APPROACHES TO ASSESSING WAGE LOSS DURATION AT THE WORKERS' COMPENSATION BOARD OF BRITISH COLUMBIA

By

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ABSTRACT

The Workers' Compensation Board of British Columbia monitors the wage loss duration of claims processed by their organization in order to assess organizational effectiveness and track a system cost driver. Multiple methods of calculating and reporting claim wage loss exist within the organization and performance results depend on which metric is used. Using existing WCB claim data, new measurements of claim duration are proposed and a comparison of wage loss metrics is conducted.

The methods of wage loss measurement proposed in this study include predicted claim wage loss duration, cumulative wage loss paid to claims, claim age at closure identified using survival analysis, uncensored claim wage loss and the proportion of claims closed in the months following registration. These metrics are compared to the existing wage loss metrics which are retrospective wage loss duration and the Association of Workers' Compensation Boards of Canada complete duration.

A comparison of wage loss metrics indicates that claim durations vary depending on which calculation is used. Cumulative wage loss duration is found to be higher than either of the existing metrics. Age at closure and uncensored claim duration are higher than predicted wage loss duration but lower than existing metrics. Each of the proposed metrics is capable of identifying the effect of claimant age and injury type when wage loss durations are compared across sub groups of claims.

The study also indicates that in the current form, predicted wage loss duration does not accurately represent claim wage loss. The study identifies weakness in each method of computing claim wage loss and that depending on the use of the metric different measures may be appropriate. In some cases, using cumulative wage loss duration may be worthwhile to track longer claims. Uncensored claim duration and age at closure are more appropriate when comparisons of claim duration for different periods are required.
# TABLE OF CONTENTS

ABSTRACT .................................................................................................................. ii 
LIST OF TABLES ........................................................................................................ iv 
LIST OF FIGURES ....................................................................................................... v 
ACKNOWLEDGEMENTS ............................................................................................. vi 

1. INTRODUCTION .................................................................................................... 1 
   1.1. COMPANY BACKGROUND ............................................................................. 1 
   1.2. REHABILITATION AND COMPENSATION SERVICES .................................. 1 
   1.3. WAGE LOSS CLAIMS AND WAGE LOSS DURATION ................................... 2 
   1.4. PRELIMINARY PROJECTS ............................................................................ 2 
      1.4.1. ASTD Specialization Impact Analysis ..................................................... 2 
      1.4.2. Interior Business Guidelines Impact Analysis ........................................ 3 
   1.5. PROBLEM DESCRIPTION ........................................................................... 3 
      1.5.1. Retrospective Wage Loss Duration ....................................................... 3 
      1.5.2. AWCBC Duration ................................................................................ 4 
      1.5.3. Comparison of Retrospective WLD and AWCBC Duration .................... 5 
   1.6. PROBLEM STATEMENT SUMMARY ........................................................... 6 

2. LITERATURE REVIEW ............................................................................................ 7 
   2.1. DEVELOPING PERFORMANCE METRICS ................................................. 7 

3. ANALYSIS METHODOLOGY ................................................................................ 9 
   3.1. SOLUTION APPROACH ............................................................................... 9 
      3.1.1. Predicted Wage Loss Duration .............................................................. 9 
      3.1.2. Cumulative Wage Loss Duration .......................................................... 10 
      3.1.3. Claim Survival Duration .................................................................... 11 
      3.1.4. Wage Loss Duration of Uncensored Claims ........................................ 16 
   3.2. WORKERS’ COMPENSATION BOARD DATA ............................................. 17 
   3.3. ANALYSIS DATA SET ................................................................................ 18 
   3.4. DATA MANIPULATION .............................................................................. 19 

4. RESULTS .................................................................................................................. 21 
   4.1. PREDICTED WAGE LOSS DURATION ......................................................... 21 
   4.2. CUMULATIVE WAGE LOSS DURATION ..................................................... 23 
   4.3. CLAIM SURVIVAL WAGE LOSS DURATION .............................................. 25 
   4.4. UNCENSORED CLAIM DURATION .............................................................. 27 
   4.5. WAGE LOSS DURATION MEASUREMENT COMPARISON .......................... 32 

5. MEASUREMENT SELECTION ............................................................................... 35 
   5.1. STRENGTHS AND WEAKNESSES OF DURATION METRICS ...................... 35 
   5.2. WCB SPECIFIC METRIC DEVELOPMENT CONSIDERATIONS ................... 35 
   5.3. METRIC USE .............................................................................................. 36 

6. SUMMARY .............................................................................................................. 38 

7. FUTURE DIRECTIONS AND COMMENTS ......................................................... 39 
   7.1. APPLICATION OF SURVIVAL ANALYSIS TO WCB DURATION DATA ....... 39 
   7.2. IMPROVING PREDICTED WAGE LOSS DURATIONS ................................. 39 
   7.3. DATA REQUIREMENTS FOR WAGE LOSS DURATION ANALYSIS ............. 39 

8. REFERENCES .......................................................................................................... 40 

APPENDIX A: ANALYSIS DATA SET ....................................................................... 41 
APPENDIX B: INTERPRETATION OF MODIFIED BOXPLOTS ................................. 42 
APPENDIX C: SUMMARY OF OBSERVED AND CENSORED DATA ...................... 43 
APPENDIX D: UNCENSORED WAGE LOSS DURATION DISTRIBUTIONS ............ 44 
APPENDIX E: COMPARISONS OF MEAN WAGE LOSS DURATIONS .................... 45 
APPENDIX F: COMPARISONS OF MEDIAN WAGE LOSS DURATIONS .................. 46
LIST OF TABLES

Table 1.1     Sample AWCBC Complete Duration Calculation .................................................. 4
Table 1.2     Comparison of Retrospective Wage Loss Duration and AWCBC Duration .................. 6
Table 2.1     Effective Performance Metrics and Comparison to Existing Metrics ..................... 8
Table 3.1     Excerpt from January 2000 Life Table .................................................................. 13
Table 3.2     Summary of Initial Data Provided by the WCB ...................................................... 18
Table 3.3     Full and Reduced Claim Information Data Sets ..................................................... 19
Table 3.4     Calculated Data Fields Added to the Analysis Data Set .......................................... 19
Table 4.1     Mantel-Cox Log-Rank Test Results for Differences in Survival Functions ............... 27
Table 4.2     Months with Similar Survival Functions ................................................................. 27
Table 5.1     Summary of Metric Strengths and Weaknesses ...................................................... 35
Table 5.2     WCB Duration Measurement Parameters ............................................................... 36
LIST OF FIGURES

Figure 1.1  WCB Corporate Structure ................................................................. 1
Figure 1.2  Comparison of Retrospective Wage Loss Duration and AWCBC Duration ................................................................. 5
Figure 3.1  Sample Summary of Predicted Wage Loss Duration ................................................................. 10
Figure 3.2  Sample of Cumulative Wage Loss Duration .............................................................................. 11
Figure 3.3  Example of Claims in WCB Data ....................................................................................... 12
Figure 3.4  Sample Survival Functions .............................................................................................. 14
Figure 3.5  Sample Claim Survival Durations .......................................................................................... 15
Figure 3.6  Sample Wage Loss Duration for Uncensored Claims ............................................................... 16
Figure 3.7  Sample Cumulative Proportion of Claims Closed Following Registration ................................................................. 17
Figure 4.1  Current Wage Loss Duration Line Identifiers .............................................................................. 21
Figure 4.2  Predicted Wage Loss Duration of Claims .............................................................................. 21
Figure 4.3  Comparison of Median Predicted Wage Loss Duration and Actual Median RWLD .............................................................................. 22
Figure 4.4  Comparison of Predicted WLD to Retrospective WLD and to AWCBC Duration .............................................................................. 23
Figure 4.5  Distribution of Residuals for Actual and Expected Wage Loss Duration .............................................................................. 23
Figure 4.6  Cumulative Wage Loss Duration of Claims by Month of Payment .............................................................................. 24
Figure 4.7  Proportion of Claims by Elapsed Wage Loss Duration Group .............................................................................. 24
Figure 4.8  Comparison of Cumulative Wage Loss Days Paid to Predicted Wage Loss Days .............................................................................. 25
Figure 4.9  Claim Survival Duration after 12 Month Observation Period .............................................................................. 26
Figure 4.10  Wage Loss Duration of Uncensored Claims Following Observation ................................................................. 28
Figure 4.11  Proportion of Uncensored Claims Closed Each Month .............................................................................. 29
Figure 4.12  Cumulative Proportion of Uncensored Claims Closed Monthly .............................................................................. 30
Figure 4.13  Mean Yearly Wage Loss Duration of Uncensored Claims .............................................................................. 30
Figure 4.14  Median Yearly Wage Loss Duration of Uncensored Claims .............................................................................. 31
Figure 4.15  Distribution of Yearly Wage Loss Duration for Uncensored Claims (1998) .............................................................................. 32
Figure 4.16  Comparison of Mean Monthly Wage Loss Duration .............................................................................. 32
Figure 4.18  Mean Wage Loss Duration Measurements by Age Group and Injury Type - 2000 .............................................................................. 33
Figure 4.17  Comparison of Median Monthly Wage Loss Duration .............................................................................. 33
Figure 4.19  Median Wage Loss Duration Measurements by Age Group and Injury Type - 2000 .............................................................................. 34
Figure 9.1  Distribution of Yearly Wage Loss Duration for Uncensored Claims (1999) .............................................................................. 44
Figure 9.2  Distribution of Yearly Wage Loss Duration for Uncensored Claims (2000) .............................................................................. 44
Figure 9.3  Mean Wage Loss Duration Measurements by Age Group and Injury Type - 1998 .............................................................................. 45
Figure 9.4  Mean Wage Loss Duration Measurements by Age Group and Injury Type - 1999 .............................................................................. 45
Figure 9.5  Median Wage Loss Duration Measurements by Age Group and Injury Type - 1998 .............................................................................. 46
Figure 9.6  Median Wage Loss Duration Measurements by Age Group and Injury Type - 1999 .............................................................................. 46
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1. INTRODUCTION

1.1. Company Background

The Workers’ Compensation Board of British Columbia (WCB) is an administrative organization charged with the responsibility of ensuring the workplace safety of individuals employed by organizations covered by the Workers’ Compensation Act in the Province of British Columbia. The WCB administers the Workers’ Compensation Act of British Columbia for the B.C. Ministry of Skills Development and Labour. The Workers’ Compensation Act provides the WCB with the authority to establish and enforce occupational health and safety regulations, to compensate injured or disabled workers, to evaluate employer adherence to occupational health and safety regulations and to collect money from employers in order to fund the agency. The WCB is completely funded by the fees collected by the Board.

In 2002, the Workers’ Compensation Act covered two million employees and 170,000 employers. (WCB Website, 2003) Prior to the passage of the Workers’ Compensation Act the only recourse available to employees who were injured while working was to file a lawsuit against their employer. The Workers’ Compensation Act protects both employees and employers. The Act ensures that compensation is available to employees who are injured while working. The compensation available to employees includes remuneration for wages and pension benefits lost as a result of work place injury and payment of medical expenses associated with the injury. In exchange for the employee’s right to compensation the Workers’ Compensation Act protects employers from lawsuits filed by employees and their dependants.

