. Costs have increased in some areas such as energy, but raw material costs have slightly decreased with the availability of Mountain Pine Beetle (MPB) wood. A plot of average cost versus annual production is presented in Figure 3.2 reflecting the site’s performance from 2000 – 2006 (estimated). Given capacity, short run average costs vary with output due to the effects of capacity utilization. The reduction in costs was
realized by adding an additional shift thereby increasing capacity utilization. The short run average costs are minimized at a production level of 200,000 mbf/annum, although there does not appear to be a sharp increase in costs beyond this point as the curve remains rather flat.

Figure 3.2: Kamloops Lumbermill Average Cost of Production versus Total Net production 2000 – 2006 (estimated)

Source: Author

Capacity utilization is important for the Kamloops site particularly during the low points of the lumber market economic cycle. During these times the mill should not be over-producing since the market is usually oversupplied, prices are low and margins are very thin or negative. Knowledge of the production rate at which average costs reach a minimum would enable the site to keep operating at a lower level of production and possibly still maintain positive cash flows.

The mill has been running 116 production hrs/week over the past 2.5 years.

Varying 2007 production levels by changing the operating posture from 116 hours to 100 hours per week confirmed that there was little difference in average costs with the lower production levels at 100 hrs actually showing slightly lower COGS. This appears to confirm that the site may
be running at or marginally above its minimum average cost rate of output. Varying the production by 20,000 mbf on both sides of the minimum results in a $4/mbf and $6/mbf increase in the COGS on the low and high side of the curves respectively, assuming all other factors remain constant. Although this does not appear to be very significant, it would represent an average additional cost of $720,000 and $1,320,000 per annum based on a production of 180,000 mbf and 220,000 mbf respectively.

3.6 Kamloops Future State and Economy of Scale

The future of scale of sustainable operations at Kamloops is envisaged to reach 350 mmbf/year. The final constraint will be the Thompson valley wood basket sustainable annual allowable cut (AAC) assuming institutional factors and sales are relatively stable.

This potential production level is well beyond the current capacity of the site’s current processes even at 100 percent utilization running 24/7. Significant machinery and processing upgrades will be required to achieve this projection. The proposed upgrades along with potential date and volume increases are presented in Table 3.1. Each major upgrade moves the constraint to a different sub-unit of the mill. The production volume reflects the next constraint level.

Constraints are worked from the process closest to the customer backwards. The exception to this is shipping, which is not constrained until quite late in the upgrading sequence. For example, the planer mill upgrade planned for 2007 will be able to cope with the 360,000 mbf production level from the sawmill, which will not take place until 2009 at the earliest. This will be the same for the kilns and shipping. From 2007 until the sawmill upgrade is complete, only relatively small incremental gains can be achieved by working issues related to reliability and waste reduction.

The log yard was not included in the capital upgrade plan as it was assumed that it would be a cut-to-length and/or contracted-out function. These upgrades will change economies of scale as they are implemented. This is a long term plan for the Kamloops site which will radically change
its operating posture. The changes will require significant capital investment but the returns to
capital are likewise impressive. State-of-the-art technology will enable the mill to improve
recovery by 11 percent and reduce the CNOL by 42 percent. None of the planned changes have
yet commenced their approval process through the corporate capital approval labyrinth. There
have been promises to upgrade the planermill over the past five years but the capital has not yet
materialized.

Table 3.1: Kamloops Long Term Future State

<table>
<thead>
<tr>
<th>Year</th>
<th>Constraint before Upgrade</th>
<th>Upgrade</th>
<th>Constraint after Upgrade</th>
<th>Production Volume Net Mbf</th>
<th>Cost $ million</th>
<th>Estimated CNOL $/mbf</th>
<th>Recovery mbf/m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>Planermill</td>
<td>Minor modifications</td>
<td>Planer</td>
<td>215,000</td>
<td>0.4</td>
<td>139</td>
<td>0.276</td>
</tr>
<tr>
<td>2007</td>
<td>Planer</td>
<td>Replace planer</td>
<td>Kiln</td>
<td>260,000</td>
<td>6</td>
<td>105</td>
<td>0.286</td>
</tr>
<tr>
<td>2008</td>
<td>Kiln</td>
<td>4 additional kilns</td>
<td>Shipping</td>
<td>260,000</td>
<td>4</td>
<td>105</td>
<td>0.286</td>
</tr>
<tr>
<td>2008</td>
<td>Shipping</td>
<td>Additional rail spurs</td>
<td>Sawmill</td>
<td>265,000</td>
<td>0.25</td>
<td>105</td>
<td>0.286</td>
</tr>
<tr>
<td>2009</td>
<td>Sawmill</td>
<td>Large log line Small log line Edger Stacker By-product processors</td>
<td>Sustainable log supply</td>
<td>360,000</td>
<td>50</td>
<td>80</td>
<td>0.305</td>
</tr>
</tbody>
</table>

Source: Author

3.7 Economies of Scale and Capacity Utilization – Summary and Conclusions

Kamloops has demonstrated increased capacity utilization over the past five years. With the site
now close to operating capacity, any further gains in the near future will have to come from
reliability improvements and cost reductions. The short run average cost for the unit was
empirically determined to reach a minimum at an output rate of approximately 200 mbf/annum.
Average COGS/mbf was shown to be sensitive to annual production. At current market lows,
adjusting production levels has both the benefit of a minimum COGS and a very minor effect on taking volume out of the market to raise demand and price. The site will establish new economies of scale with advanced process technology once major mill upgrades are complete. These changes would enable the mill to run profitably at the bottom of the economic cycle and place it firmly in the top performance quartile. The challenge is to demonstrate continuous improvement in the interim.
4 Lean Manufacturing and the Lumber Production Process

Lean manufacturing is a strategy to achieve smooth, even product flow with minimal waste and high product quality. The term lean production was coined by Womack et al. (1990) in their book, “The Machine That Changed the World”.

The Japanese auto industry and the Toyota Motor Company in particular are most often cited as the paragons of leanness to the point where lean manufacturing is sometimes seen as synonymous with the Toyota Production System methodology.

The original theory of lean manufacturing focused on seven types of waste, but recently an eighth has been added. The categories are as follows:

a. **Overproduction**: producing more than the market demands and creating excess inventory
b. **Transportation**: Movement of materials further than absolutely necessary
c. **Waiting**: Products or people waiting for the next process step
d. **Inventory**: Having more inventory than is absolutely essential
e. **Motion**: Inefficient use of body motions or machinery actions in production
f. **Processing**: wasteful, non-value added process and information gathering activities.
g. **Defects**: Poor quality products requiring either rework or scrapping
h. **Ineffective use of human resources**: not making use of the inputs of all employees

There are overlaps in the above eight factors. Evidence of all these forms of waste is apparent at the Kamloops lumber mill. A partial exploration of overproduction has already been discussed in Chapter 3 regarding capacity utilization.
4.1 Kamloops Site Process Flow Waste Reduction Opportunities

Process flow for the Kamloops mill is presented in Figure 4.1 showing a detailed sequence of operations from logs to finished lumber packages. Each major operational unit will be examined with respect to the resources employed, inventory levels, operating rate, reliability, capacity, and effects on product quality.

4.1.1 Log Yard

The log yard’s current function is to receive raw material from the logging contractors by weighing the incoming loads and performing a random scale check to correlate log volumes to weight and determining the quality of the logs. The site receives from zero to 100 log trucks per day each carrying approximately 50 m³ of logs with an average of 56 trucks per day. Shift hours are adjusted to account for periods of peak activity. Seven Weyerhaeuser personnel and one contract scaler operate in close conjunction with the Ministry of Forests (MOF), Weyerhaeuser forestlands department, and the logging contractors and contract haulers. The weigh masters and log scalar roles are particularly critical in ensuring that the MOF is satisfied that the province is receiving the correct amount of stumpage and that the company is getting the appropriate quality of wood. Logs are usually in mixed lengths, diameters, and orientation when delivered. A button-top machine is used to sort logs into three diameter classifications while at the same time orienting the timber. This is important for subsequent feeding of high taper logs into the mill since each primary breakdown line has a range of diameters it is capable of processing efficiently.

Machine reliability is generally low, with the larger mobile equipment suffering frequent breakdowns. The site employs five full time heavy duty mechanics to keep their mobile equipment functioning as well as contracting out vehicle repair work to original equipment manufacturers (OEMs).
Inventory levels in the log yard range from a low of approximately 10,000 m³ to a high of 155,000 m³.

The log yard suffers from six forms of waste identified in lean manufacturing.

Processing waste is generated by broken logs and non-value added labour. From the time timber arrives at the gate to the time it is placed on the mill in-feeds the log can be handled up to five times. This results in significant breakage with a conservatively estimated loss of one point of recovery worth $150,000/annum. Not only does the breakage reduce recovery, $85,000/annum in labour cost plus $50,000/annum in mobile equipment maintenance and $125,000 of capital every five years to replace mobile equipment is required to support clean-up. Waste timber is usually hauled to the company landfill. With steadily increasing production, the volume of waste has grown to the point where disposal is becoming an issue. The site currently disposes six truck loads equivalent to 50 m³ per day to the landfill. Landfill management has stated that this has to be cut back to 35 m³ per day by year end. Should this not be possible, additional landfill costs would be incurred.
Quintuple handling of logs represents both wasted transportation and motion in the log yard. Logs can travel up to one kilometre from the in-feed decks requiring considerable time and effort to
transport. These forms of waste could be identified by using a spaghetti map to determine the current routing of log yard machinery and optimizing log yard layout to minimize future machine paths. This would decrease fuel usage and operating time. Transport distances could be reduced by keeping logs more frequently in demand, i.e. smaller diameter logs, closer to the sawmill.

Waiting for logging trucks and waiting for pull from sawmill is waste of time for log yard personnel. The log yard currently employs eight people. Two weigh masters spend some of their time waiting for logging trucks. Log yard loader drivers also wait for trucks and wait for direction from the mill to forward logs to the in-feed decks.

The costs of excessive transport (including fuel and wear and tear on the machinery) and waiting is estimated at $50,000/annum.

Inventory is highly variable, both in volume and diameter class. Waste is produced downstream from the log yard when the appropriate diameter mix is not available to the sawmill resulting in idle primary log breakdown machinery. Inventory should be managed by diameter class to minimize this effect. While it is recognized that an inventory build-up is necessary in the log yard prior to break-up, high levels could be avoided during normal logging seasons. Assuming that the log yard will hold an average of one month’s inventory for sawmill consumption and discounting the two months of inventory build-up prior to break-up, the excessive inventory is estimated at $5,700,000 in unnecessary working capital based on July 2005 to June 2006 inventory data. This working capital represents a significant opportunity cost savings.

