Technical Paper:
Forecasting Departures in the
Executive Community 1998-2007

The Research Directorate,
Labour Market Analysis, Modelling and
Demographics Division

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[1] **Note: The information and data contained in this paper is based on the Base Case model ex98bs3b using March 31, 1997 population data. For this reason it may differ slightly from forecasting data done in other models. This paper should be used as documentation on the original model only.**

1.0 Introduction

In the Spring of 1998, analytic work was undertaken to develop forecasts of future departures from the executive community. The modelling and forecasting of the Executive group is part of a larger inter-department effort on demographic analysis led by the La Relève task force.   In support of these efforts, the Research Directorate at the Public Service Commission was tasked to provide a macro-simulation model (using *ithink* modelling software) of the Executive Community.[2]   The goal of the exercise was to provide more in-depth demographic analysis of human resources which ultimately could provide useful inputs to the succession planning and business planning process in Federal Government Departments. The purpose of this paper is to document the methodologies and the processes required to construct human resource based statistical models and at the same time examine some of the results produced by the modelling process.

The paper focusses on two interrelated modelling projects. In the first project, a model of the executive community was developed to support corporate analysis of the recruitment requirements for the leadership cadre.   The second project created a sub-model of the first, specifically assessing the departure patterns of the ADM Community. The work itself, is an example of the adaptation and application of forecasting software to demographic analysis issues which could potentially be generalized to a variety of Human Resources issues.

The value of dynamic modelling is that it allows human resource practitioners to examine human resource issues by simulating and forecasting potential scenarios.   The modelling software itself incorporates a number of different variables into the forecasting process, allowing the researcher to change assumptions made on each variable. It is a valuable planning tool as it allows the planner to set goals or targets and then determine what practices are required to meet the objective.

2.0 Dynamic HR Modelling for the Executive group

This particular research provides a series of predictions and forecasts based on historical trends within the Executive community.[3] Through these forecasts we can explore possible futures for the Executive community in the Federal Public Service and provide insight on potential human resource program and policy issues through the use of modelling.

This study details a dynamic macro-simulation model which looks at the aggregate stocks and flows by examining the movement of the entire Executive group within the Public Service. Different scenarios were constructed based on historical trends of retirements, resignations and other separations, promotions and recruitment at a variety of different levels within the

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[2] In a macro simulation model, aggregation of data and trend analysis is done outside the modelling structure and fed into the model. This allows for the testing of assumptions by changing the inputs. A micro-simulation model uses the micro or individual records of a particular database. The trend analysis is done within the model and it is therefore more difficult to change assumptions.

[3] A companion demographic analysis of the Executive community is being prepared based on the preparatory work required to develop the basic parameters of the model. See Nehmé, M. and Gorber, T., ***Demographic Study of the Executive Community, 1991-98.*** Research Directorate, Public Service Commission. 1999.

Executive community. Modelling and scenario testing enable us to identify the future trends within the system in terms of human resource flows, and the action needed to rejuvenate the Public Service.

2.1 A stock and flow model using "ithink" modelling software

The tool used to produce the models is an aggregate modelling software package called *"ithink"*[4]. The software allows one to build system dynamic models for the purpose of simulation, forecasting, and scenario testing. It has been successfully applied to a wide variety of areas, including business re-engineering, organizational learning, and strategic planning. In this instance, it has been adapted for use as a human resource management tool for the Federal Public Service.

The benefit of the system dynamic model for human resource planning is that it allows you to incorporate a series of key variables into the forecasting process. It then provides you with an aggregation of the effects of these variables, allowing the planner to understand the inter-relation of a series of impacts on a particular issue.

The primary building blocks of an *ithink* model for a human resource system are stocks, flows, convertors and connectors. A stock could be the population of a department or that of a particular occupational group; it can also be any attribute of the population, such as knowledge, skill, age, or years of service. Flows include inflows and outflows. An inflow to a stock, such as recruitment or the accumulation of knowledge, leads to an increase in the stock; whereas an outflow from a stock, such as retirement, resignation or depletion of knowledge, causes a decrease in the stock. Converters are "catchalls", which can represent either assumptions, regulations, or numerical relations amongst variables; either any input required in the model, or any other factor relevant to the model. Stocks, flows and convertors are linked in a model by connectors to form feedback loops, which make the model integrated and dynamic.

The model developed for the Executive group consists of seven blocks: EX Minus[5], EX Equivalents[6], and EX 1 to EX 5. Each block depicts a particular stock or population and portrays the inflows and outflows into each level. The inflows into each level of the model include external recruitment and promotions from within the Public Service; The outflows include promotion out of the level, retirement, and other separations which include resignation, dismissal and death. The infrastructure of the model is shown in the above chart. The modelling structure of one block of the actual model is shown in Appendix 1.

