ESTIMATING THE COST OF A PROPOSED CHANGE TO CANADIAN ARMED FORCES PROMOTION POLICY

Michelle C. Straver, Sonia A. Latchman, Major Neil Tabbenor
Department of National Defence – Director General Military Personnel Research and Analysis
101 Colonel By Drive, Ottawa, ON, K1A 0K2 Canada
Michelle.Straver@forces.gc.ca, Sonia.Latchman@forces.gc.ca, Neil.Tabbenor@forces.gc.ca

ABSTRACT
Under current Canadian Armed Forces (CAF) policy, personnel at the rank of Private (Pte) are typically promoted to the rank of Corporal (Cpl) after 4 years of service (YOS). A proposed policy, if implemented, will have this requirement reduced to 3 YOS. This research was undertaken to estimate the cost of the proposed policy change. Using historical data, a workforce modelling approach was taken to forecast the population for the next 10 Fiscal Years (FYs) under the two different policies. The cost of the policy change was then calculated based on the difference in the numbers of personnel at each rank. Several factors were considered, including the current population, population promotion and attrition rates, and future recruiting numbers. The cost of the policy change was estimated at $22.1M for FY 13/14, and averaged $13.4M between FYs 14/15 and 21/22. The long-term annual cost was estimated at $15.3M.

KEY WORDS
Operations Research; Policy Issues; Forecasting; Workforce Modelling

1. INTRODUCTION
The Canadian Armed Forces (CAF) promotion policy is monitored on an on-going basis to ensure that it continues to enable the CAF to meet its obligations to its personnel, while effectively delivering its mandate to the Government of Canada. At this time, the Chief of Military Personnel (CMP) is considering the release of a consolidated Defence Administrative Order and Directive (DAOD) series that will update and simplify the present policies; such as, for example, minimizing the distinction between Regular Force (RegF) and Reserve Force (ResF) personnel.

One major change being considered is a reduction in the number of years of service (YOS) required for promotion from the rank of Private (Pte) to Corporal (Cpl). Under the proposed DAOD series, this condition would be harmonized to a requirement of 3 YOS. Given that promotion affects pay, the reduction of the requirement for the RegF from 4 to 3 YOS would incur a cost to the CAF since RegF Non-Commissioned Members (NCMs) will spend less time in the rank of Pte, and more time in the rank of Cpl. This research was conducted to estimate the cost of this proposed policy change for the RegF.

2. PREVIOUS WORK
Military organizations are distinct from civilian organizations in that personnel generally join at the lowest rank (Pte, in the case of the CAF’s NCMs) and progress to the higher ranks through promotion [1, 3]. Consequently, it is important for military organizations to conduct workforce planning on an ongoing basis to ensure that their personnel requirements are met at all ranks, and at all times [1, 3].

Perhaps as a consequence of this need, there are many publications that document workforce modelling activities as applied to military organizations around the world. These activities address a variety of problems that span a wide range of timelines (from months to 20 or more years) and scales (to address problems pertaining to a small subgroup of a military organization, or across the entire organization). Some of these activities have elements in common with the work described in this report. To note only a few examples:

- A methodology for forecasting attrition based on the YOS profile of a population was developed for the CAF [4,5].
- A cohort analysis of new CAF recruits examined attrition during the first YOS [6].

1 In the Royal Canadian Navy (RCN), the equivalent of a Pte is an Ordinary or Able Seaman (OS or AB), while the equivalent of a Cpl is a Leading Seaman (LS). For simplicity, the terms Pte and Cpl are used throughout this paper.

2 Within the CAF, promotion from Pte to Cpl can be described as a “push” promotion. This means that promotions are not driven by vacancies at the Cpl rank, but rather by the experience level of those at the lower rank (i.e. Pte). This is in contrast to the “pull” system that applies to higher ranks, where, for example, the promotions from Cpl to Master Corporal (MCpl) are driven by the number of MCpl vacancies. Push and pull promotions are described further in [1] and [2].
• The Army Manpower Long-Range Planning System (MLRPS) was created to simulate the interactions of factors such as recruitment, attrition, and promotion to enable an analyst to evaluate the impact of U.S. Army policies in the long term, and to determine what changes may be required to reach a desired end state [7].
• The Arena Career Modeling Environment (ACME) Individual Training and Education (IT&E) projection tool was developed to simulate rank-oriented career progression, while taking into account factors such as promotion rates, IT&E requirements for promotion, recruiting levels, age and experience profiles, and member leaving patterns [8].
• A “push-pull” manpower planning model was developed for application to organizations in which both push and pull promotions could occur [2].
• A model simulating attrition, promotion, and recruitment was developed [9] and used to evaluate a new structure for the Search and Rescue Technician within the CAF [10].
• A steady-state (Markovian) model and a dynamic (simulation-based) model were developed for the Belgian Defence. Both models were useful for assessing the impact that policy changes could have; while the steady-state model evaluated the potential long-term effects, the dynamic model was appropriate for evaluating the short-, medium- and long-term effects [11].
• A simulation model was used to evaluate the impact of a new policy on U.S. Army officer professional development, as well as the impact of the policy on the future supply of qualified officers [1, 12].