1.2. Rehabilitation and Compensation Services

The WCB is separated into five main operating divisions: Finance and Information Services, Human Resources, Legal Services, Prevention, and Rehabilitation and Compensation Services. (WCB Annual Report, 2001) The Compensation Services component of the Rehabilitation and Compensation Services division was the main group involved with this study. The role of Compensation Services at the WCB includes adjudicating and managing claims filed by injured employees, monitoring employee return-to-work, administering the benefits allowed by claims and reporting on WCB performance with regards to these responsibilities. Figure 1.1 is an overview of the main organizational components of the WCB.

Figure 1.1  WCB Corporate Structure

A key responsibility of the Rehabilitation and Compensation Services division is assessing claim validity. Valid claims are eligible for coverage under the Workers’ Compensation Act. Claims are considered valid if a worker’s injuries occurred while they were working and if their employer is covered by the WCB. The nature of the occupational injuries and diseases covered by the WCB is extensive, however, they must have occurred as a result of the work conducted by the employee or as a result of the work environment. If the WCB determines that the injury or disease was caused as a result of employment and
if the employee is covered under the Workers’ Compensation Act then the employee is compensated. An appeal process exists for claimants who disagree with WCB adjudication decisions.

1.3. Wage Loss Claims and Wage Loss Duration

During 2001, the WCB received approximately 180,000 claims. (WCB Annual Report, 2001) Claims are categorized into health care only (HCO) claims and wage loss claims. As the name implies, HCO claims are claims that receive compensation exclusively for health care expenses. HCO claimants have not missed work as a result of their injury and are not seeking compensation for unpaid leave. Alternatively, wage loss claims submitted by injured workers request compensation for loss of wages and benefits as well as medical expenses incurred as a result of workplace injury or disease. Foregone salary costs made up 79 percent of total claim costs in 2001. This study focuses specifically on wage loss claims.

The WCB monitors wage loss claims by tracking the number of wage loss days paid on these claims. A wage loss day is a day where a claimant is away from work and receives compensation for that day from the WCB. In 2001 the WCB covered approximately 2.2 million wage loss days. The duration of a wage loss claim is the total number of wage days an employee is away from work due to injury. This duration of lost time is known as wage loss duration (WLD).

At the aggregate level, WLD is reported as an average number of wage loss days incurred per wage loss claim. WLD is a WCB cost driver since the board incurs costs for each wage loss day covered. The use of WLD rather than wage loss costs retains focus on return to work rather than on salaries. Reductions in WLD will reduce the costs incurred by the workers’ compensation system. The WCB’s Strategic Plan for 2002 indicates that the Board’s goal is to reduce their average total claim duration by 1 day from 50.8 days to 49.8 days. (WCB Strategic Plan, 2001)

1.4. Preliminary Projects

The following are brief descriptions of two components of an industrial project that was undertaken for the WCB by the Centre for Operations Excellence (COE). These analyses identified that the WCB could benefit from further investigation of wage loss duration measurement and reporting.

In each of the analyses, a WLD metric was used to assess whether or not a change in business processes had, or would have, the desired impact on WCB performance.

1.4.1. ASTD Specialization Impact Analysis

A post-implementation analysis of an activity-related soft tissue disorder (ASTD) case management specialization initiative was conducted in an attempt to quantify the impact of the change. ASTD claims are claims that occur without specific incident such as back strain that develops over a long period. ASTD claims typically incur more wage loss than other claims. ASTD case management specialists are charged with managing only ASTD claims rather than the mix of claims handled by other case managers. The intent of specialization was to reduce the WLD of ASTD claims by having specialists adjudicate and manage the claims. The WCB initiated case management ASTD specialization in the Lower Mainland in September 2000 and currently five of the seven offices in the region are specialized. As a component of this analysis, WLD was evaluated to determine whether or not a change in claim duration occurred after the implementation of specialization. The following outlines the major objectives of the analysis.

- Identification and quantification of performance changes occurring as a result of specialization
- Identification of the approximate timeframe of the resulting changes
- Verification of performance differences between specialized and unspecialized offices
1.4.2. Interior Business Guidelines Impact Analysis

A retrospective analysis of the Interior Business Guidelines implementation was conducted in an attempt to quantify the impact changing business guidelines. The WCB operates across the entire province of BC using 17 local offices. Local offices are grouped into three operational regions – the Interior, the Lower Mainland and Vancouver Island. The WCB implemented new Interior Business Guidelines in their Kelowna office during January 2000 and in the remainder of the Interior offices during February 2000. These guidelines presented different approaches to claim management that took into consideration claim complexity, with a focus on return to work issues and adjudication decisions. All Interior offices currently follow these guidelines, however, the degree to which the guidelines are implemented varies across offices. As a component of this analysis, WLD was evaluated in order to determine if the implementation of new business rules resulted in a change in duration for claims affected by the new guidelines. This analysis also identified the existence of alternate methods of calculating wage loss duration. The following outlines the major objectives of the analysis.

- Identification and quantification of the performance changes that occurred in the Interior as a result of implementing the business guidelines
- Verification of the approximate timeframe of the resulting changes
- Evaluation of the performance differences between the Interior and the Lower Mainland

1.5. Problem Description

The focus of this study is to develop new methods of reporting WLD across the WCB organization. The preliminary projects identified two methods of calculating and reporting wage loss duration within the WCB: i) retrospective wage loss duration method and ii) Association of Workers' Compensation Boards of Canada (AWCBC) complete duration method. Each of these methods calculates the mean wage loss duration in wage loss days paid for claims in a specified period. WLD is typically reported as an average monthly or average yearly figure. Both are described below.

1.5.1. Retrospective Wage Loss Duration

Retrospective wage loss duration (RWLD) is the average wage loss duration for all claims closed in a given period. At a yearly level, RWLD identifies the average claim duration for all of the claims that were closed in the reference year. This wage loss calculation does not consider when the claim was registered or the number of wage loss days paid to a claim at any time other than when a claim is closed. The calculation for RWLD for a period is:

\[ \bar{WLD}_i = \frac{\sum WLD_i}{n_i} \]

where \( WLD \) is the number of wage loss days paid to claims that close in the period \( i \) and \( n_i \) is the number of closed wage loss claims in the period. The calculation of the monthly RWLD is the same as for the annual calculation, however, the period in which the claims are closed would be a month. RWLD is only calculated for wage loss claims.

RWLD is readily accepted by the organization as the calculation and meaning are easily communicated within the organization. RWLD is a historical measurement that provides insight into past performance. This statistic, however, does not provide WCB management with insight into claims that are currently being managed. Additionally, the impact of initiatives to reduce wage loss duration may only be observed after claims close.
1.5.2. AWCBC Duration

The Association of Workers’ Compensation Boards of Canada established a claim duration measurement that estimates the entire duration of claims registered in one month or year. AWCBC complete duration provides an estimate of claim duration under the assumption that current conditions continue into future years (AWCBC Key Statistical Measures, 2002). AWCBC complete duration is calculated as a sum of the days paid per wage loss claim for the year of injury and the five years following injury (from injuries occurring in years prior to the reference year) and groups several years of data into one reference year. The following is the calculation of AWCBC complete duration period \( i \):

\[
\text{Complete Duration}_i = \frac{\sum \text{WLD}_{i(j-4)}}{n_{(j-4)}} + \frac{\sum \text{WLD}_{i(j-3)}}{n_{(j-3)}} + \frac{\sum \text{WLD}_{i(j-2)}}{n_{(j-2)}} + \frac{\sum \text{WLD}_{i(j-1)}}{n_{(j-1)}} + \frac{\sum \text{WLD}_j}{n_j} + r
\]

where \( \text{WLD}_j \) is the number of wage loss days paid in the reference period \( i \) to claims that were registered in period \( j \) and \( n_j \) is the number of wage loss claims in the period. In the reference year \( j = i \). This calculation indicates that 5 years of data are required to calculate AWCBC complete duration. A residual is added to the sum of the wage loss days to account for payments made after the fifth year. The residual, \( r \), is a value calculated based on historical claim durations and represents the number of wage loss days paid to claims after 5 years. Alternatively, a two year AWCBC complete duration calculation is also used at the WCB.

As an example, assume one claim is registered each year for five years from 1995 to 1999. In this simplified case, claims are paid one wage loss day each year. Claim details are as outlined in Table 1.1 and we assume that the residual is 0. Using 1999 as the reference year, we can see that the AWCBC complete duration would be 5 wage loss days as the days paid per claim for each of the 5 claims in 1999 is one wage loss day. For this example, RWLD for 1999 would be 3 wage loss days ((5+4+3+2+1)/5 closed claims).

Table 1.1 Sample AWCBC complete duration calculation

<table>
<thead>
<tr>
<th>Registration</th>
<th>Days Paid in:</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>1996</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>1997</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>1998</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1999</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

AWCBC duration is not a report on claim duration at closure as is retrospective WLD. The calculation groups wage loss days from different registration periods into one reference period. The effect of grouping claims from different years is that AWCBC complete duration estimates claim duration after five years for claims in the reference year. The estimate is based on the number of wage loss days paid per claim in the reference year and the data available from the previous 4 years. AWCBC complete duration requires the assumption that current conditions continue into the future. AWCBC complete duration also assumes that past claim management approaches are the same as current approaches. The preliminary projects indicate that these assumptions do not hold for the WCB as each of the projects assessed changes that could impact claim duration. In addition, the metric is difficult to explain and calculate and its acceptance is limited within the organization.
1.5.3. Comparison of Retrospective WLD and AWCBC Duration

Each of the two methods of calculating wage loss duration has limitations. Figure 1.2 presents the monthly RWLD and AWCBC complete duration for the period from January 2000 to January 2002. This figure illustrates the difference between the results of each of the two calculation methodologies.

Figure 1.2  Comparison of Retrospective Wage Loss Duration and AWCBC Duration

The Retrospective WLD clearly indicates the presence of an increasing trend in wage loss duration throughout the time period while AWCBC duration remains stable. Additionally, Retrospective WLD indicates a peak in the wage loss duration during May 2001. A similar peak in the AWCBC duration is not present for this month.