Log defects are recorded on a sampling basis. An example of a log quality check monthly summary for September 2006 is shown in Figure 4.2. Inspected loads are assigned a quality point number. The site point goal is 95. While this target is seldom missed, it is also hardly ever exceeded. Logging contractors are aware of the minimum acceptable level of quality and do not waste a perfectly good target.
A six sigma program for the logging contractors might produce a better quality of log for the mill. Low quality logs increase waste downstream in a number of ways. Logs that are too short or too long within a two foot length increment, lose recovery by having to be trimmed to the nearest even length. As can be seen from Figure 4.2, incorrect lengths form the second highest percentage of defect. Rot, pitch pockets and other natural defects obviously affect the grade of lumber being produced. Logs with severe geometric shapes (sweep, crook, pistol grip, & flared butts) present processing issues downstream by causing cross-ups and jams in machinery and also result in quality losses in the finished lumber. Dry timber, is currently the most frequent defect present in MPB logs. Over dryness causes splits and breaks easily decreasing recovery. Recovery losses from poor log quality are conservatively estimated at two points worth $300,000/annum. Value
loss from natural defects is too difficult to approximately quantify due to lack of specific lumber grading data for these defects.

4.1.2 Sawmill

The sawmill’s prime function is to transform logs to rough green lumber and collect the by-products of wood chips, sawdust and hog for direct sale to the pulp mill. This is the most complex of all the departments in the production process. As can be seen in Figure 4.1, there are many parallel process flows and feedback loops. The sawmill currently consumes timber at a rate of approximately 127 m$^3$/hr. This sub-unit has an uptime of 71 percent and runs 116 hours out of a possible 168 hours per week for a capacity utilization of 49 percent.

Upon delivery to the mill, logs are metered onto cut-off saw decks with mobile log loaders. Cut-off saw operators then decide what lengths to buck the long stems. This is a manual decision relying on the operators’ experience, intelligence and attentiveness to extract the greatest potential value from long logs. Errors in judgment can result in a loss of 2’ to 4’ off the ends of long logs equivalent to a three to seven percent recovery loss. Cut to length logs (those 20’ long and under) only require verification by the cut-off saw operator that the log is of sufficient quality, and does not exceed the operating parameters (maximum length and diameter of 30”) of the downstream equipment. The log segments are then automatically separated by diameter onto one of two buffer decks where they queue to be debarked. Either a 30” Cambio or a 17” Nicholson debarker are used to strip the bark off the large and small diameter logs. There is opportunity for error here. Although logs are sorted automatically by diameter, there is a manual override and the automatic system sometimes fails. Large logs end up on the small log deck and vice versa. Inattentiveness by the cut-off saw operator sometimes results in an oversize log finding its way into the 30” debarker with bad consequences and prolonged loss of production.
The primary disadvantage of the large log line is its processing speed which is limited by the C-frame’s maximum rate of five stems per minute. The process is also complex requiring three machines with all the attendant material transfer machinery and two operators to produce the final product. Current technology equipment uses a single modular machine with one operator to convert a log directly to lumber.

The small log line employs a chip’n saw (CNS) machine centre to reduce logs to lumber. This machine takes the log in at one end and lumber emerges at the output. It can consume up to 16 logs per minute but is limited as to the log diameter it can efficiently process. This machine will produce up to five pieces of lumber ranging from 4” to 10” wide and 10’ to 20’ long.

Both the C-frame and CNS use laser vision technology to create a digital image of the log. This data is then analyzed by a computer which tries to extract the maximum value of lumber from the log based on current lumber price tables. The computer then sets the chipping heads, and, in the case of the C-frame, the side board saws for the optimum cut configuration. There is material wastage when the CNS does not set properly due to dirty scanners and either electrical or program problems in the system. Miss-manufactured boards due to these issues result in recovery losses and downgrades in the planermill. Failure to update lumber value tables frequently can result in the machine sub-optimizing cut patterns.

The rough lumber then passes under another smart scanner which decides whether the board is ready for trimming or if it requires further processing by the edger based upon its shape characteristics. Boards with excessive wane (rounded edges from the side of the log) are directed to the edger for length-wise ripping into narrower, more valuable lumber. Square lumber is usually of a higher grade than one with excessive wane. After edging, the remanufactured lumber is sent back through the trimmer scanner, and should pass on to the trimmer and sorter.
A bank of 12 parallel saws trims each piece to its optimum length. After this the lumber is automatically sorted by length and width into one of 68 sorter bins. Miss-sorting of lumber requires the next downstream operator to separate and re-circulate these pieces.

A stacker then stacks the lumber into tiers, with sticks between each tier for the next major process, kiln drying. There is considerable wastage of sticks in this process due to a poorly designed stick dispenser. The site spends approximately $200,000/annum on these sticks which are worth $0.73 each making these items worth more than our highest grade of 2x4 at current market prices! Loads are then transported by forklift to the green rough yard storage area covering approximately eight acres.

The sawmill has opportunities to eliminate all eight forms of waste identified by lean manufacturing.

Over-production relative to the downstream internal customers, the kilns and planermill results in excessive inventory. Within the sawmill itself there are many forms of overproduction. The primary breakdown machines (CNS & C-frame) will often over run the capacity of the downstream secondary breakdown systems (trimmer and edger). This results in an accumulation of lumber in at the primary/secondary transition deck buffer to a point where the upstream primary machines are forced to stop.

There are also instances of waiting wastage. This is most prevalent in the large log line (C-frame) when there are insufficient quantities of minimum diameter (8”) logs for this machine. The result is lost production for a machine producing 45 percent of the mills output. In addition to log size issues, C-frame waiting occurs because of poor upstream processing equipment reliability (bucking stations, transfer decks and 30” debarker) and lack of large logs being delivered from the log yard.
Operator inattention at the cut-off saws and debarkers results in waiting downtime when over-size or crooked logs cause jams in the debarker.

Lumber is also transported greater distances than necessary, particularly in the remanufacturing loop. The edger machine is the heart of this process. Unfortunately the lumber transport system to this machine centre is its main weakness. As can be seen from Figure 4.1, three streams of rough lumber converge at this machine. There are seven changes in elevation combined with four direction changes for lumber to get to the edger. The lumber transport route is convoluted. A mixture of large and small side-boards falling into the same conveyor at different points combined with direction and elevation changes result in “haystacks” and cross-ups causing wasted time and effort. When edger is down, lumber requiring remanufacturing (reman) is re-routed to a collection point and accumulates as re-work inventory. Reman usually constitutes between 300 – 500 mbf, equivalent to one normal shift of production. This rough lumber degrades outside awaiting remanufacture. The repeated handling by forklifts and front-end loaders causes breakage further adding to the waste in this process. This stock must then be either slowly re-introduced into the flow during production or run as a separate overtime shift. Both of these are a form of wastage since this lumber is in effect being run through the mill twice. Overtime reman shifts are estimated to cost $50,000/annum in addition to 0.001 points of wasted recovery due to handling breakage and weathering, estimated at $150,000/annum for a total additional cost to the site of $200,000/annum.

The edger loop has another inherent wasteful process. Lumber that does not require edging gets trapped into the edger processing loop becoming what is termed a “resident board”. This occurs from the optimizers in the edger and trimmer working at cross purposes when they have different value tables. These boards take up process time that could be used by boards requiring edging and lower the edger’s utilization.
The sawmill produces rough lumber at a rate higher than kilns can successfully process. This results in an accumulation of green lumber inventory which is greater than necessary to meet customer demand.

There are a number of general wasteful practices. Compressed air is used extensively in the mill to power equipment. Air hoses are also used to “blow down” equipment from wood dust and debris. Use of air for cleaning purposes is excessive and, combined with air leaks on the site accounts for the running of an additional compressor. This adds to power costs, as well as the maintenance required sustaining an additional compressor, and the eventual capital cost for a replacement for a total wastage bill of an estimated $50,000/num.

Electricity is also wasted by operators leaving machinery running between breaks and over lunch.

Forklift drivers generally leave their machines idling when not in use thus wasting fuel.

Motion wastage occurs in both machinery and with operators. Usually malfunctioning machines are the root cause of wasted body motions. When the edger does not perform properly, slivers of wood end up at the trimmer. This forces the trimmer operator to contend with miss-fed lumber. The edger operator frequently has to remove broken lumber and slivers from his machine and dispose of these in a conveyor 15' distant. In addition to being wasteful motion these actions constitute potential safety hazards with handling of long slivers of rough wood.

There are numerous natural defects in logs, resulting in material wastage once this fibre gets into the sawmill. To avoid these defects would require a more thorough screening either in the bush or at the log yard.

Machine-produced defects also cause degradation in lumber quality and these could be mitigated at the mill. A common defect is debarker fibre tear resulting from excessive tool arm pressure during debarking. Currently there is no automatic means to detect this form of damage. Operator
vigilance at the debarker, primary breakdown machines and the trimmer are relied upon to notice
the damage and initiate corrective action. Operator assessment of this damage is somewhat
subjective, and unfortunately sometimes large quantities of lumber are produced before the
problem is rectified.

Spike roll damage from rolls used to control the log or cant during primary processing also can
result in downstream quality degrades. The further downstream the damage occurs, the fewer the
number of operators likely to see the problem and report or initiate corrective action. Knife and
knot tears from the chipping process result in deep divots on the lumber surface reducing value to
the customer. These are most often caused by dull knives. Operators and supervisors reluctant to
shut down the process for a knife or saw change, will often produce up to two hours of poor
quality product until a production break occurs. Probably the most common defect, termed saw
offset, happens when two saw lines do not properly overlap causing a step on the face of the
board. A certain amount of offset can be dealt with at the planer, but excessive offset will result in
the piece being a lower grade with the consequent loss of value.

The most serious defect in the sawmill would be the production of off-size or miss-shaped
lumber. This can happen from a number of causes ranging from optimizer scanner errors to a
sliver stuck in a saw box. With real time size control, most of these defects are caught early in the
process. However should a supervisor turn off the pager alarm for this system, large quantities of
thin, narrow, short and/or miss-shaped boards are produced very quickly.

Insufficient removal of bark can cause rejection of wood chips and sawdust. Loads of these by-
products with excessive bark are relegated to hog resulting in a 12 to 60 fold reduction in
revenue.

There are processes and machine centres which are not truly value adding.
Kamloops is the only mill in BC employing a full time operator to empty sawdust, chips, and hog from bins into short haul trucks. All other sites allow the truck drivers to perform this task. This function adds no value to the final product.

The lumber sorter has a bin attendant on each shift to straighten out lumber as it falls into the bins. There are numerous sorter designs running without bin attendants. The sawmill stacker runs so poorly that a half time helper is required in addition to the operator. The total loaded cost of these two non-value added work functions is $465,000/annum.

The canter machine, downstream from the C-frame is also unnecessary. Cants could go directly to the double arbour saw box and be cut into dimension lumber and slabs. The reduced maintenance expense plus one less operator would save the site approximately $120,000/annum.