Model 1: Structure of the EX model: the Base Case Scenario

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[4]This software is a systems thinking tool developed by the High Performance Systems, Inc. in the United States. The web site of the High Performance System Inc. is http://www.hps-inc.com/ .

[5] The EX Minus 1 & 2 levels used in this model are analytic categories developed by Treasury Board which refer to groups of positions considered to be one and two levels below the EX 1 Level. These positions are generally considered to be the feeder groups for the EX group.

[6] EX Equivalent positions are professional level positions considered as equivalent to the Executive group on the basis of salary.

Structure of the ithink
Model for EX Group
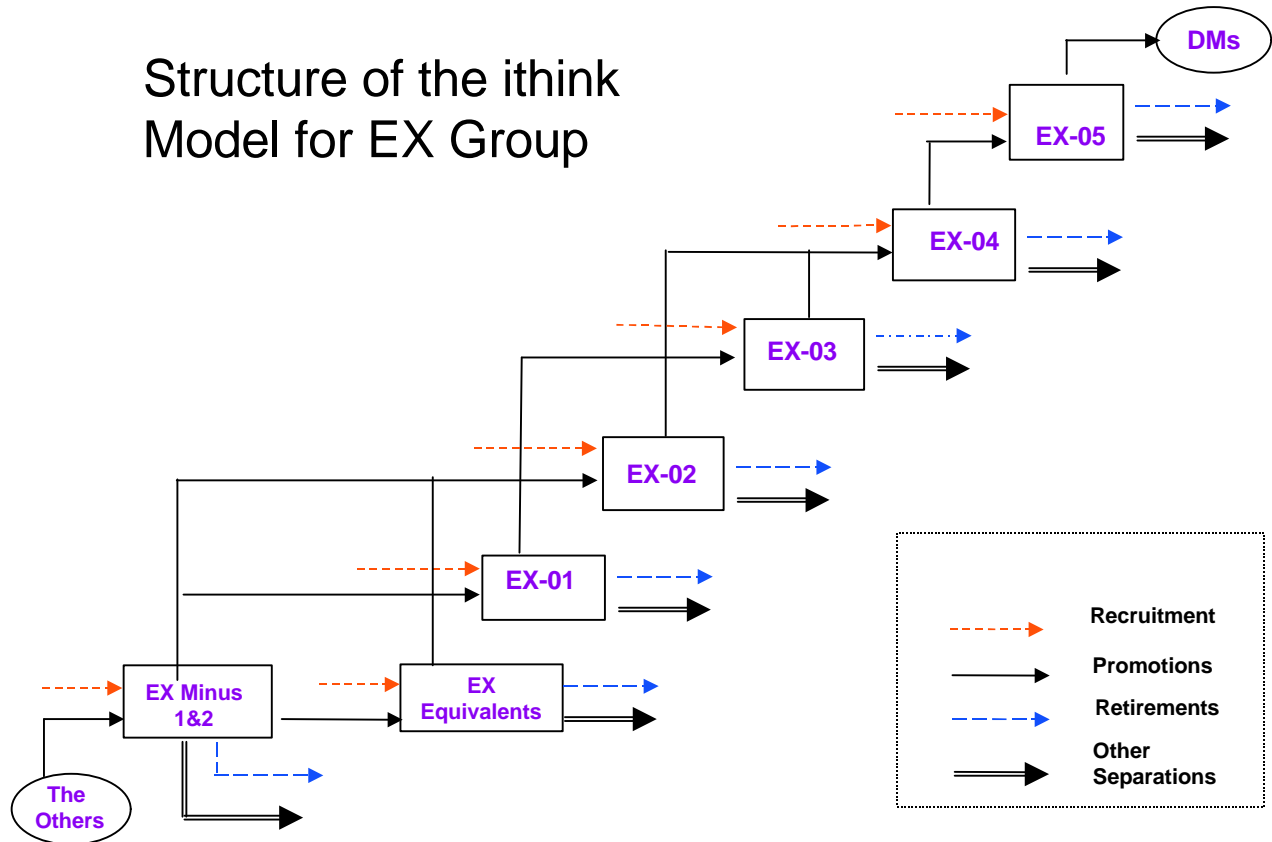
The chart maps the basic flow patterns of the EX model. The boxes represent the stable populations at the 7 different levels in the model and the arrows the movements in and out of the population at each level.

3.0 Implicit Assumptions and Limitations of the Model

A scenario is a set of plausible assumptions and the outcomes of the model under a given set of assumptions. For the purpose of this study, the following assumptions have been used in creating the base case scenario:

Assumption 1 *Population*: The population at each level is held stable throughout the forecast period at the same levels as of March 31, 1997. Using this assumption, the seven blocks of the model used the populations defined below (Table 1).

The rationale for stabilizing the population at these levels is that the majority of reductions in the Executive community and feeder groups have been completed and the population of these groups can be expected to remain stable from this point forward, barring new policy decisions.