To the authors’ knowledge, despite the areas of commonality with the study presented in this paper (such as attrition and promotion forecasting), no previous work has been done to look at the specific issue of the financial cost associated with a change in the promotion point from one rank to the next.

3. METHOD

The cost associated with the proposed policy change for a given month can be estimated by calculating the total number of person-months (PMs) that would be spent across all individuals that would be at the rank of Cpl under the proposed policy but at the rank of Pte under the current policy (referred to as the “PM-Delta” within this document), and multiplying this number by the difference in cost between one Cpl and one Pte for one month. It is important to note that, in this analysis, a PM-Delta is not associated to one individual; rather, a PM-Delta is the sum of PMs across all personnel of interest for a selected time period.

With this in mind, a model was built to make projections of the population on a monthly basis, beginning from the start of Fiscal Year (FY) 12/13 (1 April 2012) up to the end of FY 21/22. Some parameters used by the model, discussed in greater detail in Section 3.3, were derived from patterns observed in historical data. The model was used to obtain the distribution, month by month, of the population under both the current policy and the proposed policy.

3.1 Assumptions

For the purposes of this analysis, several assumptions were made, the most important ones being the following:
• The size of the RegF will be maintained at 67 500 personnel, 75% of which will be NCMs.
• The proposed policy will not make any provisions for accelerated promotion before 3 YOS. Therefore, the probability of promotion up to 3 YOS will be equal under both promotion policies.
• Personnel who are promoted between 3 and 4 YOS under the current policy will be promoted when they reach 3 YOS under the proposed policy. Implicit in this is the assumption that these members would achieve their occupation’s prerequisite qualification within their first 3 YOS.
• Personnel who are promoted beyond 4 YOS under the current policy will be promoted beyond 4 YOS under the proposed policy. This implies that the factors causing an individual’s promotion point to be delayed beyond 4 YOS under the current policy (e.g. failure to obtain the necessary qualifications before 4 YOS) would also be present under the proposed policy.

3.2 Cohort Analysis

With the aim of identifying the characteristics of the population that would be affected by the policy change, the first step in the analysis was to conduct a cohort analysis, or longitudinal study, of NCMs recruited between FYs 03/04...

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3 The data used in this study came from an extensive personnel database held by the Department of National Defence. The database stores historical and current information on each member of the RegF. This includes demographic data (e.g. gender, age), as well as information on the individual’s career (e.g. hire date, promotion dates and ranks, release date (if applicable)).
4 The Canada First Defence Strategy [14], released in 2008, allowed for the expansion of the RegF to 70 000. However, the size of the RegF was later frozen [15]. The figure of 67 500 was selected based on consultation with a Subject Matter Expert, while the figure of 75% NCMs was derived from patterns observed in historical data [16].
5 According to CFAO 49-4, the minimum time prerequisite for accelerated promotion is 3 YOS [17]. This is not expected to change under the proposed policy.
6 According to CFAO 49-4, along with the minimum qualifying service prerequisite, eligibility for promotion from Pte to Cpl requires the individual to achieve a minimum qualification for their occupation [17].
and 05/06. The method is similar to that of previous studies that used survival analysis techniques to examine attrition within the CAF population [6, 13]; however, in our case, it was necessary to track the ranks of the personnel throughout the analysis period.

Specifically, for each progressive month of service (MOS) point from the date of joining the RegF up to 71 MOS\(^7\) (6 YOS)\(^8\), each individual was categorized according to the changes (if any) that occurred during the MOS. The categories were the following: note that the term “Cpl+” refers to personnel at the rank of Cpl or higher:

- **Pte, Remain Pte**: The individual started and finished the MOS as a Pte.
- **Pte, Promo to Cpl**: The individual started the MOS as a Pte and was promoted to Cpl during the MOS.
- **Pte, Rel**: The individual started the MOS as a Pte and was released during the MOS.
- **Cpl+, Remain Cpl+:** The individual started and finished the MOS as a Cpl or higher.
- **Cpl+, Rel**: The individual started the MOS as a Cpl or higher and was released during the month.