The site does not have a formal program to recognize, evaluate and implement employees’ suggestions on waste reduction. The company RADAR program serves this function in the field of safety. While there have been sporadic efforts at establishing machine centre teams, these have not persevered. This last of the eight areas of waste from lean manufacturing is a great improvement opportunity for the mill.

4.1.3 Kilns

The site’s five natural gas fired kilns are fairly efficient, but have potential to benefit from several areas of waste reduction. Each of three double-track kilns can hold 250 mbf while the two single tracks contain 125 mbf each for a total drying capacity of 1,000 mbf. Lumber of a similar width is dried together; mixed width kiln charges are rare. Kiln loading takes approximately one hour. Drying times range from 19 hours in the summer to 39 hours in winter. Average kiln utilization is 74 percent which is identical to the capacity utilization since the kilns run on a 24/7 basis.
Lumber moisture content is monitored during the drying process with a target moisture content of 11 to 13 percent. Drying rates and kiln schedules are extremely important to achieve appropriate final moisture content. Over-dry lumber is very brittle resulting in processing issues. Wet lumber (termed wets) has a drastic value de-grade commanding only half the price of kiln dried lumber. Some wets are unavoidable and usually comprise less than four percent of kiln output. Poor drying has resulted in up to 11 percent wets in some loads with the accompanying wastage of potential value.

The kilns dry lumber faster than the planer can process it, resulting in a build-up of dry rough lumber inventory. This a form of both overproduction and excessive inventory waste.

Forklift traffic from the green lumber yard to the kilns and from the kilns to the dry yard could benefit from a spaghetti plot of lumber movements. The loading and unloading of kiln carts during the changeover process currently ranges from 45 to 60 minutes.

Lumber drying is the one process that cannot improve the quality of the product. Customers desire dry lumber because it is more dimensionally stable than green wood and it resists fungal growth. Recently phytosanitary requirements for exporting lumber necessitate holding the wood at an elevated temperature for at least 12 hours to kill any potential fungi and bacteria.

Drying can introduce more defects into lumber such as warp and splits. The best one can hope for through the drying process is to at least retain the quality of lumber that entered the kiln. Boards with excessive drying defects have to be down-graded or chipped. Excessive drying also makes the wood more brittle causing process upsets in the planer.

There are two alternatives for expensive natural gas as a heating medium for the kilns. The pulp mill produces an excess of steam which could be piped to site to dry wood. The mill could use hog as a fuel to provide the necessary heat. These options would require capital investments of
approximately $2,000,000 and $4,000,000 respectively. The site currently spends approximately $2,400,000 on natural gas.

Future site expansion to a 350 mmbf facility would require four additional kilns.

4.1.4 Planermill

The planermill is the site constraint. Lumber is transferred from the rough dry storage yard to the planer in-feed where a tilt hoist feeds the boards tier by tier from the lumber stack onto an in-feed table. Kiln sticks separating the tiers are removed and recycled to the sawmill stacker during this process. Some wastage of kiln sticks occurs at this point when the stick monitor rejects acceptable kiln sticks. The stick monitor is another position which could be eliminated. There are several mills with automatic systems for the recirculation of kiln sticks. With the current four shift planermill configuration elimination of this task would save the site $340,000/annum.

The planer machine is a Stetson-Ross Maximizer and is the only one of its type left in the world. Only three were made, and the machine was designed to plane cants and mouldings. This machine has been modified many times but it is still not well suited to planing dimension lumber, and is the main cause of process downtime in the planermill. The planer runs at different speeds depending on width and length. Run speed is determined both by planer machine capability and speed limitations of downstream processes.

Finished lumber emerging from the planer has its moisture content measured, and any boards with too much retained water are colour-coded as wets. Lumber then either passes through a mechanical stress rating (MSR) machine where each piece is strength tested and sprayed with a colour designating a strength value; or is sent on directly to the grading table. Only 2x4 and 2x6 are passed through the MSR. Two by ten (2x10) and 2x12 are visually graded and all 2x8 is split at the planer machine into 2x4s.
Grading is a manual process. Three graders have approximately two seconds to evaluate each piece of lumber. They mark the piece with one of eight grades dependant on geometric characteristics (wane, knot size and spacing), natural defects (rot & splits) and manufacturing defects. The graders also decide on where trimming back the lumber will yield more value and mark the boards appropriately. Each board, with the exception of economy grades, is stamped with a kiln dried designation (except the wets), and the appropriate grade.

The grading and stamping operations are critical as the site is inspected by an external agency at least once per month to ensure that it meets grading standards. The lumber is stored in the sorter by grade and length since all lumber is batch run in the planer by width. From the sorter, lumber is stacked into full and at times, half packages. These packages are then pressed into rectangular shape, banded, wrapped, and labelled.

Overproduction here is not really a problem, nor is starving the planer from a lack of dry lumber at the in-feed. There is a build-up of dry rough inventory in front of the planer as mentioned in the discussion on kilns.

Transportation of dry lumber from the dry yard to the infeed storage area is an issue. Travel distances are long and the dry yard inventory is not always thoroughly segregated by lumber lengths and widths, making it difficult to locate loads. The yard would benefit from first-in-first-out (FIFO) inventory control and a time/motion study of forklift traffic. There are times when the planer is waiting for wood to run from the staging area but this is fairly infrequent and due to operator negligence.

There is considerable waiting time in the planermill due to jams in the planer machine, lumber cross ups on the various landing tables (planer to MSR, planer to by-pass) and problems at the sorter. The single largest cause of waiting waste is planer jams, where a piece of lumber will break-up in the planer or not feed properly. This accounts for 15 percent or 900 production
hours/annum of waste. This waste forms a large part of the requirement to run a fourth shift at the planer. Planermill average utilization is at 54 percent with 62 percent uptime. This sub-process is currently running at 141 of a possible 168 hours/week, which, when combined with its run time utilization, yields an operating rate of 47.9 percent of its theoretical maximum capacity.

There are inefficiencies of motion in the grading procedure with human graders. This process can now be fully automated eliminating the need for human graders except for a quality control (QC) person. An automated lumber grader optimizer at one of Weyerhaeuser’s mills has demonstrated cost savings of $900,000/annum in wages as well as a significant value and recovery up-lift.

The planermill process is closely coupled from the planer machine to the sorter with very little non-value added buffer storage points.

Planermill defects produce the most visible effects to the customer. Mis-graded lumber is the most common defect requiring rework. Considerable overtime is expended in re-grading and then repackaging lumber.

Other defects which have been encountered producing waste are:

- a. undersize lumber (width, thickness and length),
- b. unstamped or miss-stamped grades,
- c. miss-labelled lumber packages requiring extensive searching, quarantine and re-labelling,
- d. Mixed grade lumber packages, and planing defects resulting from improper planer set-up (edge grooving, skip, tapered boards) or debris in the planer machine.

Almost all of the above defects are the results of human error.
4.1.5 Shipping

The shipping department is fairly small consisting of two rail car loaders and two assistant shippers. These personnel load an average of five railcars (110 mbf/car) and five to eight trucks (40 mbf/truck)/day accounting for 700 – 900 mbf of finished inventory leaving the site for customers each day. Loading is accomplished with four forklifts dedicated to this function during the day. The finished lumber yard covers approximately five acres and lumber is stored in areas by width, length, grade and specie.

Wastage in shipping occurs primarily from rework as a result of forklift damage to lumber packages. These packages have to be recycled through the planer stacker and wrap stations.

Finished lumber shipments are a function of spot market and contract customer sales.

4.2 Lean Manufacturing and the Value Stream

Most of the applications of lean manufacturing have been in discrete fabrication industries such as automobiles and consumer goods. There are several examples of lean successes in the secondary wood products industries which are more labour intensive involving numerous manual operations. The hardwood lumber industry which is more of a continuous process has had some success in implementing lean methods. An analysis of the benefits of lead time reduction in Southern Yellow Pine production was done by Taylor (2005) using value stream analysis. He found a potential reduction in lead times from 35.3 days in the current state, to a low of 10.8 days in a future state analysis resulting in a potential reduction in working capital of 50 percent.

In “Lean Thinking” (1996), Womack and Jones introduced the following five concepts focusing on customers and employees that would characterize a lean organization:

a. Determine what product and service attributes customers value
b. Map the product value stream and eliminate/reduce waste
c. Manufacture product according to customer pull
d. Encourage employee input for improvements and act on suggestions

e. Pursue continuous improvement.

Value adding attributes from the internal and final customer perspectives were discussed in
Chapter 2. Customers place a value on price, quality, on time delivery and quick response to
orders. Meeting base quality requirements such as lumber being the correct dimension and on
grade are largely givens in customer satisfaction. Internally, producing the highest margin, on
specification product, at the lowest cost, with the highest recovery are the value added attributes
sought by lumber companies.

Eliminating waste from the production process, the core of lean manufacturing, adds value from
both the final customer and internal customer’s perspective. From a value stream viewpoint, the
current state at the Kamloops site is, for the most part, providing value to the customer, but at an
unacceptable cost to the business.

Mapping the value stream at the Kamloops site is one of the steps to identifying waste as
proposed by lean thinking theory.

4.3 Value Stream Mapping the Kamloops Sawmill

Value stream mapping is a process that will assist in achieving the lean goals of lowering costs,
improving quality and shortening product delivery time. The site current state must first be
mapped by recording all the process activities, flow times, queuing and inventory points and
information flows. The current state value stream will form the basis for the proposed future state
where waste and inventory will be reduced or eliminated.

The objectives of a value stream map of the Kamloops site are the following:

a. To identify the value-added activities and information flows and establish where flow can be
   improved.

b. Determine which areas have waste reduction opportunities
c. Estimate the Takt (German word for beat) time for the site. Takt time is the production rate necessary to meet customer demand rate.

d. Identify process bottlenecks and what should be done to reduce them

e. Determine where inventories and queuing time should be reduced.