Table 1.2 is a comparison of the two calculations. In examining the table we are able to identify improvements to the calculation and report of wage loss duration. A calculation that can accurately identify claim WLD early in the lifecycle of a claim would improve on existing calculations. Additional considerations for a revised calculation include developing a metric that is simple to calculate and communicate throughout the organization. This calculation should also accurately reflect what is occurring in the operating environment and indicate of the month-to-month variation that naturally appears.
Table 1.2 Comparison of Retrospective Wage Loss Duration and AWCBC Duration

<table>
<thead>
<tr>
<th>Comparison</th>
<th>AWCBC Duration</th>
<th>Retrospective WLD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calculation Complexity</td>
<td>Complicated calculation including estimation component</td>
<td>Relatively simple calculation</td>
</tr>
<tr>
<td>Measurement Perspective</td>
<td>Based on month of claim registration, does not require month of closure</td>
<td>Requires claim closure and reports durations based on month of closure</td>
</tr>
<tr>
<td>Calculation Availability</td>
<td>Not available until the observation period has elapsed</td>
<td>Available immediately following the period during which claims close</td>
</tr>
<tr>
<td>National Comparability</td>
<td>Nationally recognized standard and calculation methodology</td>
<td>Metric and calculation methodology not nationally recognized</td>
</tr>
<tr>
<td>Monthly Variance</td>
<td>Limited monthly variance</td>
<td>High degree of monthly variance</td>
</tr>
<tr>
<td>Recent Indications</td>
<td>Stable for the period from January 2000 to January 2002</td>
<td>Increasing for the period from January 2000 to January 2002</td>
</tr>
<tr>
<td>Data Misrepresentation</td>
<td>Groups claims registered in different years into one duration measure</td>
<td>Wage loss duration is high in months when long claims are closed</td>
</tr>
<tr>
<td>Strengths</td>
<td>Provides insight into future claim duration</td>
<td>Accepted calculation within the WCB</td>
</tr>
<tr>
<td>Weaknesses</td>
<td>Responds slowly to changes in performance</td>
<td>Associates claims with close month</td>
</tr>
</tbody>
</table>

1.6. Problem Statement Summary

The intent of this study is to identify performance measurements that span multiple reporting periods and supports each of the following attributes:

- Timeliness
- Representativeness
- Simplicity
- Actionability

Additionally, the performance measures identified in the study should support the WCB in making the following decisions:

- What management interventions reduced claim duration
- How to monitor changes in claim duration over time
- Which regions or offices have shorter claim durations
- What claims require the most attention due to the injury duration
2. LITERATURE REVIEW

The intent of this study is to develop new methods of calculating and reporting wage loss duration. This necessitates examination of the research that has been conducted on performance monitoring.

2.1. Developing Performance Metrics

The organizational effectiveness literature identifies several important factors to consider when establishing performance measurements. Globerson, Globerson and Frampton (1991) present ten factors for developing performance criteria that can be divided into two sub-groups – organizational considerations and analytical considerations. The organizational considerations include aligning criteria to organization objectives, including all stakeholders in the development and selection of criteria, ensuring that the reasons for the existence of the criteria are clear, determining whether objective or subjective measures will be used and making sure that criteria are appropriate for the organizational unit where they will be used. Analytical considerations for effective criteria identified in the study include providing clear methods of calculation, determining whether ratio or absolute values will be used, ensuring that criteria can be used to compare similar organizational units and that the criteria are reliable in that repeated calculation will result in similar findings. This work also suggests that that criterion used by an organization must actually measure what the organization intends to measure. Finally, this work indicates that organizations must ensure that the measurements that are used are not only used because they are obvious or easy to calculate.

Wesner, Hiatt, and Trimble (1995) established six points to consider while establishing organizational metrics. This work indicates that those responsible for developing metrics should carefully evaluate metrics to ensure that the metric is driving the right behaviour from employees who are evaluated against the metric. This study indicates that metrics should be specific, measurable and accurate. These findings are similar to the factors presented by Globerson et al; however, the authors include two considerations that were not included in the 10 factors presented. This work suggests that performance metrics should be easy to understand and that they should be available in a timely fashion. These two considerations are important for ensuring organizational acceptance of performance metrics.

Balanced Scorecard literature also provides insight into effective performance metrics. Kaplan and Norton (1991) suggests that a key consideration in developing performance metrics is the alignment of each metric to the organizational strategy. The balanced scorecard literature indicates that performance metrics are more than a tool that is used to control behaviour. The clear indication in this work is that measures should be used to articulate corporate strategy. This suggests that the development process must consider how effectively each metric is aligned with the corporate strategy and how clearly it communicates the strategic vision. The work indicates that the time perspective of the performance measure must capture the information required by the organization to assess whether or not they are achieving their strategic objectives. Performance metrics can be lagging or leading. Each type of metric can be appropriate under different circumstances, given the benefits and drawbacks of each of these time perspectives, and what the organization hopes to gain by using the metric. This work also highlights the importance of recognizing the difference between strategic and diagnostic performance measures.

Table 2.1 is a summary of the requirements for establishing effective performance metrics as identified in the literature. This table includes an examination of the existing WCB WLD measurements in comparison to the design characteristics of effective performance measures.
<table>
<thead>
<tr>
<th>Source</th>
<th>Design Characteristic</th>
<th>Retrospective WLD</th>
<th>AWCBC Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Globerson</td>
<td>Alignment with Objectives</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Inclusion of Stakeholders</td>
<td>Unknown</td>
<td>Unknown</td>
</tr>
<tr>
<td></td>
<td>Clear Reason for Measure</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Objective/Subjective</td>
<td>Objective</td>
<td>Objective</td>
</tr>
<tr>
<td></td>
<td>Appropriateness</td>
<td>Unknown</td>
<td>Unknown</td>
</tr>
<tr>
<td></td>
<td>Method of Calculation</td>
<td>Clear</td>
<td>Unclear</td>
</tr>
<tr>
<td></td>
<td>Ratio/Absolute values</td>
<td>Absolute (Average) Value</td>
<td>Absolute (Average) Value</td>
</tr>
<tr>
<td></td>
<td>Comparison Factor</td>
<td>Comparable</td>
<td>Comparable</td>
</tr>
<tr>
<td></td>
<td>Reliability</td>
<td>Yes</td>
<td>Yes if method understood</td>
</tr>
<tr>
<td></td>
<td>Measure Intended Factor</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Wesner</td>
<td>Specific</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Measurable</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Accurate</td>
<td>Unknown</td>
<td>Unknown</td>
</tr>
<tr>
<td></td>
<td>Easy to Understand</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Availability</td>
<td>Limited</td>
<td>Delayed and Limited</td>
</tr>
<tr>
<td>Kaplan</td>
<td>Related to Strategy</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Communicates Strategy</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Time Perspective</td>
<td>Lagging</td>
<td>Leading but delayed</td>
</tr>
<tr>
<td></td>
<td>Strategic versus Diagnostic</td>
<td>Diagnostic</td>
<td>Diagnostic</td>
</tr>
</tbody>
</table>
3. ANALYSIS METHODOLOGY

3.1. Solution Approach

Several methods of wage loss duration measurement and reporting using WCB data are proposed in this study. The proposed methods are:

- Measuring predicted wage loss duration using the WCB predictions
- Calculating the cumulative number of wage loss days paid to claims
- Estimating claim duration using survival analysis
- Calculating the wage loss duration of uncensored claims and the proportion of uncensored claims closed following registration.

Each of the proposed wage loss duration models is a result of manipulating existing WCB data in order to extract information that is not currently available. This study proposes methods of reporting and measuring wage loss duration and creates comparisons between proposed and existing performance measures.

3.1.1. Predicted Wage Loss Duration

The WCB calculates predicted wage loss durations (PWLD) for individual claims. Predicted claim durations are based on internationally recognized injury and disease description codes (ICD9 – International Classification of Diseases 9th revision codes) and the disability duration associated with each code. These predictions provide an opportunity to model predicted claim duration in the month or year of registration. The predicted claim duration is the median number of wage loss days incurred by individuals within an age group that have the same injury code as the WCB claimant.

Using ICD9 predictions, summaries of predicted wage loss durations were created based on registration month. To report predicted wage loss duration, the month of claim registration and the predicted wage loss duration of claims is required. The mean, median, 25th percentile and 75th percentile of PWLD were calculated for each month between January 2000 and January 2002. The results are plotted as a time series of modified boxplots. Appendix B describes the interpretation of the modified boxplots and Figure 3.1 is an example of a summary of predicted wage loss duration.
Figure 3.1 indicates the distribution of predicted wage loss durations for each registration month. In this summary, it is possible to identify monthly variation and trends in the data. Summary statistics based on predicted wage loss durations provide a forward looking metric that accounts for factors such as claimant age and type of injury. Variation in monthly predicted wage loss durations occur as a result of changes in the type of claims that are registered each month. Reporting on PWLD would indicate changes in the duration of open claims and would provide insight into potential changes in WCB costs.

There are two limitations associated with predicted wage loss duration; it does not reflect WCB management practices nor does it measure factors over which the WCB has direct control. Predicted wage loss duration only indicates changes in claims filed with the WCB. The accuracy of predicted wage loss durations is limited. By definition, 50 percent of WCB claims will have an actual wage loss that is greater than the predicted wage loss. Predicted wage loss duration does a poor job identifying the duration outliers which account for a large proportion of wage loss costs.

### 3.1.2. Cumulative Wage Loss Duration

WCB payments data can be used to track the number of wage loss payments made to claims. With these data, it is possible to identify the accumulation of wage loss days paid to each claim as the claim ages. The cumulative number of wage loss days received by claims provides an alternative description of claim duration since it reports on claims currently under management at the WCB. The calculation of the cumulative age of a claim in period $i$ for one claim is:

$$\text{Cumulative days paid}_i = \sum_{t=r}^{i} WLD_t$$

where $t$ is the month in which a payment is made, $r$ is the registration month and $i$ is the month for which the cumulative age is being calculated. Cumulative days paid is the sum of days paid to date and can be viewed as the current age of the claim in wage loss days. It is given that $r \leq i$.

The mean, median, 25th and 75th percentile of the cumulative days paid were calculated for each month between January 2000 and January 2002. The results are plotted as a time series of modified boxplots and Figure 3.2 is an example of the measurement of cumulative wage loss duration.
Figure 3.2 indicates the distribution of accumulated wage loss days for claims in each month, for claims receiving wage loss payments. Claims that do not receive payments are not included in the age calculation. In this presentation, it is possible to identify monthly variation and trends in the data.

Cumulative wage loss duration indicates the age of claims in the month in which the payments are made rather than the age of claims at closing or after observing an initial portion of claim activity. This metric reports on the status of claims while they are under management by the WCB and does not require an observation period. This enables WCB management to identify changes in performance more quickly than methods that require claim closure or an observation period. An additional benefit of CWLD is that it can be used to identify claims where the cumulative wage loss duration exceeds the predicted wage loss duration. This can be tracked for individual claims and the transition of claims from one state to another can be monitored.

3.1.3. Claim Survival Duration

Survival analysis was used to model the probability of claim closure across wage loss durations. This model of survival duration measures the number of wage loss days paid to claims prior to closure in an observation period. Claims that are not closed in the observation period are considered censored in that full claim duration information is not available at the end of the observation period. Figure 3.3 provides an example of censored and uncensored claims throughout the 12 month observation period.