Examination of these historical patterns revealed important insights. For example, despite the fact that the current promotion point is at exactly 48 MOS, for those promotions that occurred during the 48th MOS, few occurred at exactly 48 MOS; rather, promotions were distributed throughout the 48th MOS. Similarly, promotions were distributed throughout the 36th MOS, rather than occurring at exactly 36 MOS. The reason for these short delays is unknown, but could be related to administrative issues. Regardless of the reason, however, it is reasonable to assume that personnel were in fact eligible for promotion upon reaching 48 (or 36) MOS, and that these delays will continue to exist if the proposed promotion policy is implemented.

Based on this assumption, as well as the assumptions noted in Section 3.1, the only members who would be affected by the proposed policy change are in the range of 37 and 48 MOS. However, not all personnel in this range would be affected. Since we are assuming that those who would be promoted beyond 48 MOS under the current policy would be promoted beyond 48 MOS under the proposed policy, they would be at the rank of Pte until at least 48 MOS under both policies, and would therefore be unaffected by the change.

This added another layer of complexity to the cohort analysis, as it became necessary in the population modelling to separate the Ptes in the 37 to 48 MOS range who would be affected by the policy change from those who would not. This was done by categorizing the Ptes of our analysis in another way for each of the MOS points within this range, as follows:

- **Affected Pte**: The individual was a Pte at the beginning of the MOS and was promoted to Cpl at 48 MOS or less.\(^9\)
- **Unaffected Pte**: The individual was a Pte at the beginning of the MOS and was _not_ promoted to Cpl by 48 MOS.

Based on this cohort analysis, Figure 1 illustrates how the population of interest was distributed. Those who would be affected by the change in the promotion policy, i.e. the individuals of the Affected Pte category, are represented by the “Affected Personnel” series in Figure 1. The Pte and Cpl+ series represent those in the other Pte and Cpl+ categories, respectively.

Simply stated, Figure 1 shows the percentage of recruits that continued to serve in the RegF, by rank, after each MOS point. From the steep drops in the upper line, it can be seen that there is a high attrition rate between 0 and 2 MOS, and again at 36 MOS. Due to the terms of service (TOS) changes implemented in 2005 [18], this cohort would not necessarily have been subjected to the same TOS that are currently in place.\(^10\) For this reason, the attrition rates used in our model were not derived from this information; rather, the expected attrition rates were derived from more recent data. From the steep drops in the lower line, Figure 1 also shows that the highest promotion rate is at 48 MOS, followed by 36 MOS. Further details on how attrition and promotion were modelled are discussed in more detail later in this document.

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7 Note that within this document, the MOS refers to the number of complete MOS; so, 71 MOS refers to the range from exactly 71 MOS to 72 MOS less one day.

8 The population was not examined beyond 6 YOS, as nearly all personnel are promoted to Cpl by this point.

9 It is recognized that there is a possibility that some personnel who were promoted at 48 MOS or earlier would not have been ready for promotion at 36 MOS (and would consequently have been affected by the policy change for only _some_ of the MOS points in the range of interest). However, this was not accounted for in this analysis due to the lack of data that would enable further investigation.

10 Prior to the implementation of the current TOS on 1 May 2005, NCMS joining the RegF with no prior service were enrolled on a Basic Engagement with a length of three years [19]. Under the current TOS, personnel are enrolled on a Variable Initial Engagement (VIE). The length of the VIE varies among the occupations, ranging from three to nine years, excluding subsidized training [18].
3.3 Input Parameters for Population Modelling

Several input parameters were required by the population forecasting model. These include the following, each of which is discussed below:

- Starting population;
- probability of promotion from Pte to Cpl at each MOS point;
- attrition rate for each MOS point;
- monthly intake at 0 MOS; and
- percentage of intake at the rank of Pte.

3.3.1 Starting Population

The starting population, shown in Figure 2 and summarized in Table 1, was taken as of 1 April 2012. Ptes who would be affected by the policy change are represented by the “Affected Personnel” series. Note that within the 37 to 48 MOS range, the affected Ptes were separated from the unaffected Ptes at each MOS point by assuming a constant proportion of the Affected Pte category (vs. the Unaffected Pte category) from the cohort analysis described previously.

Figure 2 also illustrates that recruitment varied considerably over six-year period, both between years and within a given year. This variability highlights the importance of modelling the actual population where possible (rather than a hypothetical steady-state population) when estimating the cost of the proposed promotion policy change over the next few FYs.