Table 1: Populations of the 7 Levels used in the Executive Model	
	Population
EX Minus	17204
EX Equivalents	2380
EX1	1604
EX2	720
EX3	425
EX4	157
EX5	74

This assumption is required because of the profound impacts of incorporating the population trends of the program review period into the model. If we were to project solely on the basis of recent historical trends (the program review period) the population of the each forecasted group would approach zero before the end of the 10 year forecast.

Assumption 2 *Feeder Groups*: The model uses two feeder groups to represent inflow into the Executive population, the Ex Minus group and the Ex Equivalents group. Each group is assigned an aggregate inflow rate based on average movement within the respective group. In reality, there are over 20 sub-populations at the group level within the EX Minus and Ex Equivalents communities with substantial variation in "behaviour" between groups.

Aggregation of the feeder groups was required because of the difficulty of incorporating the 20 sub-populations into the model. Future research[7] should provide better definition of the feeder groups and focus primarily on the key feeder populations.

Assumption 3 :*Population* The population used in the model does not include terms, acting appointments and persons "temporarily struck off strength" (i.e on assignment outside the Public Service, or on longer term medical leave). The reason for using substantive level and indeterminate positions is that, under the PSEA, acting and term appointments are by definition temporary and transitory. Given our interest in the core Executive population these other groups have not been included in the analysis[8].

Assumption 4: Future retirement flows are based on the earliest retirement year for the population as of March 1997, adjusted for projected inflows and outflows, and for the historical probability of retirement, (i.e., the probability of those eligible to retire versus those who actually retired during 1991/2-93/4).

It was necessary to calculate the retirement probabilities using 1991-94 data because retirement patterns in the pre-Program Review period were more reflective of "a natural rate". During the Program Review period (1994/5-1997/8) retirement patterns changed dramatically as the number of people taking retirement relative to those eligible accelerated due to the early retirement incentive (ERI).

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[7] See Malizia, K. ***Demographic Profile of the EX Feeder Groups***. Research Directorate, Public Service Commission. 1998. Also, Nehmé, M. and Gorber, T., ***Demographic Study of Executive Community, 1991-98***. Research Directorate, Public Service Commission. 1999.

[8] In reality, the number of term positions at the Executive level is quite low, representing only 0.23% as of March, 1997; Occupational Group Data System, Public Service Commission.

Assumption 5: Other separation rates (which include voluntary departures) are based on the average rates of 1991/2-1993/4, the years prior to Program Review. This assumption is required again because during the Program Review years do not reflect long term historical trends. During this period other separations tended to be reduced substantially as persons availed of the EDI (early departure incentive) and ERI.

Assumption 6: Total inflows match total outflows at each EX level. This allows us to maintain a stable population in the model. The assumption is again based on the proposition that Program Review reductions are essentially complete and there will be no major restructuring at the departmental level which would impact on the number of Executives at a particular level.

While this assumption does create a steady state in populations in the model, it would be possible to modify or adjust the inflow to create lags in the backfilling of positions.

Assumption 7: Inflow sources are based on historical ratios of 1992/3-1996/7. In this case, the modelling team has calculated a separate share of inflow based on historical sources. This assumption is based first on the hypothesis that outflows will determine inflows and second that the inflow source (the proportion of persons entering the Executive group through either promotion, laterally from EX Equivalents or recruitment will continue at historical ratios.

Table 2: Inflow Sources: Recruitment and Promotion ratios, 1992/3-1996/7		
	Replacement Source (%)	
	Recruitment	**Promotion**
EX Minus	16.2	83.8
EX Equivalents	12.1	87.9
EX1	4.4	95.6
EX2	4.4	95.6
EX3	6.1	93.9
EX4	9.2	90.8
EX5	7.8	92.2

This assumption is not required to predict inflow, but to provide a base scenario from which to understand historical flows and a point of departure for the testing of inflow assumptions.

3.1 Limitations of the Assumptions

One limitation of assuming the population is stable at the March 1997 level is that reductions due to Program Review will likely continue until September 1998, (i.e. enduring EX population levels will likely be somewhat smaller than the March 1997 level[9]). A second limitation is that by using this particular set of assumptions, we have not accounted for predicted major changes in the structure of the Public Service. An example would be the creation of a separate Taxation Agency which would remove approximately 25% of the Public Service population as well as a comparable percent of senior executive ranks.

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[9] In fact, the number of indeterminate EX employees, as of March 31st, 1998 was 2926, down from the March 31st, 1997 level of 2980. Sources: file adpsv.sep 1990-91 to 1996-7 and FISC9798.popn981, Monitoring and Information Division PSC.