All of the claims in the chart are registered in January 2000 and are observed for 12 months. The claim labelled Censored 1 receives payments throughout the period and is not closed after observation. Censored 2 only receives payments for a portion of the period and does not close. Censored 3 does not receive payments in the period but is registered in January 2000. Each of these claims is censored since all claim information is not available after observation. Closed 1, Closed 2 and Closed 3 receive payments during the period and close prior to the end of observation. Since these claims are closed in the observation period they are uncensored.
The following explanations of the survival function and the Mantel-Cox log-rank test are adapted from Tabachnick and Fidell (2001) and Norman and Streiner (2000). The survival function was calculated by deriving the probability of survival until each interval and is estimated as:

\[ P_{i+1} = p_i P_i \quad \forall \quad i = \{0, 1, 2, \ldots, k\} \]

where:

\[ p_i = 1 - q_i \]

\[ q_i = \frac{d_i}{r_i} \]

\[ r_i = n_i - \frac{c_i}{2} \]

The method assumes that \( P_0 \) is equal to 1 as all claims are open at the beginning of the first interval. The value of \( k \) depends on the month of investigation as the number of wage loss days paid to claims in the first 12 months varies depending on the month. With an interval width of 1 day, the value of \( k \) is the maximum number of wage loss days paid to claims registered in a month. The maximum number of intervals in a month is not limited to the maximum number of days in the observation period since the WCB can make payments in the observation period for wage loss days outside of the period. The values of \( k \) are included in Appendix C.

In the final equation \( n_i \) is the number of claims that are open at the start of the interval and \( c_i \) is the number of censored claims in the interval. The number of claims at risk in the interval is \( r_i \). The probability of a claim closing in an interval, \( q_i \), is the number of claims that close in the interval, \( d_i \), divided by the number of claims at risk in the interval, \( r_i \). The probability that a claim does not close in an interval, \( p_i \), is \( 1 - q_i \). The probability that a claim survives (remains open) until the next interval is the probability that it does not close in the preceding interval, multiplied by the probability that it survived until the beginning of the interval. The survival function calculates the proportion of claims surviving until an interval \( i + 1 \) given that there is a
probability of the claim closing in each of the intervals prior to the $i + 1$st interval. The values $r_i$, $q_i$, $p_i$ and $P_i$ are calculated for each interval in a registration month and the results are tabulated as a life table.

The first step in developing the survival model was to create life tables of claim duration information for each month between January 2000 and either April 2001. A life table indicates the number of claims that are opened, closed and censored after reaching a specified duration and probability that claims were open to specified durations. Table 3.1 is an excerpt from the January 2000 life table that contains the first ten intervals of wage loss. The data required to construct the tables were the number of wage loss days paid to claims in the observation period, claim closing dates and whether or not a claim was censored at the end of the observation period. The interval used in the analysis was days, and the interval width was set at one wage loss day. Appendix C provides a summary of the number of claims registered each month, the proportion of failed and censored claims.

Table 3.1  Excerpt from January 2000 Life Table

<table>
<thead>
<tr>
<th>Interval $i$</th>
<th>Failed $d_i$</th>
<th>Censored $c_i$</th>
<th>Sample Size $r_i$</th>
<th>Survival Function $P_i$</th>
<th>Conditional Prob. of Closure $q_i$</th>
<th>Cumulative Prob. of Closure</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 1</td>
<td>64</td>
<td>3</td>
<td>5289.5</td>
<td>1.000</td>
<td>0.012</td>
<td>0.000</td>
</tr>
<tr>
<td>1 - 2</td>
<td>492</td>
<td>9</td>
<td>5219.5</td>
<td>0.988</td>
<td>0.094</td>
<td>0.012</td>
</tr>
<tr>
<td>2 - 3</td>
<td>436</td>
<td>8</td>
<td>4719</td>
<td>0.895</td>
<td>0.092</td>
<td>0.105</td>
</tr>
<tr>
<td>3 - 4</td>
<td>342</td>
<td>5</td>
<td>4276.5</td>
<td>0.812</td>
<td>0.080</td>
<td>0.188</td>
</tr>
<tr>
<td>4 - 5</td>
<td>275</td>
<td>2</td>
<td>3931</td>
<td>0.747</td>
<td>0.070</td>
<td>0.253</td>
</tr>
<tr>
<td>5 - 6</td>
<td>250</td>
<td>3</td>
<td>3653.5</td>
<td>0.695</td>
<td>0.068</td>
<td>0.305</td>
</tr>
<tr>
<td>6 - 7</td>
<td>190</td>
<td>1</td>
<td>3401.5</td>
<td>0.647</td>
<td>0.056</td>
<td>0.353</td>
</tr>
<tr>
<td>7 - 8</td>
<td>155</td>
<td>3</td>
<td>3209.5</td>
<td>0.611</td>
<td>0.048</td>
<td>0.389</td>
</tr>
<tr>
<td>8 - 9</td>
<td>119</td>
<td>1</td>
<td>3052.5</td>
<td>0.582</td>
<td>0.039</td>
<td>0.418</td>
</tr>
<tr>
<td>9 - 10</td>
<td>101</td>
<td>0</td>
<td>2933</td>
<td>0.559</td>
<td>0.034</td>
<td>0.441</td>
</tr>
</tbody>
</table>

Following the creation of life tables, survival functions are normally presented as graphs. Figure 3.4 provides an example of survival functions calculated for three months of data. In terms of the WCB data, survival functions indicate the proportion of claims that are still open at different wage loss durations.
The differences between survival functions were tested using chi-squared tests with 1 degree of freedom. Survival functions were compared in pairs of current and previous months. The degrees of freedom for this test is the number of survival functions being tested minus 1. The value of the overall test is:

$$\chi^2 = \frac{\mathbf{v}_f^2}{\mathbf{V}_j}$$

where:

$$\mathbf{v}_j = \sum_{i=1}^{k} (d_{ji} - n_{ji}d_{Ti} / n_{Ti})$$

and:

$$\mathbf{V}_j = \sum_{i=1}^{k} [(n_{Ti} - n_{ji}d_{Ti} / n_{Ti})d_{Ti}s_{Ti}] / [n_{Ti}^2(n_{Ti} - 1)]$$

In this equation, $\mathbf{v}_j^2$ is the squared value of the difference between the expected and observed number of closed claims in a month. The denominator of the equation, $\mathbf{V}_j$, is the variance of the group. Since pairwise comparisons are used, the group $j$ can be either the current month or the previous month. The null hypothesis used in each of the tests is that there is no difference between the survival functions.

In the calculation of $\mathbf{v}_j^2$, $d_{ij}$ is the number of closed claims in group $j$ during interval $i$ and $n_{ij}$ is the number of claims at risk. The total number of claims surviving across all groups is $d_{Ti}$ and the total number of claims at risk across all groups at the start of each interval is $n_{Ti}$. All of the variables used in the calculation of $\mathbf{V}_j$ are the same as for the calculation of $\mathbf{v}_j^2$; however, the equation includes $s_{Ti}$ which is the total number of claims that do not close in the interval.
Using survival functions, it is possible to identify the duration at which 25, 50 and 75 percent of claims are still open. Figure 3.5 is an example of the data extracted using survival durations. The figure indicates the wage loss duration at which a specified proportion of claims remain open based on the month of claim registration. As an example, Figure 3.4 indicates that for the claims registered in January 2000, 50 percent of claims were open at approximately 11 wage loss days and 75 percent of claims were closed before reaching a wage loss duration of 40 days. The figure also indicates that the mean age of closed claims is approximately 30 days in January 2000. This figure makes it possible to identify monthly changes in performance as well as trends in the ages at which claims close.

Figure 3.5  Sample Claim Survival Durations

Creating survival functions based on registration month allowed for each month to be tested for a difference against the previous month. Using the curves in Figure 3.3 as an example, it appears that there are differences in the survival functions. Given the variability in the survival function, it is not known, however, if a statistical difference exists. A difference in the survival function based on registration month would indicate changes in WCB performance over time. The tests of the survival functions compare the wage loss durations of the claims registered in the current month with the claims registered in the previous month. In the chart, February 2001 would be tested against January 2001 and March 2001 would be tested against February 2001. Survival analysis allows for the comparison of the entire survival function rather than testing differences at specific intervals. In order to test survival functions for differences, each pair of current and previous months was identified starting with February 2000 (current month) and January 2000 (previous month). Months with a statistically significant difference from the preceding month were identified.

Claim survival duration is a lagging metric in that it indicates claim duration prior to claim closure. An important result of the metric is that it provides an indication of how claims that are registered in a given month are managed by the WCB and allows for comparisons to be made over time. The focus of survival analysis remains on historical claims. The claims reported on using this method can be both closed or censored. This method is different than uncensored claim duration based on registration month since it includes wage loss information from censored claims in its calculations. In addition to reporting on historical claims, this method reflects management practices in place during claim management and not the practices in place when reports are available. Additionally, since complete claim information is not available for all claims after the observation period the durations provided by the metric are an estimate of the actual duration.
3.1.4. Wage Loss Duration of Uncensored Claims

Survival analysis identified that censored and uncensored claims exist after observing the first 12 months of claim wage loss. A combination of the WCB payments data, claim transaction data and the results from survival analysis were used to identify wage loss payments made to claims in the 12 months following registration and whether or not claims were censored after observation. From this, the wage loss duration of uncensored claims and the proportion of uncensored claims that close each month following registration were calculated. Uncensored claims were used to allow for comparisons across different periods and to remove the impact of long claims.

To model uncensored claim wage loss, the mean, median, 25th percentile and 75th percentile of duration were calculated for each month between January 2000 and April 2001. Figure 3.6 provides an example of this measurement.

Figure 3.6 Sample Wage Loss Duration for Uncensored Claims

The wage loss duration for censored claims provides a lagging metric that is available after an observation period. The metric indicates the wage loss duration for a group of claims based on the registration month. Uncensored claims provide a better indication of changes in monthly performance than a metric that includes all claims since the metric attempts to reduce the effect of long wage loss claims. Additionally, the metric does not compare claims based on the month of closure.

The proportion of uncensored claims that close each month was calculated by grouping claims by registration month and counting the number of claims that closed in each of first 12 months following registration. The cumulative proportion of claims closed each month was also calculated. Figure 3.7 provides a sample of the cumulative proportion of claims closed each month. This calculation indicates the proportion of claims closed up to and including a specific month after registration.
The proportion of claims that close over the 12 months following registration is a lagging metric available after an observation period. Since the metric is calculated based on the month of registration it is possible to track changes in WCB performance over time. This method has the benefit that it evaluates a more specific group of claims and that it reduces the impact of long wage loss claims on duration measures. The metric also allows for comparisons to be made between 12 months of data for each registration month rather specific point comparisons as are available with other wage loss measurements.

Figure 3.7 indicates that approximately 90 percent of claims are closed in the first 4 months following registration and an alternative to using a 12 month observation period would be to use a 4 month observation period. Using a 4 month observation period would make this metric available in a more timely manner. Figure 3.7 also indicates the proportion of censored claims after 12 months which is the gap between the uppermost value indicated on the chart and the top of the chart.

Changes in uncensored claims more accurately represent changes in WCB performance than changes in metrics that include all claims. In metrics that use all claims, variation in the metric is more likely a result of changes in the number of long wage loss claims being measured. The focus of metrics based on uncensored claims is on historical claim duration and claims management activities. The majority of claims reported on by this method are closed when the metric is calculated. The measurements, however, associate claims with the registration month rather the month of closure so it is possible to associate the claims with the management practices that were in place when the claim was managed rather than with the management practices in place at closure. Additionally, it would be possible to calculate the metric based on the close month without adding any systematic biases to the calculation.