### 4.3.1 Value Stream Mapping the Kamloops Mill Current State

#### Table 4.1: Kamloops Lumbermill Process Family Matrix

<table>
<thead>
<tr>
<th>PROCESS STEPS</th>
<th>PROCESS PRODUCTS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Full Length logs</td>
</tr>
<tr>
<td>Scales log Receiving</td>
<td>X</td>
</tr>
<tr>
<td>Truck Unloading</td>
<td>X</td>
</tr>
<tr>
<td>Log Stacking</td>
<td>X</td>
</tr>
<tr>
<td>Log Sorting</td>
<td>X</td>
</tr>
<tr>
<td>Mill Forwarding</td>
<td>X</td>
</tr>
<tr>
<td>Infeed deck Loading</td>
<td>X</td>
</tr>
<tr>
<td>Cut-off Saw #1</td>
<td>X</td>
</tr>
<tr>
<td>Cut-off Saw #2</td>
<td>X</td>
</tr>
<tr>
<td>17&quot; Debarker</td>
<td>X</td>
</tr>
<tr>
<td>30&quot; Debarker</td>
<td>X</td>
</tr>
<tr>
<td>C-Frame</td>
<td>X</td>
</tr>
<tr>
<td>Canter</td>
<td>X</td>
</tr>
<tr>
<td>12&quot; Saw box</td>
<td>X</td>
</tr>
<tr>
<td>Chip'n Saw</td>
<td>X</td>
</tr>
<tr>
<td>Edger</td>
<td>X</td>
</tr>
<tr>
<td>Chippers</td>
<td>X</td>
</tr>
<tr>
<td>Trimmer</td>
<td>X</td>
</tr>
<tr>
<td>Sawmill Sorter</td>
<td>X</td>
</tr>
<tr>
<td>Sawmill Stacker</td>
<td>X</td>
</tr>
<tr>
<td>Dry Kilns</td>
<td>X</td>
</tr>
<tr>
<td>Planer</td>
<td>X</td>
</tr>
<tr>
<td>MSR</td>
<td>X</td>
</tr>
<tr>
<td>Grading</td>
<td>X</td>
</tr>
<tr>
<td>Planer Sorter</td>
<td>X</td>
</tr>
<tr>
<td>Planer Stacker</td>
<td>X</td>
</tr>
<tr>
<td>Package Bander &amp; Wrap</td>
<td>X</td>
</tr>
<tr>
<td>Shipping</td>
<td>X</td>
</tr>
</tbody>
</table>

Source: Author
The process family matrix in Table 4.1 shows which products undergo transformation by the various machine centres.

The objective of this matrix is to ensure that the whole plant is thoroughly covered and to identify stages of production which employ the same machinery to handle different products. Different production flows could then be proposed, which would merge these products and eliminate transportation waste. Table 4.1, in conjunction with Figure 4.1, the process flow chart, gives a good overview of the Kamloops lumber production process from both a material flow viewpoint and the products and by-products as they progress through the process. In Table 4.1 products are presented as objects, but not broken down into their final dimensional and quality states. For example, short logs generally refer to those less than 20' long which are most often delivered directly to the mill versus being stored in the log yard. Rough lumber is composed of dimensions ranging from 2"x4" to 2"x12" in lengths of 8' to 20'. Finished lumber is separated into eight grades, five widths and eight lengths. The site still runs two species. Most of these variations do not affect process routing or speed. Although there are some minor rate effects due to dimension, these were not included in the matrix.

Creating the value stream for a sawmill process posses some unique challenges.

There is considerably more raw material variation in supplier input (log deliveries) than with most other manufacturing processes. This results in huge raw material inventory swings from 10,000 m$^3$ after the end of break-up in late spring, to 150,000 m$^3$ just before break-up in late winter. For the purposes of this value stream map, an average log inventory level over the past 12 months (July 2005 –June 2006) is used. Customer demand also varies considerably depending on the housing market and level of construction activity which is seasonal and usually counter cyclical to raw material supplies. Lumber customers for the Kamloops products consist of
contract orders and sales on the spot market which is a combination of push and pull. This results in a variation in finished lumber inventory.

Process reliability at the site has been highly unstable but is improving. Annual average utilization is used in the value flow chart. Flow chart symbols and conventions which are largely standard and detailed in “Learning to See” (Rother and Shook, 2003) are used in the value stream flow chart.

The current state value flow chart examines the flow and inventory between the major processing units of log yard, sawmill, kilns, planer, and shipping is depicted in Figure 4.3. The current state lead time from log delivery to lumber shipment is 51.6 days, almost all of which is spent in non-value added inventory time at storage points in front of four of the five main processing units. This compares to a value added process time of eight minutes/mbf.

Although lumber production may seem to be a continuous process, in reality it is a series of five discrete manufacturing sub-units only two of which, the planermill and sawmill, could be considered continuous. Flow through the log yard is in discrete batches, although these would be hard to distinguish separately since there should always be a supply of logs in front of the sawmill. The log yard, kilns and shipping are really batch sub-processes since each deals with distinct volumes of materials i.e. logging trucks, kiln charges, and rail cars/trucks. The sawmill-kiln and kiln-planermill are pure push linkages. Planermill production is more of a kanban pull form of production. The planer is given a weekly production schedule based on actual and forecast sales. The product supply manager working in conjunction with the sales group defines which products (length, width and specie) to run in specific quantities.
Push in the sawmill and kilns results in overproduction relative to the downstream customer, the planermill. This creates waste in the form of inventory. Some of the material produced from the sawmill will not be required for downstream processing for several weeks.

This inventory requires careful management. It is stored and tracked, requiring a large area of real-estate and a fleet of forklifts. It is counted informally at least once weekly and formally at every month end. Discrepancies between the count and calculated inventory levels are frequent and have to be reconciled wasting management and accounting department time. Rough lumber in inventory degrades due to weathering resulting in value loss. Dry rough lumber inventory becomes over-dry in the summer if left out too long. Over-dry lumber is brittle causing planer jams and with the resulting downtime and material loss. Due to upstream disconnects between log size and customer requirements, some products remain in inventory for prolonged periods (up to two months). Reducing inventory represents one of the largest opportunities for waste reduction, lowering lead time, and cutting working capital. Lowering working capital represents an opportunity to invest these funds into yield at least the cost of capital.
The first step in decreasing inventory is to link production to customer demand. In the case of lumber manufacturing, this is a formidable challenge. Demand in this industry has both a seasonal and economic cycle that is superimposed. There are also variations in the market for specie, dimension and grade.

Takt (the German word for musical beat) time is a measure used to synchronize production with sales. It was defined by Ducharme et al. (2004) in three variations:

a. A general definition: "the desired time that it takes to make one unit of production output"

b. Customer driven: "Available Operating Time/Customer Demand" and
c. Operations driven: "Available Operating Time / "Forecasted" Demand"

The unit of production and customer demand for the purposes of calculating takt time will be considered as one thousand board feet of lumber (1 mbf).

The Kamloops site does not presently have a specific "desired time" to make one unit of production. The "desired time" in this case might be considered as the process time to match planer and sawmill production. This would eliminate one planermill shift and save the mill $1,200,000 per annum. The planermill would have to run at a gross rate of 39.1 mbf/hr based on current sawmill gross output. This results in a desired process takt time of 93 seconds.

Customer demand can be assumed to be the shipping rate, since lumber is not shipped without an order. There are variations in shipping rates over the year. The average shipping rate from October 2005 to September 2006 was 17,757 mbf/month with a standard deviation of 2321 mbf representing a coefficient of variation of 0.13. The customer driven takt time was calculated as 129 seconds per mbf with a variation of ± 1 mbf per standard deviation.
Forecasted demand can be considered as the plan demand for the following year. In this case 2007 forecast volume are slightly higher than 2006 resulting in a forecast operations takt time of 119 seconds.

Customer driven takt time is the most conventionally used metric for establishing the “heart beat” of the production process i.e. every 129 seconds customers take away one mbf. All other production processes should strive to be in sync with the customer driven takt time to avoid over production and inventory build-up. This is very difficult to achieve in the real world due to daily process variability. The large variety of products in the lumber industry makes this an even greater challenge.

In the future state the objective would be to level the production flows such that all the processes are working as close to the close to the takt time as feasible.

**Figure 4.4: Kamloops Current State Process Cycle Times: October 2005 – September 2006.**

![Figure 4.4](image)

Source: Author

Sub-unit process cycle times are presented in Figure 4.4 along with the customer takt time. In the Kamloops current state, none of the processes are in sync, resulting in varying degrees of over production relative to the customer driven takt time with the net effect of inventory accumulation.
Deficiencies in finished goods, usually resulting from a sudden demand for a certain combination of width, length, and grade, are accommodated by transferring material from company sister mills and by purchasing lumber from competitors. Both these actions serve to reduce mill margins.

The situation is exacerbated by over 400 SKUs consisting of eight different lengths, four varying widths, eight grades and two species. This variety of end products is also one reason for the large inventory in finished goods. Manufacturing fewer widths, lengths and grades would decrease process and information handling complexities. This would lead to a more streamlined flow from logs to the customer. Two potential candidates for this sort of streamlining would be the wide products (2x10 and 2x12) currently composing slightly less than 10 percent of production volume. These dimensions do command a price premium at times but their volume is small. The added effort to manufacture, segregate, track, and store these products may not be worthwhile. Furthermore, wide lumber is more prone to rapid degradation through cupping and checking. This relatively small volume of wide lumber could be easily converted to narrow stock in the primary breakdown process, albeit with some loss of recovery.

4.3.2 Value Added Flow – Kamloops Mill Future State

The future state discussed is referring to the time between the present and the major capital expansion which is planned to start in late 2007, but is by no means certain. The future state explored in this scenario could be achieved without the infusion of major capital discussed in Chapter 3.

The objective of the future state value flow is to reduce or eliminate wherever possible non-value added (NVA) activities. One of the most obvious areas of NVA is inventory. Decreasing overproduction at inventory points would improve the lead time from log to lumber. Less lead time would lead to quicker response to customer demand which is a value added attribute. A proposed future state value stream is shown in Figure 4.5. The significant features of this future
state are the lack of an integral log yard; much less inventory in front of the major processing sub-units, and a lower value added processing time.

Figure 4.5: Kamloops Site Future State Value Added Flow Chart

![Flow Chart Image]

Source: Adapted from “Learning to See”, Rother and Shook, 2003.

Process times would have to decrease in the future state to meet the new takt time. Figure 4.6 shows proposed future state process times. Note also that uptime has increased from the current state in most processes, most notably the planermill. Overall process time is reduced by one third from the current state. The greatest reduction in cycle time is the elimination of the log yard by contracting out this function. Non value added time is decreased by 77 percent from 51.6 to 12 days by reducing inventory levels.
The largest amount of lead time is in the log yard. An average of 31 days of log inventory valued at $3,500,000 is the biggest contributor to lead time and forms a large component of working capital. Log handling costs are estimated at $2.15/\text{m}^3$ for current log yard operations. There are several alternatives to the present log yard situation.

Log yard activities could be contracted out to an external sort yard agency, similar to what was done with the logging and hauling function. A contractual document specifically detailing mill requirements would be crucial to the success of such a venture. The benefits of contracting out this function would be numerous. An incentive clause in the contract could be structured to keep log inventory at a minimum. The site would no longer have to contend with maintaining and operating heavy mobile equipment such as log loaders and button tops. The repair bills for this equipment are currently estimated at $150,000/annum, exclusive of on-site labour. The complement of heavy duty mechanics could be reduced from its current level of five to two reducing annual costs by an additional $255,000. Losses from log breakage would be less since potential bidders for this work would have more experienced and skilled operators. The contract would also be structured to include escalating penalties for log waste. These benefits would be offset by the costs of contracting out which are estimated at $1,200,000/annum. This change could be implemented under the current logging practices where mixes of long and short logs are
delivered to the site. There are added transaction costs and potential hold up issues associated with contracting out. These would be balanced by the reduction in working capital, and a potentially more reliable operation.