Another potential limitation relates to the size of the feeder groups used in the model. The model has used an aggregation of all potential feeder groups to the Executive category from both the EX minus and EX Equivalents levels. This incorporates a potential feeder population in excess of 19,000 people[10] whereas we know that over the past 5 years (1992-97) 70% of all promotions into the Executive group came from 10 feeder groups comprising a total indeterminate population of 6,618[11].

Assumptions developed concerning departure rates could be impacted by changes in the external labour market. The early years of this decade were a recessionary period with reduced opportunities for employment in the external labour market. If the economy continues to grow, there is a potential for slightly higher rates of departure due to increased opportunities. The corollary is that projected changes in compensation for Executives could reduce the departure rates.

Assumptions concerning inflows could also be impacted by policy decisions. If the Public Service decided to address equity issues at the Executive level through recruitment there would likely be a change in the inflow source rates.

4.0 Base Case Results

For the purpose of testing different scenarios, a model known as the "Base Case" was developed. The base case incorporates all the assumptions listed in section 3.0. Through the incorporation of these existing historical trends, the base case projects outcomes based on the continuation of these historical trends.

The Base Case model developed using these assumptions projects that total separations in the EX community will remain at the historical average levels for the next 5 years with approximately 200 departures per year. Separations will then increase significantly after 2002 as the baby boomer effect begins to impact on the PS population as a whole (Table 3). The projected pattern of departures in the Executive community parallels that of the Public Service population as a whole.

Table 3: Projections of Executive Departures 1998-2007[12]				
Year	Projected Retirements	Other Separations	Total Separations	As a % of total EX Pop
1997-8	88	104	192	6.4%
1998-9	100	98	198	6.6%

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[10] From population data (EX Minus = 17,204, EX Equivalents = 2,380) as of March 31st, 1997. Supplied by the Information Management and Review Directorate (MID) at the Public Service.

[11] Groups include AS-07, AS-08, ES-06, ES-07, PM-05, PM-06, CO-03, IS-06, FS-02, and FI-04.

[12] Source: PSC Model **ex98outn** April, 1998. Labour Market Analysis, Modelling and Demographics Unit, Research Directorate, Ottawa, 1998.

1999-2000	108	93	201	6.7%
2000-1	114	90	204	6.8%
2001-2	126	85	211	7.1%
2002-3	163	78	241	8.1%
2003-4	201	72	273	9.2%
2004-5	231	68	299	10.0%
2005-6	254	64	318	10.7%
2006-7	263	62	325	10.9%

The relatively low level of separations during the next 5 years is mainly due to a large number of Executives leaving the Public Service with the incentive packages over last three years.   The steady increase in separations projected after 2002 peaking in 2007 results primarily from a phenomenon characterised as the "boomer bulge" in the age profile of the Public Service. In effect, there is a high proportion of the Public Service population belonging to the baby boom generation that will become eligible to retire by 2007.

The model also projects that Retirement exceeds other forms of separation to become the primary reason for separation, this again is due primarily to the "boomer effect". As the population continues to age, more people will become eligible to retire (Table 3).

The projections indicate that during the last three years of the forecast period 2005-2007, annual turnover in the Executive category will exceed 10% of the current population (Table 3). This implies the need for systematic succession planning as high departures of Executives will place increasing burdens on the Executive feeder groups. These high levels of departure also offer the opportunity for changing the demographic profile of the Executive group, providing increased opportunities for the recruitment of women and other employment equity target group members.

4.1 Executive Retirements: Actual and the Base Case

An examination of actual and incentive retirements helps to explain why the overall separation rates are relatively low in the first 5 years of the forecast period but then begin to increase sharply. In looking at conventional retirements up to 1996-7 (Chart 1[13]), we see two small increases in the actual retirement behaviour in 1994-5 and 1996-7. The first increase in 1994-95 came prior to the program review incentives when 125 persons left the public service as a result of actual retirements.[14] When one includes the people leaving through retirement incentive packages in 1995-6 and 1996-7, the departures spike dramatically particularly in the first year of program review.   In that year, 1995-6, there were 322 total departures through

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[13] Source: PSC Model **ex98outn** April, 1998. Labour Market Analysis, Modelling and Demographics Unit, Research Directorate, Ottawa, 1998.