3.2. Workers’ Compensation Board Data

Three main sources of data were used in the study:

- claim information data containing specific information about each claim
- payments data containing a record of payments made to individual claims
- transactions data containing a record of claim management activities

The claim information data set contained information such as claim identifier, employer, injury and geographic information. The payments data set contained the date, size, type and number of wage loss
days of each payment. The transactions data set indicated when claims were opened, closed and transferred as well as where they were managed. Table 3.2 provides a summary of these data sets.

Table 3.2 Summary of Initial Data Provided by the WCB

<table>
<thead>
<tr>
<th></th>
<th>Claim Information</th>
<th>Payment</th>
<th>Transactions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Records</td>
<td>977,242</td>
<td>2,192,788</td>
<td>1,565,213</td>
</tr>
<tr>
<td>Number of Fields</td>
<td>188</td>
<td>8</td>
<td>14</td>
</tr>
<tr>
<td>Records per Claim</td>
<td>One</td>
<td>Multiple</td>
<td>Multiple</td>
</tr>
<tr>
<td>Common Field</td>
<td>Claim Number</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The SAS System for Windows Version 8 was used to manage data and conduct statistical analyses for this study. Initially, all of the data provided by the WCB was used to create a claim level data file that included claims registered between July 1990 and April 2002. Data was assembled at the claim level where each record contained information relating to an individual application for compensation.

The WCB data contained a number of records with inaccurate information. Inaccurate records are a result of data entry errors and/or inconsistent data entry practices within the organization. This was controlled by modifying the data as required. For example, the claimant age field indicated that several WCB claimants were over 140 years old. Recognizing this as unlikely, records were corrected using alternative ages. Where errors could not be corrected, records were dropped from the analysis. The size of the initial data set was restrictive as working with the number of records provided by the WCB required significant computing resources. The SAS system accommodated working with the number of records; however, reduced data sets were used to decrease processing times. Missing data was the most significant problem with the WCB data although in some cases is was appropriate since it indicated censored durations.

3.3. Analysis Data Set

Not all of the WCB data were required to construct claim duration metrics. The analysis data set required a unique identifier for each claim, important dates, predicted durations and the wage loss days paid to claims. A description of the fields included in the analysis data set is provided in Appendix A.

Data in the analysis data set were screened to remove claims and fields that were not required. HCO and fatal claims were removed since they did not contain wage loss information. Claims that were missing the claim injury date or the claim registration date were dropped as it was not possible to analyze claims without this information and reconstructing these dates with other data was not feasible.

The payments and transactions data sets contained records from January 1998 to April 2002 while the Claim information data set contained claims that were registered before January 1998. The analysis data set was screened to remove claims registered before January 1998 in order to align the time frame of all three data sources. The payments data set was used to ensure that records in the analysis data set actually incurred wage loss payments. If a record received a wage loss payment in the payments data, it was included in the analysis data set. Table 3.3 provides a comparison of the full and the analysis data sets.
### Table 3.3 Full and Reduced Claim Information Data Sets

<table>
<thead>
<tr>
<th></th>
<th>Full Data</th>
<th>Analysis Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Records</td>
<td>977242</td>
<td>284668</td>
</tr>
<tr>
<td>Number of Fields</td>
<td>180</td>
<td>8</td>
</tr>
<tr>
<td>Blank Registration Date</td>
<td>Included</td>
<td>Dropped</td>
</tr>
<tr>
<td>Blank Injury Date</td>
<td>Included</td>
<td>Dropped</td>
</tr>
<tr>
<td>Date Range Start</td>
<td>January 1990</td>
<td>January 1998</td>
</tr>
<tr>
<td>Claims Include</td>
<td>All Claims</td>
<td>Wage Loss Claims</td>
</tr>
</tbody>
</table>

### 3.4. Data Manipulation

The combination of the analysis and payments data allowed for the creation of the new data fields identified in Table 3.4. The month and year were calculated from existing dates for all claims to allow for monthly summaries. The number of wage loss days paid in the 12 months following registration was calculated to identify payments made in the observation period. An indicator variable was used to identify whether or not claims received a payment in the first twelve months following registration.

#### Table 3.4 Calculated Data Fields Added to the Analysis Data Set

<table>
<thead>
<tr>
<th>Field</th>
<th>Percent Complete</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>Month and year of claim registration</td>
<td>100</td>
<td>Month/Year</td>
</tr>
<tr>
<td>Month and year of first claim closure</td>
<td>96.4</td>
<td>Month/Year</td>
</tr>
<tr>
<td>Month and year of last claim closure</td>
<td>96.4</td>
<td>Month/Year</td>
</tr>
<tr>
<td>Indicates a payment made in first 12 months</td>
<td>100</td>
<td>Binary</td>
</tr>
<tr>
<td>Total wage loss days paid in first 12 months</td>
<td>100</td>
<td>Number</td>
</tr>
<tr>
<td>Months between registration and first close</td>
<td>96.4</td>
<td>Number</td>
</tr>
<tr>
<td>Months between registration and last close</td>
<td>96.4</td>
<td>Number</td>
</tr>
<tr>
<td>Indicates if the data is censored</td>
<td>100</td>
<td>Number</td>
</tr>
<tr>
<td>Indicates if the data is censored</td>
<td>100</td>
<td>Number</td>
</tr>
</tbody>
</table>

Two different claim close dates are present in the WCB data. The first close date is the first date that a claim is closed and the last close date is the last date when a claim that was reopened by the WCB was closed. First close date was used for the analyses conducted in this study. Using last close date in the analysis would introduce systematic error since claims that are registered earlier have a longer duration to reopen. The first close date of claims does not change depending on how long a claim has been with the WCB. Additionally, the survival analysis literature indicates that the date of first closure is typically used for analysis if multiple closures are possible. (Norman and Steiner, 2000) Claims were censored if their first close date was not in the observation period or if the claim record did not contain a closed date. Claims were also censored if they did not receive a payment in the observation period.

The payments data provided by the WCB consisted of individual records of payment transactions. In order to construct monthly and yearly statistics payments data had to be summarized by month for each claim. In order to create monthly summaries a field was added to records for each month between January 1998 and April 2002. The data in each of these fields was the number of wage loss days paid to a claim in a specified month. If a claim did not receive a payment in a month the field was left blank. Creating a record of monthly payments made it possible to calculate the number of claims receiving payments each month, the number of payments made each month, and the number of months that claims received payments. The manipulation was also required in order to derive the cumulative wage loss duration presented earlier.
The cumulative wage loss data was used to group claims into cumulative claim duration bins. Using cumulative durations, subsets of claims were identified based on their cumulative duration. This allowed for summary statistics to be created for the subsets. Cumulative wage loss duration in combination with predicted wage loss duration was used to create a comparison of CWLD and PWLD that indicated where a claim’s cumulative wage loss duration was in relation to the predicted wage loss duration. These data allowed for the proportion of claims in each category (CWLD below PWLD, CWLD close to PWLD, and CWLD above PWLD) to be calculated.

Using monthly payment information it was possible to identify transactions following claim registration. These transactions were required to conduct survival analysis and to calculate metrics for uncensored claims. A data set was created with fields for each of the first 12 months of a claim. These fields captured the wage loss payments made each month and the status of the claims each month. These data allowed for the identification of censored and uncensored claims, the number of wage loss days paid for 12 months following registration, and the proportion of claims closed in each month after registration.
4. RESULTS

The results from modelling wage loss duration using the proposed methods are presented here. The results are provided in graphical or table format. In several cases the modified boxplots described in Appendix B are used. Wage loss duration measurements presented in this section are frequently compared to AWCBC complete duration and retrospective wage loss durations. On charts comparing a proposed metric to an existing metric, AWCBC complete duration is always presented as black line with a square marker. RWLD using closed month is presented as a grey line with a circular marker and RWLD using registration month is a dark line with a diamond marker. Examples of these lines are provided in Figure 4.1.

Figure 4.1 Current Wage Loss Duration Line Identifiers

Each of the charts presented in this section covers the period from January 2000 to January 2002 unless an observation period is used. When observation periods are used, charts cover January 2000 to April 2001. The reduced date range accommodates 12 months of observation following registration.

4.1. Predicted Wage Loss Duration

Figure 4.2 is a modified boxplot of the monthly predicted wage loss durations based on the month of claim registration. The figure indicates that this calculation creates a metric with very little monthly variance. The median predicted wage loss duration only changes in January 2000. Additionally, the distribution of predicted wage loss durations between the 25th and 75th percentile rarely changes. Monthly changes are present in the average predicted wage loss duration. This average is a mean of median values since the predicted values are the median claim duration for the age group and the ICD9 code. The figure indicates that predicted wage loss duration does not provide a responsive performance measurement.

Figure 4.2 Predicted Wage Loss Duration of Claims
A comparison of monthly PWLD and RWLD is presented in Figure 4.3. The figure displays the predicted wage loss duration and the median retrospective wage loss duration for each month. For this chart, the observed median RWLD duration is calculated using registration month to allow for comparison with PWLD. The median retrospective wage loss duration is used since the PWLD is based on medians. Figure 4.3 indicates that the median predicted wage loss duration is representative of the median retrospective wage loss duration. The RWLD does, however, indicate a higher degree of month to month variance than the predicted values.

**Figure 4.3  Comparison of Median Predicted Wage Loss Duration and Actual Median RWLD**

RWLD can be calculated based on registration month as was done for Figure 4.3 suggesting that this may be a useful measurement of wage loss. Calculating retrospective wage loss duration based on the month of claim registration is not appropriate due to systematic errors that occur when this calculation is used. These systematic errors are masked when the median RWLD is used. RWLD based on month of registration is only accurate if sufficient data are available after the registration month and if comparisons are only made on the retrospective wage loss during a defined period. Figure 4.4 displays the AWCBC complete duration, two calculations of RWLD; one using registration month and one using close month and the median PWLD. Figure 4.4 indicates that PWLD is not representative of the existing duration measures. PWLD does not capture trends or monthly variation and it underestimates average claim duration indicated by other metrics. The chart also displays the systematic errors associated with RWLD based on registration which is continuously decreasing as a result of censored data.

Figure 4.4 identifies several factors to consider when developing metrics within the WCB environment. The first consideration is whether registration or closure will be used as the time reference. Using registration date requires an observation period. A second consideration is whether to use a median, mean or a distribution of values for comparison. Figure 4.4 identifies the difference between median and mean values within the WCB data and illustrates the significant difference between predicted and observed wage loss durations.
PWLD is only an accurate performance measurement if the organization believes that the values accurately represent the claim duration. Figure 4.5 provides a comparison of actual and predicted wage loss using the residual of the actual and predicted durations. The figure displays residuals between the 5\textsuperscript{th} and 95\textsuperscript{th} percentiles and indicates that these residuals are not normally distributed. Predicted wage loss durations have a tendency to underestimate the duration of long claims and overestimate the duration of short claims. On average, PWLD underestimates the duration of claims by approximately 25 wage loss days. If the existing predictions were accurate the residuals would be normally distributed as the predictions would over and underestimate claim duration equally.