A variation on this theme would involve cut-to-length (CTL) timber being delivered to the mill site. With this option the site could either operate the log yard as an integral part of the unit, or contract out the log yard function. Logs would have a maximum length of 16' or 20' and require no additional bucking at the site. This would eliminate the need for six bucking saw operators saving approximately $500,000/annum. The current log decks and cut-off saws are also a major maintenance expense, estimated at $150,000/annum.

With projected future increased production, the existing obsolete bucking systems would become the sawmill constraint requiring replacement over the next three years at a cost of $12,000,000.

Currently bucking is fully manual. Recovery losses from not having a bucking optimization system are conservatively estimated to be at least 0.006 mbf/m³ valued at $900,000/annum. Cut-to-length logs are optimized in the bush by the de-limber before they are bucked. These systems are reasonably accurate in providing the optimum bucking recovery.

There would be less breakage and log handling with the CTL option. Most breakage occurs due to handling a mix of short and logs. A large percentage of CTL logs would be unloaded directly onto the mill's infeed decks reducing log inventory requirements. There is a six month lead time for converting to CTL and an estimated additional cost of $2/m³.

While planermill throughput has improved slightly over the past year, it remains the site bottleneck and requires an additional 33 operating hours per week to keep dry rough inventory levels manageable. The future state will require at least a 17 percent improvement in planermill uptime. This would eliminate the additional planer shift reducing production costs by
$1,200,000/annum as well as significantly reduce inventory variability and levels. As mentioned in Chapter 2, the longer term intent is to run two planermill shifts for three sawmill ones. This will only be achievable through a new planermill.

A dry lumber and finished goods supermarket could be used at the input and outputs of the planermill since this sub-unit is still the pacemaker of the lumber manufacturing process. The supermarket would schedule rough dry lumber for planing in “kanban size” units, typically a package or half pack plus an additional quantity to account for trim loss. The planer would then produce into a finished goods supermarket where shipping could draw their orders. As finished lumber is shipped, internal kanbans are created demanding additional product from the planer. An automated system called Lumber Track already exists on the furnished goods side to coordinate customer orders with planermill production and finished goods inventory. This system could be extended to cover the rough dry yard stock.

Kiln processing time would be reduced by sorting out dry lumber in the sawmill, thereby enabling shorter drying times for these products.

Sawmill process time would be reduced by shortening the C-frame process cycle and introducing super critical speed sawing at the CNS.

Process reliability improvements at the trimmer/sorter would reduce downtime and contribute improved, balance flow.

A pure pull from log yard to the customer would be difficult to establish. To be a true pull system it would have to extend from the tree stump to the home builder. Detailed foreknowledge would be required of log lengths, diameters, shape characteristics and quality to forecast the probable output volumes of various lumber dimensions and quality. Drying degrades would require accurate forecasting. Processes would have to be extremely stable with little variation. There are
several software companies who purport to have such systems but none have yet been successfully implemented.

4.4 Summary

The eight forms of waste identified in lean manufacturing are present in many activities and in different areas of Kamloops lumber. These have been highlighted in this chapter and some potential solutions for reducing or eliminating these wastes have been suggested.

The following tables summarize the opportunities identified together with proposed actions to decrease or eradicate non-value added and waste generating practices and process elements.

Table 4.2: Log yard Waste Reduction Opportunities – Losses, Costs, and Benefits

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Log yard process waste from excessive handling and breakage</td>
<td>All losses in Thousand $</td>
<td>1. CTL or 2. Contract out 3. Reduce log handling with standardized procedures</td>
<td>1. 0.002/m³ 2. 1.2 3. Log yard improvement team – 2</td>
<td>1. Combined benefit with sawmill bucking – see sawmill table 4.3. 2. 200 3. 75 in recovery gain</td>
</tr>
<tr>
<td>Waiting &amp; transport costs</td>
<td>50</td>
<td>Analyze log yard traffic and storage patterns</td>
<td>Time for log yard team input – 2</td>
<td>48</td>
</tr>
<tr>
<td>Inventory</td>
<td>5,700 working capital</td>
<td>Synchronize log delivery rates with consumption</td>
<td>Coordination with Woodlands group – no cost</td>
<td>Reduction of 5,700 working capital</td>
</tr>
<tr>
<td>Log quality</td>
<td>2 pts of recovery = 300/annum Value loss undefined</td>
<td>Renegotiate log quality standards with Woodlands</td>
<td>Woodlands would have to pursue this with their contractors</td>
<td>300 – unknown costs of leaving NVA in the bush.</td>
</tr>
</tbody>
</table>

Source: Author
Priority should be given to reduce waste involving fibre loss as this is the largest single component in COGS. Log breakage and log quality are the two major recovery and value losses. Standardized procedures are a no cost action which would yield some quick benefits and should be started immediately. Inventory reductions, CTL and log quality changes will require longer term negotiations with suppliers but will see the greatest eventual gains.

Table 4.3: Sawmill Waste Reduction Opportunities – Losses, Costs, and Benefits

<table>
<thead>
<tr>
<th>Waste</th>
<th>Loss/annum due to waste</th>
<th>Action to eliminate/reduce waste</th>
<th>Cost/annum to eliminate/reduce waste</th>
<th>Benefit/annum waste reduction/elimination.</th>
</tr>
</thead>
<tbody>
<tr>
<td>All losses in Thousand $</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poor manual bucking decisions</td>
<td>1. Six points of recovery at 900 and 7 FTEs for 610</td>
<td>1. CTL</td>
<td>1. 0.002/m³ This benefit would be combined with log yard waste reduction</td>
<td>1. Function of annual cut. 2007 forecast benefit of 320</td>
</tr>
<tr>
<td></td>
<td>2. Six points of recovery at 900</td>
<td>2. Optimized bucking system</td>
<td>2. Six million capital</td>
<td>2. ROI = 7%</td>
</tr>
<tr>
<td>Multiple machine centres for large log line</td>
<td>150 maintenance 765 labour 20 points of recovery = 3,000. 150 mmbf of production = value is a function of future log cost and lumber prices</td>
<td>1. Reduce waste - eliminate canter from process 2. Eliminate waste - replace large log line</td>
<td>1. No Cost - 2. Seven million for new large log line</td>
<td>1. 100 reduction in cost 2. ROI = 32% Proceed when approval received from corporate</td>
</tr>
<tr>
<td>Scanner errors</td>
<td>20 in value and recovery</td>
<td>Standardize procedures for scanner cleaning and value table updates</td>
<td>No cost</td>
<td>10. Assume improvement will result in a 50% improvement</td>
</tr>
<tr>
<td>Kiln Stick breakage</td>
<td>200</td>
<td>Replace with more durable kiln sticks i.e. plywood</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Overproduction choking the trimmer</td>
<td>235</td>
<td>1. Regulate production at CNS and C-frame 2. Replace trimmer lumber handling system with state-of-the-art technology</td>
<td>1. No Cost 2. 450</td>
<td>1. 135 2. ROI = 38%</td>
</tr>
<tr>
<td>Loss/annum due to waste</td>
<td>Cost/annum to eliminate/reduce waste</td>
<td>Benefit/annum waste reduction/elimination</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------------------</td>
<td>-------------------------------------</td>
<td>------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Waiting for logs at C-frame and CNS</td>
<td>Improve log sorting and delivery of logs through performance management</td>
<td>No Cost</td>
<td>200</td>
<td></td>
</tr>
<tr>
<td>Edger Rework</td>
<td>Redesign edger wood flow</td>
<td>200</td>
<td>ROI = 70%</td>
<td></td>
</tr>
<tr>
<td>Excessive Inventory</td>
<td>Synchronize sawmill - kiln - planermill production as per future state</td>
<td>Analysis by sawmill &amp; planermill superintendents and coordination with product supply manager</td>
<td>Improved customer service, less working capital</td>
<td></td>
</tr>
<tr>
<td>Compressor waste</td>
<td>Fix leaks, remove air wands from clean-up</td>
<td>5</td>
<td>42</td>
<td></td>
</tr>
<tr>
<td>NVA operators at secondary processing</td>
<td>1. Modify/ replace lug loader 2. Convert sorter to pusher style 3. Modify stacker 4. Train truck operators to empty chip and sawdust bins</td>
<td>900</td>
<td>ROI = 72%</td>
<td></td>
</tr>
<tr>
<td>Miss-manufactured lumber</td>
<td>Value not currently tracked but conservatively estimated at 0.001/mbf or 210 for 2006</td>
<td>Standardize response to manufacturing defects</td>
<td>No cost</td>
<td>Recover half the value degrade = 105</td>
</tr>
<tr>
<td>Poor chip quality - loss of chip bonus</td>
<td>1.2 million</td>
<td>Standardize procedures for cleaning screens and chip testing</td>
<td>No Cost</td>
<td>300 – still assumes 3 months potential loss of revenue</td>
</tr>
<tr>
<td>Sawdust revenue</td>
<td>960</td>
<td>Standardize procedures for barker maintenance and monitoring</td>
<td>No Cost</td>
<td>320 – still assumes loss of revenue for 1/3 of year</td>
</tr>
</tbody>
</table>

Source: Author

Again, activities that provide added recovery should be considered first. Of those, the “no cost” or “low cost” yielding the largest cost/benefit would have the highest priority. Loss of income from by-products significantly affects cash flow and should be addressed immediately.
Table 4.4: Kilns Waste Reduction Opportunities – Losses, Costs, and Benefits

<table>
<thead>
<tr>
<th>Waste</th>
<th>Loss/annum due to waste</th>
<th>Action to eliminate/ reduce waste</th>
<th>Cost/annum to eliminate/ reduce waste</th>
<th>Benefit/annum waste reduction/elimination</th>
</tr>
</thead>
<tbody>
<tr>
<td>All losses Thousand $</td>
<td>250</td>
<td>1. Organize lumber yard on FIFO basis 2. Band rough lumber.</td>
<td>1. No cost 2. 60</td>
<td>1. 100 2. ROI = 70%</td>
</tr>
<tr>
<td>Excessive transportation of lumber and storage degrade</td>
<td>2 million for gas</td>
<td>1. Install biomass energy system or 2. Pipe steam from pulp mill</td>
<td>1. Three million 2. Two million + 250 annual expense</td>
<td>1. ROI = 48% 2. ROI = 65%</td>
</tr>
<tr>
<td>Drying degrade</td>
<td>0.001/mbf = 200</td>
<td>Wet lumber sort in sawmill</td>
<td>150</td>
<td>ROI = 90%</td>
</tr>
</tbody>
</table>

Source: Author

Improvements in drying degrade are the greatest opportunity at the kilns. Organizing the lumber yard to operate in a FIFO mode has the greatest potential improvement for the least cost. The remaining actions will be longer term requiring moderate to significant capital.