[14] In 1994-5 Public Service data systems did not distinguish between normal retirements and retirements through the Early Retirement Incentive (ERI).

retirements, 191 through the Early Retirement Incentive (ERI)[15]. The total departures in 1995-6 were 3 times the average (106.75 per annum) for the 4 years preceding program review.   In addition, a further 114 retired through the ERI in 1996-7 contributing to a total of 166 departures through retirement in that year.[16]

Chart 1: EX Retirements, Historical and Base Case Projections
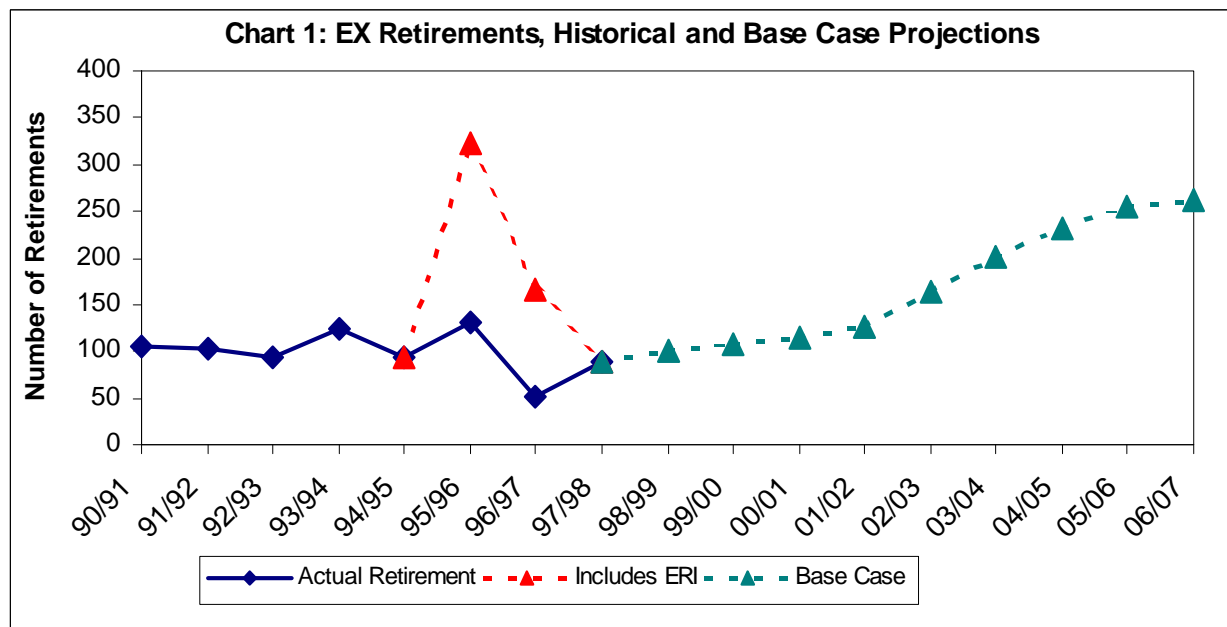
Of major significance to the projections was the age profile of Executives using the ERI, departure mechanism. In 1995-6, of the 191 Executives leaving through ERI, 161 (84.3%) were below age 55[17]. The following year 88.6% (101) of the 114 ERI departures were below 55 years old[18]. Not only did retirement departures increase substantially through the ERI but it effectively bought out a great deal of the volume of departures that would have been expected between now and 2002-3.

Another factor contributing to lower retirement numbers in the near future is that the overall pool of Executives dropped during program review from 3750 to 2980.[19]   The net effect is that the total retirement eligibility pool shrinks further. The low levels of retirement over the next five years then result from two phenomenon:

1.   relatively higher levels of retirement during program review particularly among executives under the age of 55; and
2.   large reductions in the executive population which reduce in absolute terms the prospective retirement pool.

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[15] Source: file adpsv.sep 1990-91 to 1996-7, Monitoring and Information Division PSC.

[16]Source: file adpsv.sep 1990-91 to 1996-7, Monitoring and Information Division PSC.

[17]Source: file adpsv.sep 1990-91 to 1996-7, Monitoring and Information Division PSC.

[18]Source: file adpsv.sep 1990-91 to 1996-7, Monitoring and Information Division PSC.

[19] As of March 31st, 1997. Source: file adpsv.sep 1990-91 to 1996-7, Monitoring and Information Division, PSC.

It is interesting to note, however, that despite a lower overall population for the Executive group, in the longer term there is still projected to be a fairly dramatic rise in the numbers of departures well above historical averages. This rapid increase in departures after 2004-5 as noted earlier is a result of the boomer effect, the ageing of the baby boomer generation through to the end of their public service careers.

4.2 Other Departures: Actual and the Base Case

The number of other separations,[20] which include resignations, drop consistently during the forecast period. It is forecasted that other separations will begin to increase slightly in 1998, then continue to fall through the forecast period. Again lower separation levels in the post-