Table 1. Distribution of Personnel by MOS: 1 April 2012

<table>
<thead>
<tr>
<th>MOS Range</th>
<th>Pte</th>
<th>Cpl+</th>
<th>Affected Personnel</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 YOS</td>
<td>1689</td>
<td>587</td>
<td>116</td>
</tr>
<tr>
<td>0-11 MOS</td>
<td>2149</td>
<td>608</td>
<td></td>
</tr>
<tr>
<td>1 YOS</td>
<td>3482</td>
<td>776</td>
<td></td>
</tr>
<tr>
<td>12-13 MOS</td>
<td>2494</td>
<td>1339</td>
<td></td>
</tr>
<tr>
<td>2 YOS</td>
<td>576</td>
<td>2736</td>
<td></td>
</tr>
<tr>
<td>24-25 MOS</td>
<td>3312</td>
<td>3096</td>
<td></td>
</tr>
<tr>
<td>3 YOS</td>
<td>3833</td>
<td></td>
<td></td>
</tr>
<tr>
<td>36-37 MOS</td>
<td>3251</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 YOS</td>
<td>116</td>
<td></td>
<td></td>
</tr>
<tr>
<td>48-59 MOS</td>
<td>587</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 YOS</td>
<td>2149</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60-71 MOS</td>
<td>3251</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3.3.2 Probability of Promotion from Pte to Cpl

The probability of promotion from Pte to Cpl is shown in Figure 3, and was based on the cohort analysis that was presented in Figure 1. The probability of promotion was obtained for each MOS point \( n \) according to the following equation, where \( P_{\text{Promo},n} \) refers to the probability of promotion during MOS \( n \), and \((Pte,\text{Promo to Cpl})_n\) and \((Pte,\text{Remain Pte})_n\) refer to the numbers of personnel in these categories from the cohort analysis described previously:

\[
P_{\text{Promo},n} = \frac{(Pte,\text{Promo to Cpl})_n}{(Pte,\text{Remain Pte})_n + (Pte,\text{Promo to Cpl})_n}
\]

Note that the denominator only includes the Ptes who remained in the RegF, and not those who were released in that MOS. This is because, in our model, attrition is applied before promotion.\(^\text{11}\)

A relatively high promotion rate at the 36 MOS point results in a lower estimate of the cost of the proposed policy change. This is because fewer personnel will be affected by the change since they are already being promoted at the “normal” promotion point specified by the proposed policy (as opposed to the “normal” promotion point of 48 MOS under the current policy). For personnel hired between FYs 03/04 and 05/06, i.e. those selected for the cohort analysis, the promotion rate was 18.3% at 36 MOS. This rate is considerably higher than the rate observed just prior to that time: for those hired between FYs 00/01 and 02/03, the promotion rate was 10.3% at 36 MOS. The reason for this increase in accelerated promotion is unknown. Nevertheless, it is reasonable to assume that the higher promotion rates are representative of what would be observed if the current policy were kept in place in the future. (Indeed, among those hired in FY 08/09, i.e. among those who passed the 36 MOS point in FY 11/12, the promotion rate was 18.0% at 36 MOS.) However, this will be a factor in a sensitivity analysis described later in this paper.

\(^{11}\) It is rare for an individual to be promoted and released in the same MOS.
3.3.3 Attrition Rates

The YOS-based attrition forecasting method commonly used for the CAF, described in detail in [4] and [5], was used for the population projections in our model. This method relies upon first calculating historical attrition rates based on one or more years of historical data. In general, for near-term forecasts such as this one, it is preferable to use only the most recent available data to ensure that the most recent trends in attrition behaviour are captured [20].

Accordingly, attrition data from FYs 10/11 and 11/12 were used to calculate the attrition rate for each YOS point according to the equations below. In the equations, Attr_m is the average attrition rate for m YOS; a’_m[y] is the number of releases during year y of members having m YOS; p_m[y] is the population having m YOS at the end of year y (i.e. the beginning of year y+1); and r_0[y] is the number of recruits (i.e. the intake) during year y. For m>0:

$$Attr_m = \frac{\sum_{y=1}^{Y} a'_m[y]}{\sum_{y=1}^{Y} \left( \frac{1}{2} p_{m-1}[y-1] + \frac{1}{2} p_m[y-1] \right)}$$

When m=0:

$$Attr_0 = \frac{\sum_{y=1}^{Y} a'_0[y]}{\sum_{y=1}^{Y} \left( \frac{1}{2} p_0[y-1] + \frac{1}{2} r_0[y] \right)}$$

Next, the annual attrition rate for each of the first 6 YOS was converted to a monthly rate using the following equation, where Attr_n refers to the attrition rate for n MOS, and Attr_m refers to the attrition rate for m YOS:

$$Attr_n = 1 - \left(1 - Attr_m \right)^{1/12}$$

This assumes a constant attrition rate throughout a given YOS. The monthly equivalent for the 0 YOS attrition rate (i.e. the rate applicable throughout the first YOS) was applied for 0 to 11 MOS; the equivalent for the 1 YOS rate was applied for 12 to 23 MOS; and so on. The attrition rate was assumed to be independent of rank. Monthly attrition rates are given in Table 2.