Figure 4.5 Distribution of Residuals for Actual and Expected Wage Loss Duration

Cumulative monthly wage loss duration is presented in Figure 4.6. This figure indicates the age of claims based on the month of compensation. The mean age of claims declined between January 2000 and May 2001 and increased after that point. The range of the distribution of claims between the 25\textsuperscript{th} and 75\textsuperscript{th} percentiles decreased and increased over the same periods. Figure 4.6 supports a known fact that a
A review of long claims was conducted at the WCB around May 2001 where the intent of the review was to close long claims.

**Figure 4.6** Cumulative Wage Loss Duration of Claims by Month of Payment

The mean cumulative wage loss duration is considerably higher than the median value indicating the influence of long claims on duration measurement. In the case of cumulative wage loss duration, the mean age is consistently higher than any of the other wage loss measurements. The trends shown in cumulative wage loss duration are not present in other measurements.

The proportions of claims at different ages are identified in Figure 4.7 to investigate what claims are responsible for changes in cumulative wage loss. Claims were divided into 5 groups based on the number of wage loss days paid to claims in the month of payment. The subgroups of claims identified in Figure 4.7 are claims paid between 0 and 20 days, 20 and 40 days, 40 and 60 days, 60 and 100 days and more than 100 days.

**Figure 4.7** Proportion of Claims by Elapsed Wage Loss Duration Group
The chart indicates an increase in the number of claims in the 0 to 20 day group throughout the period. Similar, smaller, trends in occur in the 20 to 40 and 40 to 60 day groups. The figure also indicates a significant decrease in the number of claims that are older than 100 days. Figure 4.7 indicates that changes in cumulative wage loss duration identified in Figure 4.6 are most likely a result of the decrease in claims with a wage loss duration greater than 100 days. The figure also indicates that in both December 2000 and December 2001 a noticeable decrease in the proportion of claims in the 0 to 20 days group occurs. Increases in the median duration of claims in these months are also observed in Figure 4.6. Given the data, however, it is not possible to determine whether or not this deviation is random or repetitive.

The relationship between cumulative wage loss duration and predicted claim duration is illustrated in Figure 4.8. This figure indicates the proportion of claims that are below the PWLD, at the PWLD and above the PWLD in each month. Claims were considered to be at their predicted wage loss duration if they were within ±1 wage loss day of the prediction. The most noticeable change on this figure is the increase in the proportion of claims at their predicted wage loss duration and the decrease in the proportion of claims above their predicted wage loss duration in December 2000.

Figure 4.8 Comparison of Cumulative Wage Loss Days Paid to Predicted Wage Loss Days

![Figure 4.8](image)

The proportion of claims below the PWLD is slightly increasing prior to July 2001 and then decreases. The proportion of claims at their PWLD slowly increases prior to December 2000, jumps in January 2001 and then declines. The opposite is true for claims above their PWLD. The figure indicates that the proportion of claims at the PWLD and above the PWLD appear to reflect one another indicating the relationship between these two groups of claims. This figure confirms that the PWLD tends to underestimate claim duration since the majority of claims are at, or above, their PWLD.

4.3. Claim Survival Wage Loss Duration

The proportion of claims surviving to specified wage loss durations are shown on Figure 4.9 for each month between January 2000 and April 2001. Claims were separated based on the registration month and were observed for 12 months. The figure indicates the wage loss duration at which 25, 50 and 75 percent of claims close as well as the average number of days at which claims close. The shaded region indicates the age range over which 25 to 75 percent of claims close and the dash indicates the duration where 50 percent of claims are active. The black dot indicates the mean age of claims at closure.
Figure 4.9 indicates that the ages at which 25 and 50 percent of claims close exhibit limited variation. Regardless of the registration month, 25 percent of claims were consistently closed at three wage loss days and 50 percent of claims were closed when they reached a duration of approximately 10 days. The mean age at which claims closed decreased from January until December 2000, but increased significantly in January 2001. The mean age of closure increased slightly from January 2001 April 2001. The age at which 75 percent of wage loss claims are closed varied throughout the period.

The ages at which claims close provide results much lower than either AWCBC complete duration or RWLD using close month. These differences are shown in Figure 4.9. The figure indicates, however, that the difference between the mean age at closure using survival analysis is very similar to RWLD using registration month. The systematic errors present with this RWLD calculation do not occur if the mean age of claim closure is calculated using survival analysis. Systematic errors obfuscate changes in performance over the period as it is unclear whether the RWLD of claims changes or if the decrease is caused by the methodology. Survival analysis does not bias the measurement towards claims registered in earlier periods since all claims are observed equally. The trade-off required to use survival analysis is that reports are not available until the end of an observation period. The benefit, however, of using survival analysis is that the calculation methodology does not hide performance changes.

The survival functions created for survival analysis provide an opportunity to identify whether claims registered in a specific month were closed in a statistically different manner than the claims registered in the previous month. Registration months were tested using a Mantel-Cox log-rank test at a confidence level of 95 percent. The results of these tests are identified in Table 4.1. The test indicated that between January 2000 and April 2001 four months were statistically different than the preceding month. The months with a statistically significant difference are shown in bold in Table 4.1. The table shows for example, that claims registered in February 2000 have a different survival function than claims closed in January 2000. Using the information in the table it is possible to identify groups of months with similar survival functions. Similar survival functions can be interpreted as months where the probability claims surviving until different ages is the same.
Table 4.1  Mantel-Cox Log-Rank Test Results for Differences in Survival Functions

<table>
<thead>
<tr>
<th>Current Month</th>
<th>Feb-00</th>
<th>Mar-00</th>
<th>Apr-00</th>
<th>May-00</th>
<th>Jun-00</th>
<th>Jul-00</th>
<th>Aug-00</th>
<th>Sep-00</th>
<th>Oct-00</th>
<th>Nov-00</th>
<th>Dec-00</th>
<th>Jan-01</th>
<th>Feb-01</th>
<th>Mar-01</th>
<th>Apr-01</th>
</tr>
</thead>
<tbody>
<tr>
<td>P-Value</td>
<td>0.00</td>
<td>0.16</td>
<td>0.19</td>
<td>0.91</td>
<td>0.96</td>
<td>0.03</td>
<td>0.63</td>
<td>0.25</td>
<td>0.53</td>
<td>0.01</td>
<td>0.00</td>
<td>0.69</td>
<td>0.06</td>
<td>0.21</td>
<td></td>
</tr>
<tr>
<td>Difference</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

Statistical testing only indicated presence of differences in survival functions not the type of difference. Combining the testing results with Figure 4.9 allows for the type of difference between groups to be determined. The direction of changes between groups is included in Table 4.2. A decrease in the survival function means that claims close faster and an increase has the opposite effect. As an example, testing identified a difference between January and February 2000. The chart indicates that a decrease in durations occurred. This indicates that claims registered in February 2000 were closed faster than the claims registered in January 2000. Figure 4.9 and the testing results indicate that the duration at which claims closed declined 4 times after January 2000, but increase following the decrease in December 2001.

Table 4.2  Months with Similar Survival Functions

<table>
<thead>
<tr>
<th>Months</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
<th>Group 4</th>
<th>Group 5</th>
<th>Group 6</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Jan-00</td>
<td>Feb-00</td>
<td>May-00</td>
<td>Aug-00</td>
<td>Dec-00</td>
<td>Jan-01</td>
</tr>
<tr>
<td></td>
<td>Mar-00</td>
<td>Jun-00</td>
<td>Sep-00</td>
<td>Oct-00</td>
<td></td>
<td>Feb-01</td>
</tr>
<tr>
<td></td>
<td>Apr-00</td>
<td>Jul-00</td>
<td>Nov-00</td>
<td></td>
<td></td>
<td>Mar-01</td>
</tr>
<tr>
<td>Comparison</td>
<td>NA</td>
<td>Jan-00</td>
<td>Apr-00</td>
<td>Jul-00</td>
<td>Nov-00</td>
<td>Dec-00</td>
</tr>
<tr>
<td>Direction</td>
<td>NA</td>
<td>Decrease</td>
<td>Decrease</td>
<td>Decrease</td>
<td>Decrease</td>
<td>Increase</td>
</tr>
</tbody>
</table>

4.4. Uncensored Claim Duration

The distribution of wage loss days paid to uncensored claims following 12 months of observation are displayed for each month between January 2000 and April 2001 in Figure 4.10. Claims in the figure are grouped by registration month.
Figure 4.10 indicates that the distribution of wage loss days paid to uncensored claims varies over time. Trends in the data are not readily apparent nor are significant changes in the distribution other than in the 75th percentile of uncensored wage loss. The 25th percentile of the metric is unchanged throughout the period, and little variance is observed in the median duration. The difference between the wage loss duration of uncensored claims and the durations of the other metrics is expected since censored claims are removed from the calculation. This figure indicates the effect of censored claims on wage loss duration measurement.

The proportion of uncensored claims closed in each month after registration is illustrated in Figure 4.11. The figure groups claims by month of registration and provides a comparison for all months between January 2000 and April 2001. The chart indicates the proportion of all registered wage loss claims that are closed in the subsequent months. On the figure, claims that are closed in the registrations month are indicated as being closed in month 1. They are shown as the black square on the chart. Dashes are used to indicate the proportion of claims closed in the following months with smaller dashes used for later months. A black and white square is used to indicate the proportion of claims that are censored after the observation period.
Figure 4.11 indicates a high degree of monthly variance in the proportion of claims closed across each of the registration months. The figure indicates that the majority of the variance occurs in the first two months. As month of closure becomes farther from registration month the proportion of claims closed in the month stabilizes. The proportion of censored claims is stable across registration months and is approximately 2 percent of claims. Two patterns exist on the chart. First, the proportion of claims closed in the first and second months mirror one another. If the proportion of claims closed is high in the registration month, the proportion of claims closed in the second month is lower. The opposite of this also holds. This mirroring effect is present to a lesser degree in the third and fourth months. Figure 4.11 does not indicate any trends or anomalous registration months.

Manipulating the data used in Figure 4.11 to show the cumulative proportion of claims closed is illustrated in Figure 4.12. Figure 4.12 supports the earlier finding of the mirroring effect of closures in the first and second. The cumulative proportion of claims closed after two months is stable across registration months. This is also the case for the rest of the months after registration. The figure indicates that the proportion of claims closed each month decreases in a non-linear manner with fewer and fewer claims closed in months farther away from registration.
Claimant age and injury type were provided by the WCB allowing for comparisons of uncensored claim wage loss between subgroups of claims. The mean wage loss duration of uncensored claims is plotted in Figure 4.13 for claims registered between 1998 and 2000. Claims in the figure are grouped by claimant age and by injury type. Claimant ages in the figure range from 10 to 69 and are divided into groups of ten years. These age ranges cover 95 percent of WCB claimants in the analysis data set. Claims were grouped by injury type as recorded by the WCB. Nine of the 35 injuries in analysis data set are included in Figure 4.13 covering 95 percent of claims in the data.