Chart 2: Other EX Separations & Resignations
Actual & Base Case
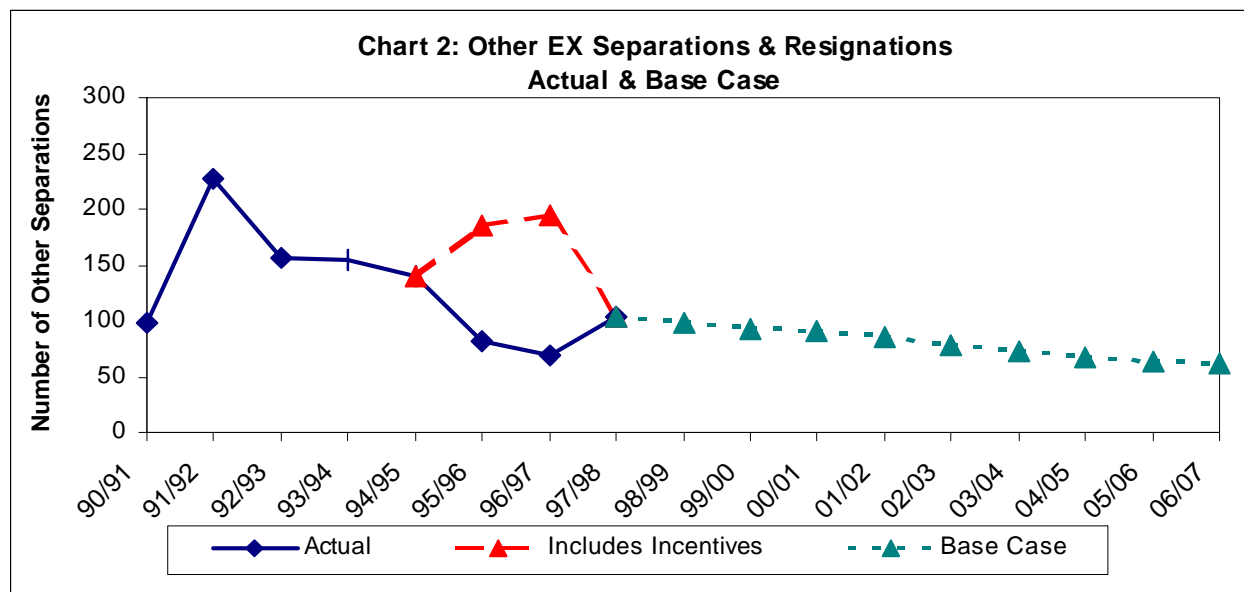
program review period can be explained in part by the overall decline in the Executive population and in part by age structure of the population.

The main rationale for the decline in separations is that it is largely an effect of the retirement profile of the Executive community. As an increasing proportion of the population of Executives become eligible to retire through the forecast period due to the boomer effect, the number of departures due to other reasons will decline over time. (Chart 2).

The chart also illustrates the impact of program review as we see elevated levels of Executive departures in the years 1994-5 and 1995-6 due largely to the early departure incentive.   In addition, there were also high levels of departure in 1992-3 and 1993-4 in the pre-program review years. In the pre-program review period these high levels of Executive separations can be explained by Executive departures at the Department of National Defence as downsizing efforts were in place much earlier at DND than in other areas of the Public Service.

5.0 Senior Executive Departures: The Base Case Forecasts

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[20] Source: PSC Model **ex98outn** April, 1998. Labour Market Analysis, Modelling and Demographics Unit, Research Directorate, Ottawa, 1998.

The ADM community (Assistant Deputy Minister) is composed of the two highest levels of the Executive category (EX4 and EX5)[21] and is made up of a total population of 231[22]. Departure levels within this community have been a concern to the Public Service primarily because of the considerable experience that is lost as a result of departures at these senior levels. An earlier forecast developed for the ADM community, however, reveals that high rates of separation would not expect to be an issue of ongoing concern within this group[23].

The senior executives exhibit much the same departure patterns as the overall Executive