### Table 2. Monthly Attrition Rate

<table>
<thead>
<tr>
<th>MOS Range</th>
<th>Monthly Attrition Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-11</td>
<td>1.35%</td>
</tr>
<tr>
<td>12-23</td>
<td>0.43%</td>
</tr>
<tr>
<td>24-35</td>
<td>0.31%</td>
</tr>
<tr>
<td>36-47</td>
<td>0.66%</td>
</tr>
<tr>
<td>48-59</td>
<td>0.43%</td>
</tr>
<tr>
<td>60-71</td>
<td>0.42%</td>
</tr>
</tbody>
</table>

3.3.4 Monthly Intake

The annual intake values for FYs 12/13 to 16/17 were obtained from the Strategic Intake Plan [21], which is produced by Director Personnel Generation Requirements (DPGR) on a regular basis. Beyond FY 16/17, the attrition and population forecasting method described in [4] and [5] was used to determine the intake that would be required to maintain a total RegF population of 67 500 personnel; or, 50 625 NCMs.

The annual intake was assumed to be evenly distributed throughout a given FY; so, the monthly intake during each FY was set to 1/12th of the annual intake. These values are given in Table 3.

### Table 3. Monthly Intake

<table>
<thead>
<tr>
<th>FY</th>
<th>Monthly Intake</th>
</tr>
</thead>
<tbody>
<tr>
<td>12/13</td>
<td>288</td>
</tr>
<tr>
<td>13/14</td>
<td>275</td>
</tr>
<tr>
<td>14/15</td>
<td>262</td>
</tr>
<tr>
<td>15/16</td>
<td>277</td>
</tr>
<tr>
<td>16/17</td>
<td>278</td>
</tr>
<tr>
<td>17/18</td>
<td>244</td>
</tr>
<tr>
<td>18/19</td>
<td>260</td>
</tr>
<tr>
<td>19/20</td>
<td>260</td>
</tr>
<tr>
<td>20/21</td>
<td>259</td>
</tr>
<tr>
<td>21/22</td>
<td>269</td>
</tr>
</tbody>
</table>

3.3.5 Percentage of Intake at the Rank of Pte

Over time, there has been some variation in the percentage of the total intake that occurs at the rank of Pte. Although the historical value based on the aforementioned cohort analysis is 89%, in recent years this figure has been lower, averaging 83% over FYs 09/10 to 11/12, and reaching a low of 74% in FY 11/12. Because of the uncertainty of how this may change in the future, the historical value of 89% was used in the results presented in the following section; however, as this value is one of the primary contributors to

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12 For members who attrite with 3 YOS, a large portion of members release at the 36 MOS point. Assuming an even distribution will result in only a small over-estimation of the number of personnel with 3 YOS, and thus a small over-estimation of the cost of the proposed policy change.

13 Previous work done for the CAF has shown that length of service, and not rank, is the primary driver of attrition [4, 5].
the estimate of the cost of the promotion policy change, it is explored further in a sensitivity analysis discussed below.

### 3.4 Population Modelling

With the input parameters defined, the population modelling was carried out based on the current promotion policy. First, the starting populations of personnel at the ranks of Pte and Cpl+ were entered into the model for each MOS point. Next, the total population as of the beginning of the next month was projected by applying the losses due to attrition. This is given by the following equation, where \( p_n[z] \) is the population having \( n \) MOS at the end of simulation month \( z \) (where \( z > 0 \)), and \( Attr_n \) is the attrition rate for \( n \) MOS:

\[
p_n[z] = p_{n-1}[z-1](1 - Attr_n)
\]

Next, the total population was divided into Pte and Cpl+ \( (p_{Pte,n}[z] \text{ and } p_{Cpl+,n}[z]) \) based on the promotion rates.

\[
p_{Pte,n}[z] = p_{Pte,n-1}[z-1](1 - Attr_n)(1 - Promo_{n})
\]

\[
p_{Cpl+,n}[z] = p_n[z] - p_{Pte,n}[z]
\]

These equations were applied for \( n > 0 \). For \( n = 0 \), \( p_0[z] \) was set to the intake from Table 3, and \( p_{Pte,n}[z] \) and \( p_{Cpl+,n}[z] \) were established according to the percentage of intake occurring at the rank of Pte (as noted in Section 3.3.5). The procedure was carried out for \( z = 1 \) to \( z = 120 \), i.e. 10 simulation years, from April 2012 to March 2022.

### 3.5 Calculation of PM-Delta and Cost of Proposed Promotion Policy Change

In the previous section, we described the modelling that was done to make projections of the Pte and Cpl+ populations as they would be under the current promotion policy. The next step of the analysis was to calculate the PM-Delta; i.e., the total number of PMs within a single month that would be spent at the rank of Pte under the current policy but at Cpl under the proposed policy.