Figure 4.13 identifies clear differences in uncensored claim wage loss duration across injuries and ages. Of the most common injuries, abrasions require the least number of wage loss days and fractures result in the most wage loss. The figure indicates that across age groups in the majority of injuries the wage loss of claims is associated with the claimant age. Older claimants require more wage loss. This trend is present in all injuries, however, the degree of the age effect differs between injuries.
A minimal age effect is present in abrasions. The effect of age in burns, contusions, lacerations and fractures is relatively linear and increasing. Tendonitis and strains exhibit an age effect that is non-linear and decreasing. The wage loss duration of these claims increases rapidly across lower age groups and plateaus in higher groups. Bursitis has a unique age effect; wage loss increases in lower age groups, plateaus and then decreases in the highest age groups in 1999 and 2000. This is most easily seen using Figure 4.15, Figure 9.1, or Figure 9.2.

Figure 4.13 provides indicates changes in wage loss over time. Across several age groups and injury types there is little difference in wage loss duration between years. Contusions, lacerations, abrasions and strains exhibit limited yearly variation in majority of the age groups. Most yearly differences are found in within fractures, bursitis and tendonitis. The yearly differences within these groups vary depending on the age group and consistent changes over time and age groups are not present.

Figure 4.14 is the same chart as Figure 4.13 except that it presents median rather than mean wage loss durations. Figure 4.14 provides the same findings as to differences in wage loss duration and age effect as the previous chart. The figure indicates minimal changes in yearly wage loss but that the median wage loss duration for bursitis claims appears to be higher in 2000 than in the previous years for most age groups. The age effect is reduced when median values are used instead of means.

The following figure indicates the wage loss duration of uncensored claims across age groups and injury types for claims registered in 1998. Charts for 1999 and 2000 are included in Appendix D: Uncensored Wage Loss Duration Distributions. Figure 4.15 indicates that the distribution of wage loss days paid to uncensored claims varies across ages and injuries. The distribution of wage loss is greater in higher age groups for the majority of injury types. This, however, does not occur in fractures or abrasions. In fractures the range between the 25th and 75th percentile of wage loss appears relatively constant across age groups. In abrasions, the distribution of wage loss is tightly grouped for most age ranges. The figure indicates that the 25th percentile of wage loss duration is stable across the majority of injuries and ages although, the 25th percentiles of uncensored wage loss for fractures is different from other injuries. The figure also indicates that in burns, contusions, lacerations and abrasions the mean and the 75th percentile of wage loss are similar across the age groups.
Figure 4.15  Distribution of Yearly Wage Loss Duration for Uncensored Claims (1998)

4.5. Wage Loss Duration Measurement Comparison

A comparison of the existing and proposed wage loss metrics is presented in Figure 4.16. The mean values are identified for each registration month. The figure indicates that at monthly intervals each of the measurements provides a unique claim duration except for RWLD based on registration month and survival duration which report similar durations. The minimum indicator of duration is PWLD and CWLD is the highest. Cumulative wage loss duration is the only metric that exceeds AWCBC complete duration and is the only measurement indicating a downward trend in duration. Consistent trends are not present across measurements and CWLD and RWLD based on closure indicate conflicting trends.

Figure 4.16  Comparison of Mean Monthly Wage Loss Duration

Figure 4.17 is the same chart as Figure 4.16 using median rather than mean durations except for AWCBC complete duration which is not calculated as a median since the metric is set by the AWCBC. The figure indicates that at the median level, the majority of wage loss duration measurements are the same. In the figure, RWLD, survival duration, PWLD and uncensored claim duration are tightly grouped around a
median duration of 10 wage loss days. In Figure 4.17 AWCBC complete duration provides the highest duration as CWLD is now lower than AWCBC duration. Figure 4.17 also indicates that the mean wage loss durations presented in Figure 4.16 are substantially higher than the median duration values.

Figure 4.17 Comparison of Median Monthly Wage Loss Duration

![Graph showing comparison of median monthly wage loss duration with different symbols representing various metrics: AWCBC Duration, PWLD_Reg, RWLD (Closure), CWLD, RWLD (Registration), Survival Duration, Uncensored Claims.]

Earlier results identified the impact of claimant age and injury type on wage loss. Figure 4.18 is a comparison the mean wage loss duration across proposed metrics for the year 2000. Charts for the years 1998 and 1999 are included in Appendix E: Comparison of Mean Wage Loss Durations, however, since CWLD requires a stabilization period, 2000 is the first year where CWLD should be examined. RWLD is included to compare proposed and existing measures. Figure 4.18 indicates the age and injury effects identified while computing uncensored claim duration and illustrates that each of the proposed metrics is capable of capturing age and injury effects in the data.

Figure 4.18 Mean Wage Loss Duration Measurements by Age Group and Injury Type - 2000

![Graph showing mean wage loss duration by age group and injury type with various symbols representing different metrics and injuries.]

The proposed measures of wage loss duration each have unique relationships with RWLD. PWLD is generally the lowest of all measures across injuries and ages. Additionally, PWLD is always lower than
RWLD. CWLD, conversely, is normally higher than RWLD. Survival duration and uncensored claim duration are closely grouped and are similar in duration to RWLD across many ages and injuries.

Figure 4.19 compares median wage loss durations rather than mean values. The results indicated by the figure are similar to those identified in the previous graph. Age group and injury type effects appear while using median values. As with previous examinations of median values, the results of all four proposed metrics are more tightly grouped than when mean durations are used. In the case of burns, contusions, lacerations and abrasions, the values across all ages are almost identical. Longer wage loss claims have a greater range between results.

**Figure 4.19 Median Wage Loss Duration Measurements by Age Group and Injury Type - 2000**
5. MEASUREMENT SELECTION

A number of alternative wage loss metrics were proposed to assess wage loss duration at the WCB. The results of this study indicate that a number of the metrics yield similar measures of duration. Implementing all of the measures within the organization is not feasible nor is it required and as such identifying the best alternatives is needed. Strengths and weaknesses of each metric and WCB specific duration measurement considerations were identified throughout the course of the study. Selecting the best method of wage loss measurement for the organization requires balancing the strengths and weaknesses of each of the metrics and clearly defining the metric according to WCB considerations.

5.1. Strengths and Weaknesses of Duration Metrics

Table 5.1 provides a summary of the strengths and weaknesses of proposed and existing wage loss metrics. The main strengths and weaknesses identified in the table are how claim durations are associated with a time frame, whether or not an observation period is used, which claims are included and how much data can be compared for any given month. An ideal measurement would report duration based on month of registration or month of activity, would not require an observation period, would report the duration of all claims, would not make point comparisons and would be available in real time. Claim duration at the WCB does not allow for an ideal metric and as such trade-offs in strengths and weaknesses are needed.

Table 5.1 Summary of Metric Strengths and Weaknesses

<table>
<thead>
<tr>
<th>Metric</th>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>AWCBC Complete Duration</td>
<td>• Exhibits monthly variation</td>
<td>• Calculation complexity</td>
</tr>
<tr>
<td></td>
<td>• Comparable across WCBs</td>
<td>• Long observation period</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Considerable assumption</td>
</tr>
<tr>
<td>Retrospective Wage Loss Duration</td>
<td>• Accepted calculation</td>
<td>• Duration with close month</td>
</tr>
<tr>
<td></td>
<td>• Observation period not required</td>
<td>• All claims included</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Stabilization period</td>
</tr>
<tr>
<td>Predicted Wage Loss Duration</td>
<td>• Predictive measure</td>
<td>• Beyond WCB control</td>
</tr>
<tr>
<td></td>
<td>• Prediction with registration month</td>
<td>• Inaccurate predictions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Predictions based on medians</td>
</tr>
<tr>
<td>Cumulative Wage Loss Duration</td>
<td>• Wage loss with month of activity</td>
<td>• Stabilization period</td>
</tr>
<tr>
<td></td>
<td>• Real-time reporting</td>
<td>• Increased calculation complexity</td>
</tr>
<tr>
<td>Claims Survival Duration</td>
<td>• Duration with registration month</td>
<td>• Calculation complexity</td>
</tr>
<tr>
<td></td>
<td>• Compare survival functions</td>
<td>• Observation period</td>
</tr>
<tr>
<td>Uncensored Claim Duration</td>
<td>• Duration with registration month</td>
<td>• Observation period</td>
</tr>
<tr>
<td></td>
<td>• Sub set of uncensored claims</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Compares period of time</td>
<td></td>
</tr>
<tr>
<td>Monthly Proportion of Claims Closed</td>
<td>• Claims divided based on registration</td>
<td>• Not a direct duration measurement</td>
</tr>
<tr>
<td></td>
<td>• Comparisons of multiple months</td>
<td>• Observation period</td>
</tr>
<tr>
<td></td>
<td>• Sub set of uncensored claims</td>
<td></td>
</tr>
</tbody>
</table>

5.2. WCB Specific Metric Development Considerations

Regardless of the measurement that is chosen, clearly defining the metric involves several WCB specific considerations in addition to the requirements for developing effective performance measurements.
outlined in Table 2.1 of the Literature Review. Table 5.2 provides a list of WCB specific considerations required to define metrics.

### Table 5.2  WCB Duration Measurement Parameters

<table>
<thead>
<tr>
<th>Consideration</th>
<th>Definition Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Close Date</td>
<td>Which close date will be used – first close, last close, other?</td>
</tr>
<tr>
<td>Reference Period</td>
<td>Should measurements be reported based on registration month, month of activity or close month?</td>
</tr>
<tr>
<td>Observation Period</td>
<td>Is an observation period required? How long should the observation period be?</td>
</tr>
<tr>
<td>Claim Completion</td>
<td>Will censored or uncensored claims be used or is complete claim information available? How will long claims be accounted for?</td>
</tr>
<tr>
<td>Systematic Errors</td>
<td>Does the method of calculation create systematic errors? Can the systematic errors be resolved by changing the methodology</td>
</tr>
<tr>
<td>Report Level</td>
<td>How will results be presented? Are aggregate or specific measurements required? What specific measures will be used?</td>
</tr>
<tr>
<td>Metric Comparisons</td>
<td>How will metrics be compared between groups and over time? Will point comparisons be used or can more data be compared?</td>
</tr>
<tr>
<td>Reported Values</td>
<td>Does it make sense to report mean or median values? Is there a difference if alternative values are used?</td>
</tr>
<tr>
<td>Data Availability</td>
<td>What data will be used to calculate duration? When will calculation take place?</td>
</tr>
</tbody>
</table>

### 5.3. Metric Use

Currently, predicted wage loss duration is not accurate enough to warrant use as a measure of wage loss. Cumulative wage loss duration, claim survival duration and uncensored claim wage loss duration provide adequate measurements of wage loss.

The study identifies that examining more specific subsets of claims is worthwhile and that depending on the type of claim under observation the most suitable wage loss metric may vary. The mean retrospective wage loss duration for shorter injuries was closely matched by mean claim survival duration and mean uncensored claim duration. In this case, the proposed metrics are better than the existing metric since they associated claims with the registration month and they are better able to identify changes in WCB performance rather than changes that result from closing long claims.