Chart 3: ADM Separations (Actual & Base Case Forecasts)
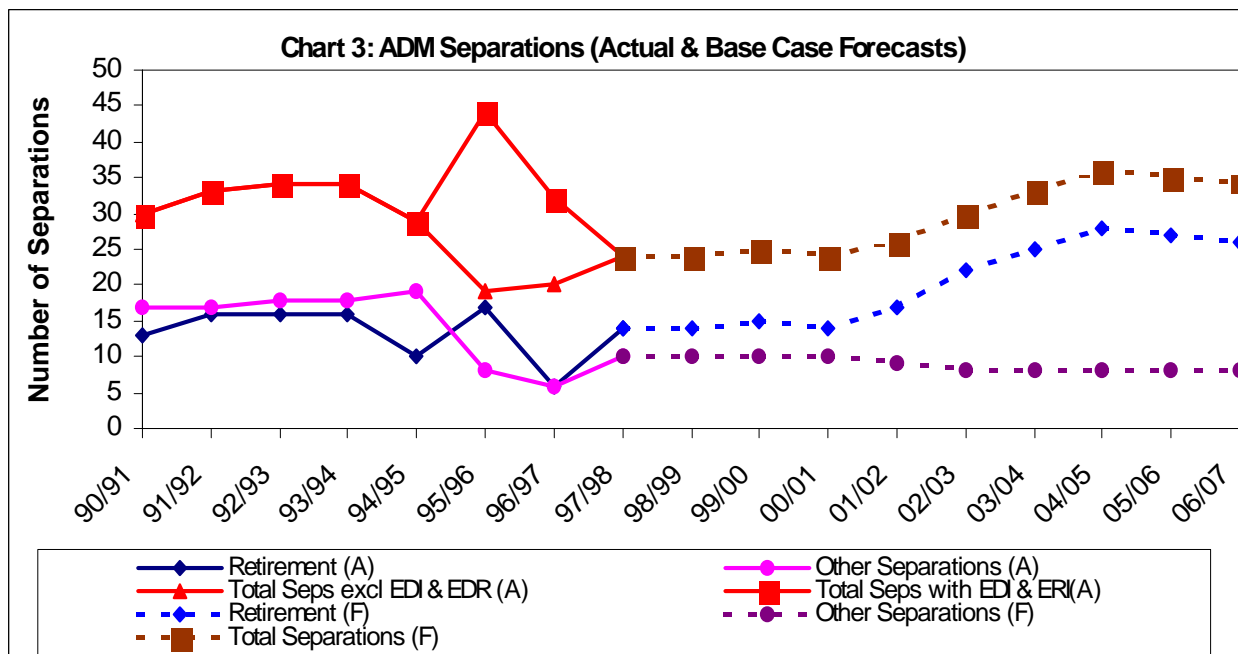
community. There was a significant increase in departure levels in the first two years of program review due to program review. The key factor again in increasing levels of departure was again the departure incentives the ERI and employment transition programs produced 19 additional ADM departures in 1995-6 and a further 20 additional departures in 1996-7.

In terms of projected departures at the ADM level total separations are expected to level off at approximately 25 total departures per year over the next five years at a level slightly below historical levels. This slight decline in the levels of ADM departures is a result primarily of the buy out of retirement potential in the short-term. Following this period of relative stability there will be a slight increase in departure levels before gradually peaking at a level of approximately 35 departures in 2004-5.

Retirement is expected to be the main reason for departure as the ADM population ages. It is

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[21] Source: PSC Model **ex98outn** April, 1998. Labour Market Analysis, Modelling and Demographics Unit, Research Directorate, Ottawa, 1998.

[22] Indeterminate population at substantive level, March 31, 1997.

[23] This forecast was produced for Executive Programs Branch at the PSC to support programming decisions around the need for external recruitment of senior Executives.

for this reason that we do not project an impending departure crisis for the ADM community over the short-term, though departures will increase substantially in the 6 to 10 year range.

6.0 Summary and Conclusions

The project on the Executive community provides an illustration as to how modelling and systems thinking can be utilized as an effective human resources planning tool.   The projections of the Executive group provides both a historical profile of the community, as well as predictions and forecasts based on these past trends.

This study builds a dynamic macro-simulation model which looks at the aggregate stocks, flows and average levels of parameters by examining a Public Service-wide sample of the entire Executive group. We constructed different scenarios based on historical trends of retirements, resignations and other separations, promotions and recruitment. Modelling and scenario testing enable us to identify the future trends of human resource flows, potential points of vulnerability and the action needed to rejuvenate the Public Service.

Using the Base Case scenario as a model, we can anticipate a relatively modest departure rate of the Executive community during the next 5 years, however this rate will increase dramatically in the next 6-10 years. Retirement rates will increase for the Executive group, while other forms of separation will decrease.

Given the anticipated higher rates of departure at all Executive levels and therefore higher promotion rates from feeder groups into the Executive Category after 2002, training and development will be needed to ensure a suitable pool of candidates with the right skills and competencies.

7.0 Policy and Planning Implications

The results of the forecast cast a measure of doubt on the notion of a short-term crisis in Executive succession but indicate the very real possibility of a crisis in the longer-term. While the Public Service has witnessed large scale departures in the past 4 years as a result of program review and Executives voluntarily taking early retirement, expected departures will drop in early years of the forecast period.

Clearly the next 5 years appear to provide a period of relative stability in the Executive resourcing system with relatively low rates of turnover as compared with the volatility of the program review years. In the first 4 years of the forecast turnover rates will be below 7% of the current Executive compliment. Over the longer 6-10 year horizon, however, departures will rise dramatically with the potential exits of Executives exceeding 10% of the current Executive population in 2004-5, 2005-6, and 2006-7.

While the relative difference in turnover seems small, the need to replace almost 100 more executives over a number of years will place considerable pressure on the feeder groups to meet the needs generated by increasing numbers of Executive departures.

On a positive note, the projected higher levels of departures in the future provide an opportunity for the public service to change its demographic profile. A major precondition to meeting equity targets is a the opportunity for mobility within the system and the increasing departures resulting from a maturing baby boom generation offer the opportunity for the Public Service to

redesign its demographic character.