Recall that, from the cohort analysis of Section 3.2, it was determined that those who would be affected by the policy change were at the rank of Pte in the range of 37 and 48 MOS; further, not all of these personnel would be affected. To calculate the PM-Delta, then, we calculated the historical percentage of those in the Affected Pte category, and applied these figures to our calculations of \( p_{Pte,n}[z] \) for \( n = 37 \) to \( n = 48 \). Therefore, for simulation month \( z \),

\[
PM-Delta[z] = \sum_{n=37}^{48} \frac{p_{Pte,n}[z]}{\text{Affected Pte}_n} \left( \frac{\text{Affected Pte}_n + \text{Unaffected Pte}_n}{\text{Affected Pte}_n} \right)
\]

Finally, the cost of the proposed policy change for each month was determined by multiplying the PM-Delta by the difference in the cost of 1 Cpl PM ($6 212) and 1 Pte PM ($4 847).16,17 For each of the next 10 FYs, the annual cost was then obtained by summing the cost for each month of the FY.

### 4. RESULTS

The results presented in Section 4.1 pertain to the projections up to FY 21/22. Following this, results are given for a steady-state, long-term case.

#### 4.1 Estimation of Cost for FYs 13/14 to 21/22

Figure 4 and Figure 5 show the projected population profiles (up to 6 YOS (71 MOS)) as of the beginning of FY 15/16 (April 2015) and FY 18/19 (April 2018), respectively. The starting population, which was illustrated in Figure 2, can be easily identified as it moves ahead to the higher MOS points by its irregular profile, in contrast to the smooth profile that is based on relatively stable intake forecasts. Beginning in FY 18/19, the projections reach a relatively steady state, yielding profiles similar to that shown in Figure 5.18

As in Figures 1 and 2, the personnel who would be affected by the policy change are represented by the “Affected Personnel” series. It can be derived from Figure 4 that there are 581 of these affected personnel on 1 April 2015. Stated another way, during the month of April 2015, there are 581 cases in which an individual would be paid as a Pte (1 Pte PM) under the current policy, and as a Cpl (1 Cpl PM) under the proposed policy. This PM-Delta of 581 contributes to the total additional cost of the proposed policy, in comparison to the cost of the current policy. As noted in Section 3.5, a similar calculation was conducted to obtain the PM-Delta for each month in the time period of interest.

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16 As noted in the Cost Factors Manual [22], for analyses comparing the personnel costs of various ranks, costs can be taken as the sum of the pay and the cost of the Employee Benefit Plan (EBP). The EBP can be estimated as 20% of the pay and allowances.
17 The Pte pay was taken as Pay Increment 3 for the Pte rank, and the Cpl pay was taken as the Basic pay for the Cpl rank in the Specialist 1 trade group. These figures are current to FY 12/13 [23]. No adjustments were made for future inflation.
18 The transitions at the year-start points (12, 24, 36, 48, and 60 MOS) are a result of the changes in the annual intake levels.
Table 4 gives the total PM-Delta for each year from FY 13/14 to 21/22. The cost of the proposed policy change is also given (expressed in millions of dollars).

<table>
<thead>
<tr>
<th>FY</th>
<th>PM-Delta</th>
<th>Cost of Proposed Policy ($M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>13/14</td>
<td>16 166</td>
<td>22.1</td>
</tr>
<tr>
<td>14/15</td>
<td>12 210</td>
<td>11.2</td>
</tr>
<tr>
<td>15/16</td>
<td>8 248</td>
<td>11.3</td>
</tr>
<tr>
<td>16/17</td>
<td>10 842</td>
<td>14.8</td>
</tr>
<tr>
<td>17/18</td>
<td>10 389</td>
<td>14.2</td>
</tr>
<tr>
<td>18/19</td>
<td>10 373</td>
<td>14.2</td>
</tr>
<tr>
<td>19/20</td>
<td>10 711</td>
<td>14.6</td>
</tr>
<tr>
<td>20/21</td>
<td>10 145</td>
<td>13.9</td>
</tr>
<tr>
<td>21/22</td>
<td>9 701</td>
<td>13.2</td>
</tr>
</tbody>
</table>

As shown in Table 4, if the proposed promotion policy is implemented at the beginning of FY 13/14, the cost for that FY will be an estimated $22.1M; the total cost of the policy change will be the sum of the cost in that year plus the cost over the subsequent years. It is noteworthy that the cost of the proposed policy change is markedly higher for FY 13/14 than for later years. This is a result of the high recruiting numbers of FYs 09/10 and 10/11; each person hired in these two years will spend some time in the YOS range of interest during FY 13/14. While those hired in FY 09/10 will exit the range of interest throughout the year as they complete 48 MOS, those hired in FY 10/11 will enter the range of interest as they complete 36 MOS.