Many of the duration metrics indicate limited variation over time suggesting that wage loss duration should be monitored for exceptions rather than consistent change. The study suggests that if a metric is used to identify substantial deviations in performance uncensored claim duration or claim survival duration should be used. If the intent of wage loss measurement is to track and respond to changes in wage loss a measure that exhibits a higher degree of monthly variability, such as cumulative wage loss or one of the existing metrics is appropriate.

For longer claims, the mean retrospective wage loss duration was more closely matched by the mean cumulative wage loss duration suggesting that this metric may be better for longer claims. Cumulative wage loss duration is better than other proposed metrics since it uses all claims like RWLD and it is better
than RWLD since it reports on wage loss payments in the month of payment rather than the month of closure.

Alternately, if median values are examined, all metrics provide an accurate representation of median retrospective wage loss duration. PWLD continues to underestimate RWLD but not to the same extent as when mean values are used. If median values are used, CWLD becomes the metric of choice since it does not require an observation period and associates wage loss with the month of payment.
6. SUMMARY

This study proposed a number of alternative methods to calculate and report wage loss duration for claims registered with the Workers’ Compensation Board of British Columbia. The measures of wage loss created for the study include: predicted wage loss duration, cumulative wage loss duration, claim duration identified using survival analysis and the duration of uncensored claims.

An examination of the practice or reporting wage loss duration at an aggregate level, either monthly or yearly, for all ages and claims types revealed that aggregate durations may not adequately identify fluctuations in wage loss. At the aggregate level, existing measures of wage loss duration are biased to reporting the duration of long claims which are the minority of all claims. Fluctuations in durations at the aggregate level are more likely to indicate changes in long claims than overall changes in WCB performance. The effect of long wage loss claims was seen in the difference between mean and median claim durations.

The study found that the current predictions of wage loss duration contained in the WCB data do not accurately identify the duration of claims in the system. Wage loss predictions based on ICD9 codes had a tendency to underestimate claim duration for long claims and overestimate the duration of short claims. As such, predicted wage loss duration is not an appropriate measurement of wage loss for the WCB.

Cumulative wage loss duration identified that the age of claims managed by the WCB decreased between January 2000 and May 2001 and increased after that point. Cumulative wage loss duration was the only metric indicating a downward trend in duration and was also the only metric with a duration higher than AWCBC complete duration.

Evaluating wage loss across different age categories and injury types identified that each of the proposed metrics accurately indicated the differences in wage loss that are known to exist across age groups and injury types. The study found that investigating durations for subgroups may be a more appropriate approach to wage loss measurement. Durations within subgroups appeared relatively stable over time and changes in performance within specific subgroups of claims are easy to identify.

This study found that when proposed metrics were compared to the existing metrics it is possible to improve on measurements that are currently in place although the existing metrics remain valid. Claim survival duration or uncensored claim duration are more appropriate for comparisons between time periods or when comparing large groups of claims. These methods remove some of the bias towards long claims and allow for actual changes in performance to be identified. Cumulative wage loss duration is more appropriate when all claims need to be included in duration measures. Although long claims influence cumulative wage loss duration this metric is unique in that wage loss duration is associated with the month in which the wage loss days were paid rather than registration or closure.
7. **FUTURE DIRECTIONS AND COMMENTS**

Throughout the course of this study a number of extensions to the work became apparent. These extensions are briefly discussed to highlight possible sources of future research. A comment on the data required to investigate wage loss duration is also included.

7.1. **Application of Survival Analysis to WCB Duration Data**

A number of opportunities to apply survival analysis to WCB duration data became apparent throughout the course of this study. Claim duration is an important measure of performance within the organization and it is used to assess employee, office and regional performance. In most cases censored data exist since claims can extend for many years and waiting until claims end is not feasible. Survival analysis could be used within the organization to determine if certain employees, offices or regions are closing claims more effectively than others. Survival analysis could also be used to assess any management interventions intended to reduce claim wage loss.

7.2. **Improving Predicted Wage Loss Durations**

The results of modeling predicted wage loss duration indicate that developing a predictive model of wage loss duration may be worthwhile. If wage loss predictions were improved reporting predicted wage loss duration based on registration month could be a worthwhile metric for WCB management. Currently, the ability to create the metric for management exists but the results have little meaning. The implications of improved wage loss predictions include the ability to create comparisons between predicted wage loss and any other wage loss measures.

7.3. **Data Requirements for Wage Loss Duration Analysis**

Assessing wage loss duration at the WCB requires several years of claim data. This study used a data set with slightly more than four years of claim data. Since AWCBC complete duration is frequently calculated using 5 years of data it would be worth having a data set that contained at least 5 years of data. The AWCBC durations for this analysis were provided by the organization and as such 5 years of data were not required. Another data consideration arose, however, in that when examining data from a specific time period many wage loss measurements require several years to stabilize. In some cases a two year stabilization period was observed. If this is not understood it can appear as though wage loss is increasing. The end result is that wage loss measurement is easier with more data, but more data increases computing and processing requirements.
8. REFERENCES


#### 9. APPENDICES

**Appendix A: Analysis Data Set**

<table>
<thead>
<tr>
<th>Field</th>
<th>Percent Complete</th>
<th>Censored Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unique claim number for each record</td>
<td>100</td>
<td>No</td>
</tr>
<tr>
<td>• Only claims with registration numbers were included</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Date of claimant injury</td>
<td>100</td>
<td>No</td>
</tr>
<tr>
<td>• Only claims with injury dates were included</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Date of registration with WCB</td>
<td>100</td>
<td>No</td>
</tr>
<tr>
<td>• Only claims with registration dates were included</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Date the claim is first closed</td>
<td>96.4</td>
<td>Yes</td>
</tr>
<tr>
<td>• No first close data screening</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Date the claim was last closed</td>
<td>96.4</td>
<td>Yes</td>
</tr>
<tr>
<td>• No last close data screening</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total wage loss days of claim</td>
<td>100</td>
<td>Yes</td>
</tr>
<tr>
<td>• Only claims with wage loss payments were included</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total wage loss days of claim before reactivation</td>
<td>88.8</td>
<td>No</td>
</tr>
<tr>
<td>• No wage loss before reactivation screening</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Predicted wage loss duration</td>
<td>81.4</td>
<td>No</td>
</tr>
<tr>
<td>• No predicted wage loss duration screening</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age adjusted predicted wage loss duration</td>
<td>81.4</td>
<td>No</td>
</tr>
<tr>
<td>• No age adjusted predicted wage loss duration screening</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix B: Interpretation of Modified Boxplots

Modified boxplots were used to illustrate data throughout this study. The following is a sample boxplot that will be used as an example in this appendix.

A standard boxplot includes the 5th percentile, the 25th percentile, the median, the 75th percentile and the 95th percentile. On the preceding example the values between the 25th and 75th percentile are shown using the shaded region. The 5th and the 95th percentiles are shown using the lines extending beyond the ends of the shaded region and the median is shown using the dash.

The modified version of the boxplot removes the lines indicating the 5th and 95th percentiles and includes an extra marker indicating the mean value for each category. The shaded region remains unchanged on the modified chart.

The charts on the modified boxplots indicate the middle 50 percent of values from the 25th to the 75th percentiles and include both the mean and median values for each category. The modified charts are similar to standard boxplots in that the values indicated on the chart are calculated for each of the categories. This allows for comparisons to be made across categories.
Appendix C: Summary of Observed and Censored Data

<table>
<thead>
<tr>
<th>Registration Month</th>
<th>Total Claims</th>
<th>Closed Claims</th>
<th>Censored Claims</th>
<th>Percent Censored</th>
<th>Maximum Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>January-00</td>
<td>5291</td>
<td>5185</td>
<td>106</td>
<td>2.00</td>
<td>391</td>
</tr>
<tr>
<td>February-00</td>
<td>5702</td>
<td>5597</td>
<td>105</td>
<td>1.84</td>
<td>376</td>
</tr>
<tr>
<td>March-00</td>
<td>6326</td>
<td>6239</td>
<td>87</td>
<td>1.38</td>
<td>389</td>
</tr>
<tr>
<td>April-00</td>
<td>5310</td>
<td>5231</td>
<td>79</td>
<td>1.49</td>
<td>371</td>
</tr>
<tr>
<td>May-00</td>
<td>6233</td>
<td>6156</td>
<td>77</td>
<td>1.24</td>
<td>377</td>
</tr>
<tr>
<td>June-00</td>
<td>6269</td>
<td>6192</td>
<td>77</td>
<td>1.23</td>
<td>369</td>
</tr>
<tr>
<td>July-00</td>
<td>5632</td>
<td>5547</td>
<td>85</td>
<td>1.51</td>
<td>362</td>
</tr>
<tr>
<td>August-00</td>
<td>6112</td>
<td>6047</td>
<td>65</td>
<td>1.06</td>
<td>363</td>
</tr>
<tr>
<td>September-00</td>
<td>6192</td>
<td>6120</td>
<td>72</td>
<td>1.16</td>
<td>369</td>
</tr>
<tr>
<td>October-00</td>
<td>5509</td>
<td>5463</td>
<td>46</td>
<td>0.83</td>
<td>377</td>
</tr>
<tr>
<td>November-00</td>
<td>5613</td>
<td>5558</td>
<td>55</td>
<td>0.98</td>
<td>402</td>
</tr>
<tr>
<td>December-00</td>
<td>4569</td>
<td>4500</td>
<td>69</td>
<td>1.51</td>
<td>637</td>
</tr>
<tr>
<td>January-01</td>
<td>5332</td>
<td>5237</td>
<td>95</td>
<td>1.78</td>
<td>367</td>
</tr>
<tr>
<td>February-01</td>
<td>5375</td>
<td>5297</td>
<td>78</td>
<td>1.45</td>
<td>352</td>
</tr>
<tr>
<td>March-01</td>
<td>5720</td>
<td>5620</td>
<td>100</td>
<td>1.75</td>
<td>363</td>
</tr>
<tr>
<td>April-01</td>
<td>4577</td>
<td>4521</td>
<td>56</td>
<td>1.22</td>
<td>512</td>
</tr>
</tbody>
</table>
Appendix D: Uncensored Wage Loss Duration Distributions

Figure 9.1  Distribution of Yearly Wage Loss Duration for Uncensored Claims (1999)

Figure 9.2  Distribution of Yearly Wage Loss Duration for Uncensored Claims (2000)
Appendix E: Comparisons of Mean Wage Loss Durations

Figure 9.3  Mean Wage Loss Duration Measurements by Age Group and Injury Type - 1998

Figure 9.4  Mean Wage Loss Duration Measurements by Age Group and Injury Type - 1999
Appendix F: Comparisons of Median Wage Loss Durations

Figure 9.5  Median Wage Loss Duration Measurements by Age Group and Injury Type - 1998

Figure 9.6  Median Wage Loss Duration Measurements by Age Group and Injury Type - 1999