Planermill waste reduction opportunities are shown in Figure 4.5. Grading errors represent the largest form of waste in the planer followed closely by planer downtime. The no-capital approach to reducing errors is to use visual help systems and continual feedback to the graders. The longer term solution is to go to fully automated grading which has been shown to produce a high ROI, but requires significant capital.
### Table 4.5: Planermill Waste Reduction Opportunities – Losses, Costs, and Benefits

<table>
<thead>
<tr>
<th>Waste</th>
<th>Loss/annum due to waste</th>
<th>Action to eliminate/reduce waste</th>
<th>Cost/annum to eliminate/reduce waste</th>
<th>Benefit/annum waste reduction/ elimination.</th>
</tr>
</thead>
<tbody>
<tr>
<td>All losses in Thousand $</td>
<td></td>
<td></td>
<td>All costs in Thousand $</td>
<td></td>
</tr>
<tr>
<td>NVA labour</td>
<td>385</td>
<td>Install automatic kiln stick recycling system</td>
<td>400</td>
<td>ROI = 55%</td>
</tr>
<tr>
<td>Planermill DT</td>
<td>3,000</td>
<td>Replace planer</td>
<td>4,000</td>
<td>ROI = 53%</td>
</tr>
<tr>
<td>Grading inaccuracy</td>
<td>900 wages 2 million value uplift</td>
<td>1. Use visual help system for graders 2. Install auto-grading system</td>
<td>1. No cost 2. Three million</td>
<td>1. 500 uplift 2. ROI = 67%</td>
</tr>
<tr>
<td>Grading rework</td>
<td>100</td>
<td>As per items 1 &amp; 2 in grading inaccuracy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased process complexity from large number of SKUs</td>
<td>200</td>
<td>Stop production of 2x12 and possibly 2x10</td>
<td>No Cost</td>
<td>Requires detailed analysis</td>
</tr>
<tr>
<td>Shipping Package damage</td>
<td>10</td>
<td>Standardize forklift operating procedures</td>
<td>No Cost</td>
<td>Conservatively cut waste by 50% equalling a benefit of 5</td>
</tr>
</tbody>
</table>

Source: Author

All of the waste reduction initiatives in Tables 4.2 - 4.5 would produce a total cost reduction of approximately $8 million resulting in a reduction in the CNOL of $37.74/mbf or 27%. Additional revenues of $2.9 million per annum would also be generated. While several of the proposed actions require high capital spending, others will use lean manufacturing tools and techniques to achieve savings. Lean methodologies will be discussed in Chapter 5 along with a proposed implementation schedule.
5 Manufacturing Improvement - Implementation and Benefits

Several tools and methodologies have been identified as being particularly relevant to implementing lean manufacturing (Womack and Jones, 1996). Continuous process industries in general have not significantly embraced lean manufacturing. Industries such as steel, oil, and pulp & paper assume they are already at a high degree of efficiency and would benefit little from lean practices.

The degree of relevancy of the various tools used for implementing lean in various industries was discussed by Abdulmalek et al. (2006). They hypothesized declining applicability of lean tools in continuous processes with low material variety and high product volumes. At some point in many continuous processes, the products become discrete items, such as coils of steel and bundles of pulp. At these points lean manufacturing methods become more applicable. Lumber manufacturing embraces high product volumes as seen from the discussion and analysis of economies of scale. There is a wide variety of lumber products and discrete steps in the process which would imply that there is opportunity to apply some of the concepts of lean to lumber manufacturing.

The following are some tools that would be more applicable in a semi-continuous process such as primary lumber production.

a. Value Stream Mapping (VSM): VSM involves mapping the production and sales process from the final customer to raw material acquisition identifying processing times, inventory storage, and information flow. The current state flow chart is then used to
recognize non value added (NVA) activities which are reduced or eliminated in the future state value added flow (see 4.3.1 and 4.3.2)

b. **Visual Systems (VS):** The levels of production at the different workstations at the lumber mill need to be regulated to ensure various workstations do not get either overloaded with, or starved for material. Visual indicators such a level lines of different colour on lumber landing tables or visual displays could be used for this purpose. Visual systems would also prove extremely useful for maintenance in displaying timing and alignment marks on equipment.

c. **5S:** This comprises waste reduction by sorting, straightening, sweeping, systematizing and standardizing. Assists with prevention of downtime caused by scrap lumber and debris causing process upsets.

d. **Work Standardization (WS);** WS ensures that jobs are organized and completed to a consistent quality standard. This would be particularly relevant to: lumber graders, cut-off saw operators, lumber stackers, and drop-sort operators.

e. **Single-Minute-Exchange-of-Die (SMED):** SMED analysis reduces product changeover times and tool set-up. This would be applicable in the case of routine knife, saw, and debarker tool changes, lumber dimension changes in the planermill, kiln charge changeovers, and specie changeover.

f. **Line Balancing (LB):** The non-homogeneous nature of logs results in a high level of production variability due to variations in length, diameter, and shape. Keeping two primary sawmill production lines continually supplied with timber of the appropriate size is a challenge. At times, the resultant lumber tends to overwhelm the secondary breakdown system at the trimmer and edger.

g. **Production Smoothing/Levelling:** There is a significant variation in daily sawmill production. This requires excessive inventory to ensure customer requirements are met. A more reliable, repeatable production process would reduce this form of waste.
h. **Kaizen:** Kaizen is a translation of “change for the better” from Japanese and refers to the formation of small groups of operators, maintenance personnel, and site leadership highly focused on improving a process step to enhance continuous flow. These groups would be formed quickly and be disbanded once the issue is resolved. One week is considered a normal term for a kiazen group. The unit has had machine centre teams in the past. While these have been effective in pointing out problems and suggesting solutions, the suggestions have fallen short of implementation.

i. **Total Productive Maintenance (TPM):** This would be perhaps the tool of greatest benefit at the Kamloops site. Being an old mill, process reliability is the greatest challenge in maintaining production. TPM is an all encompassing process involving both operators and maintenance trades in monitoring, diagnosing, repairing, and maintaining equipment.

j. **Autonomation:** Autonomation is automatic process shutdown upon detection of a defect. This would prevent a tremendous amount of waste from occurring in the sawmill and planer. There have been numerous instances over the past year where lumber has been fabricated under size or miss-graded. With peak process speeds of 1 mbf/min., a large quantity of miss-manufactured lumber accumulates quickly. At best, this lumber would have to be re-manufactured, and at worst, it would go to chips or hog.

k. **Just-in-Time (JIT):** JIT involves manufacturing or delivering a product or raw material in the right quantity just in time for when it is needed. JIT is intended to reduce or eliminate inventory. Although a laudable goal, the lumber industry is not at the stage where JIT is practicable. Log inventories must be built up to high levels prior to spring break-up when logging comes to a standstill for four to six weeks. The lumber market is still largely push based where much of the product is sold on the commodity spot market.

The future state production process can be broken down into three inter-connected flows or value stream loops: supplier, sawmill/drying, and planing/shipping.
5.1 Lean Tools for Planing and Shipping – The Pacemaker Loop

Planing/shipping is the most downstream loop and can be considered the process pacemaker. It determines the takt time as discussed in Chapter 4 and governs the flow of lumber and information between the site and the final customer.

Low planermill utilization is currently one of the major opportunities for the site. The planermill has a mean-time-between-failure (MTBF) of approximately three minutes. This has resulted in a utilization rate of 54 percent and required a fourth planermill shift. Most of the reasons for low utilization were discussed in the causes of waste in Chapter 4.

One goal for the planermill/shipping loop is to raise utilization to the point where the additional planer shift can be eliminated. This is reflected in the future state value stream and is a cost reduction of $1,200,000 in wages for the site, equivalent to a reduction of 5.64 $/mbf or four percent of the current CNOL. Improved utilization will also enable rough dry and finished goods inventory reductions since a more reliable process will permit better production forecasting and lessen the necessity for safety stocks.

The lean tools to achieve better utilization in the planermill environment are; 5S, Total Productive Maintenance (TPM), SMED, kaizen, work standardization and autonomation. The most significant results of improved reliability would be getting closer to JIT inventory levels and the elimination of the fourth shift.

TPM has the potential to vastly improve uptime at the planermill. This concept is particularly relevant under current operating conditions. With the planer running 149 out of a possible 168 hours per week, there is a minimum amount of planned downtime available for maintenance. TPM emphasizes operations centred reliability. It uses operators to perform minor maintenance tasks and extensively involves them in troubleshooting activities. The current site culture may make this process difficult to implement plant wide since there is some animosity between the
trades and machine operators. The planermill would be a good sub-unit to initiate TPM. The number of planer persons who maintain the equipment is relatively small at four as compared to the site millwright complement of 20. These individuals already work fairly closely with the operators and would most likely be willing to enable operators to assume a greater maintenance role. Operators in the planermill clear planer jam-ups, perform minor maintenance on the MSR, and, at times assist planer men. The planermill is the one place on the site where TPM would have a chance of succeeding.

Much of the downtime in the planer is caused by poor housekeeping. Slivers and other wood debris are caught in the planer machine causing jams. Broken pieces of lumber are often not cleared from lumber landing tables resulting in skews and cross-ups which stop the process. Improved housekeeping through a 5S program would go far to rectify this situation and also result in safer planermill. The site recently embarked on a major clean-up program primarily in anticipation of a VIP visit. Extending this momentum would be possible through a 5S type of initiative.

The planer has changeovers for running different widths, splitting 2x8 into 2x4s and when changing from one length to another. In terms of set-up time, split stock is the most time-consuming at 40 – 50 minutes; width changes take 25 – 25 minutes, and length changes five minutes. Knife changes which occur from foreign object damage or due to dulling take 30 minutes. All of the aforementioned activities could benefit from a systematic SMED analysis to reduce NVA process time.

Kaizen teams could be used to address the many chronic upset conditions which permeate the planermill. The main caution here would be to ensure that the teams work on the issues that will yield the greatest returns and deliver concrete results over a short time period. There are on-going initiatives in the planermill to rectify process outages that involve changes to equipment.
hardware. These have been managed by the site leadership with some input from operating personnel. If successful, these improvements will be likely be embraced by the workers. Should positive results fail to materialize; operators and maintainers will rapidly become disillusioned with future management initiatives.

A kaizen type team approach should be a better means of addressing these issues by involving all persons most closely associated with the problem. The joint solutions should receive better buy-in from all.

Work standardization is already in use at the planer but there is opportunity to expand the current applications. Two major downfalls in the planermill quality arena are grading and packaging. Value loss in terms of over grade is difficult to quantify precisely, but constitutes at least several $100,000 per year. Below-grade lumber represents a loss of credibility and loyalty with customers, as well as potential law suits. In the extreme case, loss of the mill’s grade certification would likely cause plant closure until re-certification. The site has sent a QC person to customer sites to placate and reimburse customers for these products. To avoid miss-grading, the unit’s QC person and planermill supervisors spend considerable time performing grade checks, and providing coaching and feedback to graders. A system informing graders of their standard performance relative to their peers and to their own long term grade averages would alert them to potential drift and outages in their grading.