If the proposed policy were to be implemented part-way through FY 13/14, vice on 1 April 2013, the total estimate for FY 13/14 shown in Table 4 would be reduced. Table 5 shows the monthly breakdown for the year. As an example, if the promotion policy were to be implemented in Jan 2014, only the costs for Jan 2014, Feb 2014, and Mar 2014 would be incurred (i.e. $4.5M as opposed to the previously reported value of $22.1M for the full year).

Table 5. PM-Delta and Cost Estimate of Proposed Policy Change, FY 13/14

<table>
<thead>
<tr>
<th>Month</th>
<th>PM-Delta</th>
<th>Cost of Proposed Policy ($M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apr 2013</td>
<td>1 761</td>
<td>2.4</td>
</tr>
<tr>
<td>May 2013</td>
<td>1 544</td>
<td>2.1</td>
</tr>
<tr>
<td>Jun 2013</td>
<td>1 541</td>
<td>2.1</td>
</tr>
<tr>
<td>Jul 2013</td>
<td>1 445</td>
<td>2.0</td>
</tr>
<tr>
<td>Aug 2013</td>
<td>1 312</td>
<td>1.8</td>
</tr>
<tr>
<td>Sep 2013</td>
<td>1 331</td>
<td>1.8</td>
</tr>
<tr>
<td>Oct 2013</td>
<td>1 369</td>
<td>1.9</td>
</tr>
<tr>
<td>Nov 2013</td>
<td>1 291</td>
<td>1.8</td>
</tr>
<tr>
<td>Dec 2013</td>
<td>1 240</td>
<td>1.7</td>
</tr>
<tr>
<td>Jan 2014</td>
<td>1 206</td>
<td>1.6</td>
</tr>
<tr>
<td>Feb 2014</td>
<td>1 124</td>
<td>1.5</td>
</tr>
<tr>
<td>Mar 2014</td>
<td>1 003</td>
<td>1.4</td>
</tr>
<tr>
<td>Total</td>
<td>16 166</td>
<td>22.1</td>
</tr>
</tbody>
</table>

4.2 Estimation of Steady-State Annual Cost

Since the policy change would be implemented permanently (if implemented at all), it is important to estimate the annual cost in the long term, i.e. beyond the time frame presented above. To address this requirement, a steady-state scenario was developed. This can be thought of as the scenario that would arise in the long term if all variables (i.e. promotion rates, attrition rates, intake) remained the same for many years.

Past research has shown that longer-term population and attrition forecasts should be based on a larger volume of attrition data than near-term forecasts [20]. For this reason, attrition rates in this steady-state analysis are based on a 10-year historical average, i.e. from FYs 02/03 to 11/12.

The probability of promotion from Pte to Cpl and the percentage of intake at the rank of Pte were set to the same values as in the analysis described above (given in Sections 3.3.2 and 3.3.5, respectively). The monthly intake was set to the value that would be required to maintain the NCM population of 50 625. As was the case previously, this was done by using the population forecasting method described in [4] and [5].

Based on these assumptions, the steady-state annual cost of the policy change was estimated at $15.3M. It is
important to recognize that, given the fact that fluctuations in the input parameters are normal occurrences, this represents the annual cost that could be expected to arise, on average, over many years. The cost of the policy change for any one year could deviate from this average.

5. SENSITIVITY ANALYSIS

To give an indication of the sensitivity of the results of Section 4 to changes in the key input variables, additional scenarios were created to provide lower and upper estimates of the cost of the policy change. These are explained below.

5.1 Estimation of Cost for FYs 13/14 to 21/22: Sensitivity Analysis

To explore the impact of variations in the input parameters, with the exception of the starting population (which is fixed), all of the input parameters listed in Section 3.3 were varied as described below.

- **Probability of promotion from Pte to Cpl:** For our previous analysis, the population forecasts used the historical probabilities of promotion for personnel hired between FYs 03/04 and 05/06. Here, to obtain a lower cost estimate, we selected the year of history yielding the lowest cost estimate (FY 05/06). For our upper cost estimate, we selected the year of history yielding the highest cost estimate (FY 02/03).