8.0 Future Research

- There is a need to survey both the current Executive community and conduct exit interviews with those who have left the community on a variety of issues.

- An in depth analysis of the Employment Equity element is needed[24] to help better understand this issues and to support more detailed succession planning.

- Identify areas of weakness in data collection and accessibility in order to improve future analysis based on Public Service data.

- The particular focus of demographic analysis is to examine skills and competencies, the future workforce composition and to provide information for recruitment and retention. This can be expanded to provide specific recommendations for human resource planning and policies.

Appendix 1

The "wiring" behind the 'ithink' model[25]

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[24] A complementary model forecasting the four Designated Groups at the Executive level has been completed by the Labour Market Analysis, Modelling and Demographics Unit, Research Directorate and a supplementary paper will be released.

[25] Source: PSC Model **ex98bs3b** March 31, 1998. Labour Market Analysis, Modelling and Demographics Unit, Research Directorate, Ottawa, 1998.
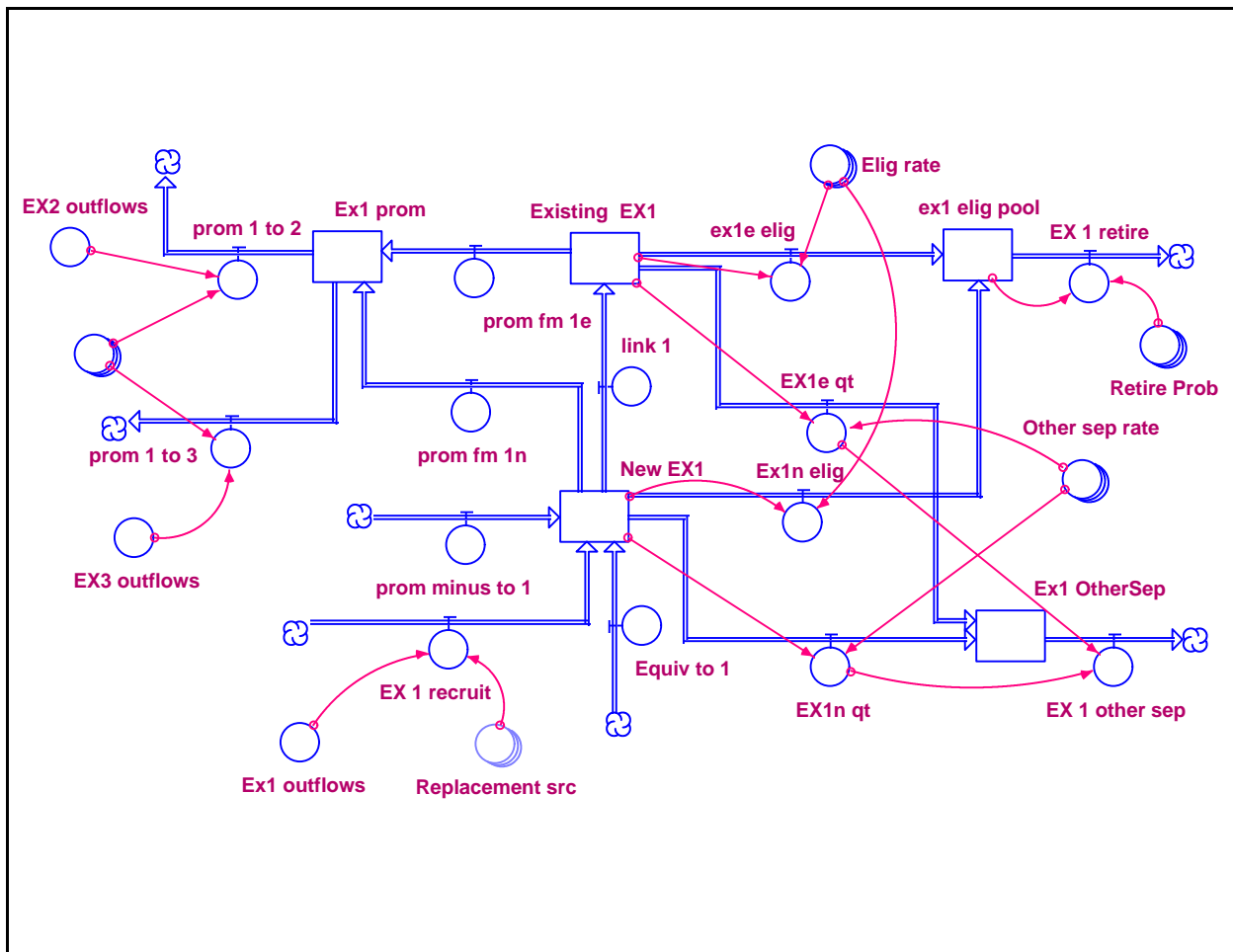
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