Planer setup is another area which could benefit from standard work practices. Each of five planer maintenance personnel currently uses a slightly different procedure and standard when setting up and aligning the planer machine. One unified standard practice, i.e. the right way as opposed to my way, would result in fewer process stoppages and a better quality of planed boards.

Lumber packaging standards are critical to ensure the correct grade is shipped to the right customer. Currently packages are checked by the press operator and again in shipping. Despite
these efforts errors have occurred where the label misrepresented the package contents and the wrong lumber has been delivered to a customer. Standard practices re-enforced by performance management would reduce these errors.

Autonomation has great potential for waste reduction in the planermill. There are already some applications in automatic length detection which will stop the process should there be an inconsistency between trim decisions and the actions of the trim saws. Real-time size control alerts operators through a visual message and supervisors through a paging system of width and thickness outages, but it does not stop the process. There is currently no detection system for missing grade or inadequate grade stamps which necessitates the re-grading of lumber. The technology exists for such as sensor.

All the aforementioned processes and tools would reduce planermill waste.

5.2 Lean Tools for the Log Yard – The Supplier Loop

The supplier loop is comprised of forestry, loggers, haulers, and log yard. The first three activities are managed by the woodlands group within the company with some mill input. These activities have a large effect on the two downstream value loops. As discussed in Chapter 4, log quality is one of the most influential variables on process reliability with concomitant effects on costs, lumber recovery, and productivity. Closer collaboration with forestlands in the future is imperative to smooth the log delivery volumes in order to reduce inventory; to raise log quality standards; and to devise innovative solutions for rising log defect rates. This last issue in particular will grow over the next three years with increasing harvests of MPB wood. These logs have numerous poor properties such as dry shake (cracks) affecting lumber recovery and grade, and poor debarking properties that lower the value of chips and sawdust.
A detailed current and future state value stream map of forestry, logging, and hauling processes would help to identify wastage in these areas and lower the cost of logs to the mill.

Although it was suggested in Chapter 4 that the log yard would be contracted out in the future state proposal, it can benefit from using several of the lean tools whether this function remains organic to the site or is contracted-out. One of greatest benefits to this area would be a better QC program such as six sigma coupled with work standards. The resultant improvement in log quality would be reflected in lower costs to the site and higher grade yields to the customer.

5.3 Lean Tools for the Sawmill/Kiln – The Critical “meat in the sandwich” Loop

A detailed current and future state sawmill value stream map would serve to better identify value added functions and potential areas for improvement.

The sawmill is the worst area on the site for housekeeping. A 5S program would definitely be an advantage in maintaining the cleanliness and orderliness in the plant as well as improving site safety and morale. Most of the wood waste is generated at this sub-unit and the plant layout that is not conducive to clean-up. It will be a struggle to get to the 5S “sorted, straightened, swept, systematized and standardized” state.

The sawmill’s greatest challenge is load balancing and production smoothing/levelling. Both operational and maintenance shortfalls adversely affect the smooth, even flow of material. The bottleneck is presently at the trimmer/sorter, where frequent stoppages result in material build-up from the two upstream primary breakdown processes causing frequent stoppages. This area could benefit from Kaizen with operators, maintainers and engineers. A machine centre team was formed for this equipment in the past. Many ideas were put forth but little action was forth-
coming. A kaizen team with a clear mandate and resources must be revived with emphasis on achieving results.

Lack of logs is the major cause of down time at the C-frame. An action team comprised of log yard, cut-off saw, debarker and C-frame operators would be able to resolve the many issues contributing to this production shortfall.

There are opportunities to use visual methods, work standards and autonomation to improve flow through the sawmill.

Autonomation is already in partial use. The upstream processes are shut down when lumber levels at the trimmer in-feed reach a certain level. A proactive approach is required to slow processes down when overload appears imminent, rather than forcing a complete stoppage. Once stopped, there is lag time for the C-frame and CNS to start operating again.

Currently, Job Safety Plans (JSP) detail operating procedures at all work stations. There is still considerable leeway for operators to make decisions which result in the process running slower or faster. Documenting and standardizing the best of these unwritten operating practices would enable all three shifts to run more consistently.

Visual systems would find particular applicability in the maintenance department with machinery alignment and timing.

SMED principles would be applicable to improving specie change over times, knife and saw changes.

In the kilns SMED would benefit the lumber loading and unloading changeover process.
5.4 Analysis of Manufacturing Improvement Benefits

Benefits accruing to the corporate shareholders from the Kamloops site can be considered in terms of improving the value-added components of income generating actions and eliminating or reducing the non value adding activities or waste thus reducing costs.

Considering the relative component costs of lumber manufacturing as presented in Figure 5.1, the priority of waste elimination should start with extracting the greatest value from the raw material. Labour being the second highest cost would be next on the priority list followed by supplies/equipment and then inventory. Energy, at six percent of COGS, is the least of the variable cost components in ranking. The values of these components are presented in Figure 5.1.

Figure 5.1: Kamloops COGS Components -$US/mbf - June 2006 YTD

Source: Author

The opportunities for various waste reduction activities in terms of costs for different log yard operating scenarios are presented in Table 5.1. These benefits are estimated relative to current operating rates and conditions.
Table 5.1: Costs of Log yard Waste for Four Operating Options

<table>
<thead>
<tr>
<th>Waste Reduction Opportunities</th>
<th>WASTE COSTS $1000/ANNUM</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Status Quo</td>
</tr>
<tr>
<td>Broken log and debris reduction</td>
<td>310</td>
</tr>
<tr>
<td>Waiting and Transportation</td>
<td>50</td>
</tr>
<tr>
<td>Inventory variation</td>
<td>100</td>
</tr>
<tr>
<td>Log quality improvement</td>
<td>200</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>660</strong></td>
</tr>
</tbody>
</table>

Source: Author

As can be seen from Table 5.1, the status quo has the highest cost of waste and conversely the greatest opportunity for waste reduction. Contracting out the log yard function was estimated to reduce waste costs by 35 percent although there could be additional transaction costs and other risks. Cut to length appears to be a good opportunity. Waste costs are 48 percent of the status quo and 65 percent of contracting out full length stem operations. There is little difference in waste reduction between the CTL and contracted-out CTL.

Options for improving the sawmill operation are incremental until a major capital expansion can be carried out. These incremental improvements are vital as they will demonstrate to the corporation that the site has the desire to embrace change. Most of these changes as presented in Table 5.3 are low to no capital and involve work system and projects to eliminate process down time. Successful implementation will result in a 20 percent increase in production, of which approximately 18 percent will be from recovery improvements. The remaining two percent will come from increased throughput rates as a result of improved process reliability.

Kiln process rates can keep up with this increased sawmill activity via shorter drying cycles (resulting from lumber that is moisture sorted at the sawmill) and reduced load transfer times.
The planermill will present the greatest challenge for the interim until a new planer is purchased. The actions listed in the implementation schedule should improve throughput to equal the sawmill rate by the end of January 2007. Should the total benefit not materialize, the improvement should be sufficient to make up the shortfall with minimal overtime. This will enable the long sought abandonment of the fourth shift. Some of the other improvements listed in Table 5.5 plus those discussed under lean tools will result in better grading accuracy.

### 5.5 Kamloops Improvement Implementation Schedule

Some of the actions to eliminate waste can be implemented relatively quickly while others will require training and a change in the site culture. Capital improvements will be a function of the corporate willingness to invest in the site. The proposed actions to increase productivity, lower costs and improve quality are presented in Tables 5.2 to 5.7.

<table>
<thead>
<tr>
<th>Table 5.2: Kamloops Log yard Improvement Implementation Schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Action</strong></td>
</tr>
<tr>
<td>-------------</td>
</tr>
</tbody>
</table>
| Change to CTL from current full stem log delivery | July 07/Sep 07 | Mill Manager Forestry lands | 1. Reduce log yard waste and inventory  
2. Eliminate need for bucking area capital ($12,000,000) in 2009  
3. Reduce cost decrease manning levels at garage, log yard and bucking stations by 8 FTE  
4. Improve recovery through well defined log lengths |
| Investigate Benefits of contracting out log yard | Feb 07/Mar 07 | Mill Manager Log yard manager | 1. Less waste  
2. Better accountability |
| Improve log quality standards - six sigma | May 07/Oct | Log yard manager Forestry lands | 1. Less Waste  
2. Improved process reliability  
3. Better recovery  
4. More HVP lumber |
| Spaghetti plot of log yard transportation patterns | Jan 07/Jan 07 | Log yard manager | 1. Reduce transportation and waiting times  
2. Reduce fuel consumption |

Source: Author
<table>
<thead>
<tr>
<th>Action</th>
<th>Implementation Timeline Start/Complete</th>
<th>Responsibility Action lead is the first manager listed</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improve lumber flow at trimmer lug loader through machine centre team approach</td>
<td>Dec 06/Feb 07</td>
<td>Reliability Manager Sawmill Superintendent</td>
<td>1. Improve productivity 2. Reduce safety risks</td>
</tr>
<tr>
<td>Move C-Frame landing table closer to saws</td>
<td>Feb 07/Feb 07</td>
<td>Maint. Superintendent</td>
<td>Reduce cycle time Avoid cross-ups</td>
</tr>
<tr>
<td>Improve Debarking quality</td>
<td>Dec 06/ Feb 07</td>
<td>Reliability Manager Sawmill Superintendent</td>
<td>1. Improve value 2. Reduce waste 3. Avoid loss of chip/sawdust revenue</td>
</tr>
<tr>
<td>Provide bucking standards to COS operators</td>
<td>Jan 07/Jan 07</td>
<td>Sawmill Superintendent</td>
<td>1. Reduce waste 2. Increase value 3. Improve recovery</td>
</tr>
<tr>
<td>Implement visual system of lumber level control on lumber landing table</td>
<td>Feb 07/Feb 07</td>
<td>Maint. Superintendent Process Control Tech</td>
<td>1. Reduce waiting time at C-Frame, edger and CNS. 2. Improve uptime at trimmer station.</td>
</tr>
<tr>
<td>Retro-fit CNS for Super Critical sawing</td>
<td>Mar 07/Apr 07</td>
<td>Reliability Manager</td>
<td>1. Increased productivity 2. Improve recovery</td>
</tr>
<tr>
<td>Improve lumber flow to edger</td>
<td>Apr 07/May 07</td>
<td>Reliability Manager Sawmill Superintendent Maint. Superintendent</td>
<td>1. Productivity 2. Overtime cost reduction</td>
</tr>
<tr>
<td>Remove Canter from Large log line process</td>
<td>Jan 07/Jan 07</td>
<td>Sawmill Superintendent Maint. Superintendent</td>
<td>1. Reduce cycle time 2. Improve Quality 3. Increase Recovery 4. Reduce cost eliminate 3 FTE</td>
</tr>
<tr>
<td>Replace lug loader system</td>
<td>May 07/June 07</td>
<td>Engineering Manager Maint. Superintendent</td>
<td>1. Improve safety 2. Reduce Downtime</td>
</tr>
<tr>
<td>Improve sorter performance Through Kaizen</td>
<td>May 07/June 07</td>
<td>Reliability Manager Sawmill Superintendent Maint. Superintendent</td>
<td>1. Improve productivity 2. Reduce cost - eliminate 3 FTE</td>
</tr>
<tr>
<td>Sawmill Capital Upgrade</td>
<td>Oct 08/ Sep 09</td>
<td>Mill Manager All Leadership</td>
<td>Increase recovery, production, quality, reduce costs</td>
</tr>
</tbody>
</table>