- **Attrition Rates:** In our previous analysis, the most recent available attrition data were used to ensure that the most recent trends (for example, changes in response to the implementation of the new TOS) were captured. However, attrition behaviours vary in response to many factors [24], and are therefore not driven solely by TOS. For the sensitivity analysis, the attrition rates of the previous analysis were scaled such that the total attrition rate of the NCM population matched the total attrition rate for an alternative historical period. This was done in order to capture the most recent TOS-related patterns while at the same time accounting for external reasons for attrition changes. For the lower cost estimate, the attrition rates were scaled so that the total attrition rate of the NCM population was the lowest observed in the data set: 6.2% for FY 03/04. Similarly, for the upper estimate, the attrition rates were scaled up to the highest rates observed in the data set: 9.8% for FY 07/08.

- **Monthly Intake:** The monthly intake was set to the value required to maintain a constant NCM population of 50,625; therefore, it was driven by the attrition of the NCM population (according to the rates specified in the previous point).

- **Percentage of intake at the rank of Pte:** For the lower estimate, this figure was set to the lowest value seen in the data examined: 74% in FY 11/12. For the upper estimate, it was set to the highest value that was observed: 91% in FY 98/99. It is worth pointing out that the higher value yields a more conservative, i.e. higher, estimate of the cost of the proposed policy change, although the total cost under either policy would be lower. A higher value means that there are more Ptes who would be promoted at 3 or more YOS (based on historical patterns) under the current policy and at 3 YOS under the proposed policy. A lower value means that more personnel would be at the rank of Cpl or higher upon joining the RegF, and would therefore be unaffected by the policy change.

Table 6 gives the lower and upper estimates of the cost of the proposed policy change for FYs 13/14 to 21/22.

<table>
<thead>
<tr>
<th>FY</th>
<th>Lower Estimate</th>
<th>Upper Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>13/14</td>
<td>21.4</td>
<td>28.2</td>
</tr>
<tr>
<td>14/15</td>
<td>11.1</td>
<td>14.1</td>
</tr>
<tr>
<td>15/16</td>
<td>8.5</td>
<td>14.4</td>
</tr>
<tr>
<td>16/17</td>
<td>10.1</td>
<td>22.0</td>
</tr>
<tr>
<td>17/18</td>
<td>11.6</td>
<td>23.8</td>
</tr>
<tr>
<td>18/19</td>
<td>11.4</td>
<td>23.1</td>
</tr>
<tr>
<td>19/20</td>
<td>11.3</td>
<td>22.7</td>
</tr>
<tr>
<td>20/21</td>
<td>11.3</td>
<td>22.2</td>
</tr>
<tr>
<td>21/22</td>
<td>11.0</td>
<td>21.3</td>
</tr>
</tbody>
</table>

It is worth pointing out that the variations for FYs 13/14 and 14/15 are driven solely by the changes in probability of promotion and attrition rates. This is because the other variables, i.e. monthly intake and percentage of intake at the rank of Pte, are applicable only to the projected future enrolment in the CAF, i.e. beginning in FY 12/13. These personnel will not enter the 37 to 48 MOS range until FY 15/16.

5.2 Estimation of Steady-State Annual Cost: Sensitivity Analysis

A sensitivity analysis of the steady-state scenario of Section 4.2 was also carried out. In this case, we only varied the promotion rates from Pte to Cpl (i.e. the year of history upon which the promotion rates are based), as well as the percentage of intake at the rank of Pte. The attrition rates were not varied since, by using a larger volume of historical data as recommended in [20], we are already accounting for variations in attrition that occur from one year to the next. Being a consequence of attrition, the total monthly intake was set to the value that would be required to maintain a constant population size.

To obtain the minimum and maximum likely outcomes, the two aforementioned variables were set to the same values as in our previous sensitivity analysis. It was found that the average annual cost of the policy change, in
the long term, would fall between $12.5M and $20.7M (with an expected value of $15.3M, as determined previously).

6. CONCLUSION

The research described above was conducted to estimate the cost of a proposed change to CAF promotion policy that, if implemented, would have Ptes eligible for promotion to the rank of Cpl at 3 YOS instead of 4 YOS. The method took into consideration several factors, including the current population profile, promotion rates, attrition rates, and future recruitment, to estimate the cost of the proposed policy change between FYs 13/14 to 21/22, as well in the longer term. Sensitivity analyses were also carried out to take into consideration the variations that have been observed in these factors in the past.

It was found that, because of the high level of recruiting that occurred in FYs 09/10 and 10/11, the cost of the proposed change would be highest in FY 13/14. Based on our assumptions, the cost for FY 13/14 was estimated at $22.1M, although it could fall between $21.4M and $28.2M.

Looking beyond FY 13/14, the average annual cost over FYs 14/15 to 21/22 was estimated at between $10.8M and $20.5M, with a most likely average annual cost of $13.4M. In the more distant future, the average annual cost of a steady-state system was estimated at between $12.5M and $20.7M, with a most likely value of $15.3M.

REFERENCES