Source: Author
### Table 5.4: Kamloops Kilns Improvement Implementation Schedule

<table>
<thead>
<tr>
<th>Action</th>
<th>Implementation Timeline Start/Complete</th>
<th>Responsibility Action lead is the first manager listed</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMED Analysis of kiln charge load/unload process</td>
<td>Dec 06/Dec 06</td>
<td>QC Manager Reliability Manager</td>
<td>1. Reduce Drying cycle time</td>
</tr>
<tr>
<td>Spaghetti plot of rough yard forklift traffic</td>
<td>Dec 06/Dec 06</td>
<td>Reliability manager</td>
<td>1. Reduce waiting time 2. Reduce fuel wastage.</td>
</tr>
<tr>
<td>Sawmill wet/dry sort of rough lumber</td>
<td>Mar 07/Apr 07</td>
<td>Process Control Tech QC Manager Sawmill Superintendent</td>
<td>1. Reduce Drying cycle time 2. Lower energy costs 3. Improve quality rough dry lumber</td>
</tr>
<tr>
<td>Investigate alternate energy sources for Kilns</td>
<td>Aug 07/Sep 07</td>
<td>Engineering Manager</td>
<td>Reduce energy costs</td>
</tr>
<tr>
<td>Capital upgrade of 4 new Kilns</td>
<td>Mar 08/Oct 08</td>
<td>Mill Manager All Leadership</td>
<td>Increase throughput</td>
</tr>
</tbody>
</table>

Source: Author

### Table 5.5: Kamloops Planermill Improvement Implementation Schedule

<table>
<thead>
<tr>
<th>Action</th>
<th>Implementation Timeline Start/Complete</th>
<th>Responsibility Action lead is the first manager listed</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Install pressure feedback system on planer infeed</td>
<td>Nov 06/Nov 06</td>
<td>Engineering Manager Maint Superintendent</td>
<td>1. Reduce lumber breakage waste 2. Improve utilization</td>
</tr>
<tr>
<td>Decrease lug pitch at grading stations</td>
<td>Dec 06/Dec 06</td>
<td>Reliability Manager Maint Superintendent</td>
<td>Improve grading accuracy</td>
</tr>
<tr>
<td>Replace MSR accelerator</td>
<td>Feb 07/Mar 07</td>
<td>Reliability Manager Maint Superintendent</td>
<td>1. Improve utilization 2. Reduce breakage</td>
</tr>
<tr>
<td>Increase grading accuracy using standardized practices</td>
<td>Dec 06 – continuous improvement</td>
<td>Planer Superintendent</td>
<td>Increase value</td>
</tr>
<tr>
<td>Raise landing table at MSR and bypass</td>
<td>Nov 06/Nov 06</td>
<td>Engineering Manager Maint Superintendent</td>
<td>Improve utilization</td>
</tr>
<tr>
<td>Replace MSR with newer unit from Drayton Valley</td>
<td>Mar 07/Mar 07</td>
<td>Engineering Manager Maint Superintendent</td>
<td>1. Improve value 2. Increase utilization</td>
</tr>
<tr>
<td>Install CRIQ auto-grading system from Drayton Valley</td>
<td>Mar 07/Mar 07</td>
<td>QC Manager Engineering Manager Maint Superintendent</td>
<td>1. Grade up-lift 2. Lower trim loss</td>
</tr>
<tr>
<td>Capital upgrade of planermill</td>
<td>Jun 07/Nov 07</td>
<td>Mill Manager All Leadership</td>
<td>1. Increase throughput 2. Reduce costs 3. Raise productivity</td>
</tr>
</tbody>
</table>

Source: Author
Table 5.6: Kamloops Shipping Improvement Implementation Schedule

<table>
<thead>
<tr>
<th>Action</th>
<th>Implementation Timeline</th>
<th>Responsibility Action lead is the first manager listed</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standardize work practices to avoid damaging finished lumber packages</td>
<td>Dec 06/Dec 06</td>
<td>Shipping supervisor</td>
<td>Reduce waste</td>
</tr>
<tr>
<td>Analyze forklift traffic and yard layout</td>
<td>Jan 07/Jan 07</td>
<td>Shipping supervisor</td>
<td>Reduce fuel consumption</td>
</tr>
<tr>
<td>Add rail spur</td>
<td>Jul 08/Sep 08</td>
<td>Engineering manager</td>
<td>Increased throughput</td>
</tr>
</tbody>
</table>

Source: Author

There are several systemic improvements that are applicable site wide that will reduce costs and increase throughput. These are listed in Table 5.7.

Table 5.7: Kamloops Systemic Improvement Implementation Schedule

<table>
<thead>
<tr>
<th>Action</th>
<th>Implementation Timeline</th>
<th>Responsibility Action lead is the first manager listed</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduce Inventory levels</td>
<td>Jan 07/Mar 07</td>
<td>Mill Manager Production Superintendents</td>
<td>Decrease customer lead time</td>
</tr>
<tr>
<td>Energy conservation a. Mobile equipment b. Electricity c. Compressed air</td>
<td>Nov 06 – continuous improvement</td>
<td>Reliability manager Production Superintendents</td>
<td>Reduce costs</td>
</tr>
<tr>
<td>Institute 5S program</td>
<td>Jan 07 –continuous improvement</td>
<td>Reliability manager Production superintendents</td>
<td>1. Improve Safety 2. Reduce waste</td>
</tr>
<tr>
<td>Reduce product SKUs</td>
<td>Apr 07/ Jun 07</td>
<td>Mill manager Product Supply Manager iLevel Sales</td>
<td>Better production flow</td>
</tr>
</tbody>
</table>

Source: Author

The actions listed in the above tables are heavily front end loaded to this year. Many are planned for November since the mill will be taking two weeks of downtime for market conditions over this period. The corporate decision concerning the future of the site will likely take place early in 2007. To make a favourable impression on the decision makers will require a good showing in all of the critical metrics over the next several months. The activities which are planned from November 2006 to March 2007 are intended to make the greatest impact on these measures.
6 Summary and Recommendations

The Weyerhaeuser Kamloops Lumbermill is currently undergoing an extremely difficult period in its evolution. With lumber prices now at their lowest point in the economic cycle, the mill is being forced to take downtime to save costs and reduce market oversupply.

The unit has demonstrated that economies can be realized through capacity utilization and that it is currently operating at close to its minimum short run average cost point. Major capital would be necessary to benefit from the economies of scale that could be realized from an expansion in capacity. There are long term plans for such an expansion; however, the mill is obligated to address the immediate situation of surviving through the lumber markets cyclical downturn which is currently at a twenty year historical low as measured by real lumber prices.

It must continue to demonstrate, as never before, that it is worthy of major corporate capital. The mill is currently in a state of metamorphosis with labour relations at a hiatus and its safety record at an unenviable level. Weyerhaeuser’s organizational structure and culture have numerous franchise requirements which somewhat inhibit the autonomy of the site to change rapidly. The value chain is highly vertically integrated, which at times results in sub-optimizing mill operations. The mill organization has opportunities for improvement with not enough responsibility with the commensurate accountability devolved to the individual workers. This is as a result of the long union culture of entitlement which has only very recently begun to change.

The Kamloops mill has seen significant improvements in production, productivity, cost reduction, and recovery over the past nine months. These have not been sufficient to avoid temporary closure for current market conditions. The site’s safety record and labour relations have
deteriorated considerably at the same time. While the improvements and detractions are somewhat counterbalancing, the corporate tolerance for the latter is very low. The corporation has informed the unit that it is facing the “close, fix or sell” decision in the imminent future. The obvious desire of the mill is to pursue the “fix” option. To convince the CEO that this is the most viable course of action will require swift and compelling actions. There is a significant opportunity to rapidly improve the cost effectiveness and add value to the operations at the Kamloops site using lean manufacturing analysis and tools combined with some low capital engineering projects.

Cutting back production to the minimum unit cost capacity utilization is recommended as an alternative to shut down. With low lumber prices, and the present cost structure, the mill cannot avoid some temporary downtime in the near future.

The aim of this project was to identify strategies and actions that could raise this mill to a top quartile performer. The following are recommendations which will further this goal:

a. Restructure the organization with fewer upper level managers and devolve more decision making responsibility to the floor level.

b. Improve communications between hourly associates and leadership.

c. Either contract out functions such as log yard which might be better done by an external agency, or proceed to a CTL strategy for raw material.

d. Eliminate positions which do not add value such as bin attendants.

e. Reduce shifting at the planer as technical and work system improvements prove themselves.

f. Improve labour relations by being more consistent with the plant committee, setting standards for performance, and management and dealing with outages fairly and promptly.

g. Review site performance metrics at least monthly with all personnel.
h. Move the site constraint from the planermill with low cost improvements followed by a capital project to upgrade the equipment with current technology.

i. Reduce waste by implementing lean manufacturing principles and tools appropriate to the processes at the site.

j. Pursue the three year capital plan to bring the plant up to a current level of sawmilling technology.

k. Ensure that new production equipment is capable of flexible manufacturing to readily make products for niche markets that can be differentiated from commodities.

l. Produce fewer SKUs by eliminating low volume, slow moving products.

m. Reduce inventory levels by synchronizing production rates between the sub-units and trying to produce as close to the takt time as possible.

n. Replicate successes from lean manufacturing at other company sites through the SUVPC team concept.

The above recommendations should elevate the site into the top quartile of lumber producers in North America. With an upcoming shortage of good timber supplies, Kamloops is in a much better position than many mills in BC. The Thompson Valley wood basket has sufficient fibre to sustain the site at a 360 mmbf production level.

All that remains is the time, resources and above all, the will to make the mill into a lean machine team that will continue to grow and prosper in the future.

“Business is like a flower, you either grow or die” – Ken Iverson former CEO of Nucor
Bibliography


PriceWaterhouseCoopers, 2004 Benchmarking Survey of Canadian Lumber Mills, Confidential, Distribution to Participants Only.


