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Dynamic Modelling
Of
Three 'Personnel' Case Studies
For
The Department of National Defence
And
The Canadian Forces

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Abstract

Pursuant to a pilot project, Defence's Director General Strategic Planning (DGSP) authorized the production of three, quantitative SD models related to the 'Personnel' aspects of the Conduct Operations Capability Program (COCP) sub-system. DGSP's objective was to present the insights and observations from the three, dynamic personnel-related models to the September 2002, Defence Management Committee (DMC) meeting, with a view to underscoring how the DMC's people-related policy decisions dynamically impact Defence's ability to generate and sustain an adequate personnel structure, over time. The three Case Models offered the following key, personnel-related management insights: **Case Model #1** strongly suggested that measuring 'Personnel Tempo', instead of 'Op Tempo', would better serve the needs of the Defence institution. **Case Model #2's** 'arrayed' nature provided the various stakeholder groups with a common, but discrete, view of the fundamental model structure, thereby promoting a balanced and integrated decision-making and planning framework regarding the personnel-related aspects of the Conduct Operations sub-system. **Case Model #3** provided insights that dynamically linked the following three important Defence issues: the Force Reduction Program (FRP), the Strategic Intake Plan (SIP), and the COCP.

Key Words: performance measurement, performance management, balanced scorecard, capability based planning, force reduction program, strategic intake plan

Introduction

Often, policies that have been adopted to resolve a business problem (i.e. personnel recruiting and retention issues) prove to be the root cause of surprising and baffling negative effects. In that light, the Performance Measurement Core Action Team (PMCAT) developed a suite of four 'beta-version' SD sector maps governing the COCP sub-system of Defence's capability-based

program: the ‘Personnel’, ‘Equipment’, ‘Materiel’, and ‘Contingency/Operations Plans’.

Pursuant to the above-cited pilot project to map the principal cause-effect relationships of the COCP, the DMC was particularly interested in the capability gaps that impact the 'Personnel' aspects of the Conduct Operations sub-system. The purpose of this paper is to summarize the results of a project undertaken by DGSP to produce three, quantitative, SD models governing the 'Personnel' aspects of the COCP sub-system of Defence's capability-based planning framework.

Defence Context

The integrated set of four SD sector maps served as the foundation for the development of a prototype Operational Status Instrument Panel (OSIP). As the PMCAT used the OSIP to test the dynamic interplay within and amongst the four, above-mentioned sector maps, several areas beckoned closer examination, in a dynamic sense: weak links, aging chains, operational tempo, and strategy to results.

Regarding 'weak links', the OSIP indicated that the time delays associated with the flows governing Defence's people constitute important leverage points for senior management, and that particular attention should be paid to identifying and improving the slowest events in the chain of causality. The OSIP also underscored the importance of arraying Defence's personnel stocks [i.e. (Military Occupation Classification (MOCs)] in a dynamic fashion, because it was the people requirement that defined Defence's ability to sustain, over time, the structure of its operational forces.

The 'ageing chain' that governed Defence's critical stock of people proved a very important factor, particularly when viewed through the lens of Future Capability-Based Planning. The dynamic complexity engendered by ageing personnel—coupled with a high turnover rate—was not yet well understood by the Defence Team. Intuitively, most Defence managers recognize 'ageing' as an important issue; however, the leverage points remain obscured by mountains of superfluous personnel-related detail. A management 'flight simulator', like the prototype OSIP, helped to shed light on the trade-offs that the DMC would need to make today to ensure that the Defence institution possesses the right blend of experience and skills necessary to deliver tomorrow's operational capabilities.

The notion of 'operational tempo' was also an issue that drew the attention of the PMCAT, because the tempo of Defence's operations appeared to affect the organization's personnel-attrition rate, and the personnel-attrition rate appeared to affect the tempo of Defence's operations.

The OSIP also underscored the important role that the men and women of the Reserves play in both domestic and international operations, and the need for Defence to manage this valuable resource in a dynamic manner.

The pilot project resulted in a dynamic model that could be reconfigured and populated with data/variables derived from Force Planning Scenarios [imagined events threatening National security] to test the DMC's underlying planning assumptions regarding Defence's people, with a view to exploring how the flow of operations (i.e. 'spike', [weeks] 'surge' [few months] and 'sustain' [years]) impact the development of a sustainable force structure. The overriding insight garnered from the project, and the OSIP, was the recognition that the context governing the Personnel Sector Map (i.e. ageing personnel) engendered a significant feedback effect over time, that was in turn effected by the tempo of Defence's operations.

Objective

Pursuant to the above-cited pilot project, DGSP directed the development and production of three, quantitative SD models related to the 'Personnel' aspects of the COCP portion of Defence's capability-based planning framework. The DMC is concerned about Defence's ability to recruit and retain adequate numbers of people to sustain its capability programs. Consequently, DGSP's objective was to present the insights and observations garnered from the three, dynamic personnel-related models to the September DMC meeting, with a view to underscoring how the DMC's people-related policy decisions dynamically impact the institution's ability to generate and sustain an adequate personnel structure, over time.

Project Approach

The two system dynamicists provided the necessary analysis and expertise leading to the design of the three quantitative, personnel-related SD models and the associated 'instrument panels'. DSPC and specific PMCAT members provided the defence-related, subject-matter knowledge and expertise required to populate the three models. The model-building process involved key stakeholders and people possessing relevant information.

Structure of the Three 'Personnel' Models

The work of the Project Team resulted in the creation of three, SD models and the associated management 'instrument panels' (i.e. flight simulators). The dynamic models provided the foundation for the development of three case studies related to the 'Personnel' aspects of the COCP sub-system of Defence's capability-based program:

Model #1 Structure

This simple, three-stock 'Personnel' model in *ithink* includes a story line and a management instrument panel. See **Appendix A1**. This model demonstrates the limits governing the size of operational deployments.

Model #2 Structure

This dynamic 'Personnel' model in *ithink* also includes a story line and an instrument panel. See **Appendix B1**. The model builds upon the structure of Model #1 and allows the user to vary the size and frequency of operational deployments (i.e. surge, spike and sustain). See **Appendix B2**. In order to generate more detailed complexity and further insights, the model's stocks are arrayed by both Regular and Reserve components (i.e. Army, Navy, Air Force, and Service Support) so that the effects of shocks (i.e. deployments) can be displayed by individual operational environment, or integrated across all the environments.

Model #3 Structure

Model #3—including a story line and instrument panel—builds upon the insights gained from the dynamics of Model #2. See **Appendix C1** Model #3 is a three-sector, non-arrayed model that links deployment rates and timings together with Defence's overall the training process. The model integrates some basic performance measures that demonstrate linkages to Defence's PMF.

Model #3 links the operations-related deployment rates (i.e. flows) and timings (i.e. delays) with the personnel training process. Model #3 places particular emphasis on Defence's demographic data to highlight the impending drought of experienced trainers that could hamper Defence's ability to properly train and groom its junior officers and Non-commissioned Members (NCMs) as more and more 'intermediate' and 'senior' personnel retire.

Summary of Insights Derived from the Three 'Personnel' Models

Case Model #1 suggests that reducing the length of operational tours from six to four months has no effect on 'Op Tempo' if the 12-month recuperation time is kept constant. 'Op Tempo' only measures the ratio of Canadian Forces (CF) personnel deployed on operations, not the total amount of time CF personnel are actually deployed on operations. The model seems to indicate that a 4-month tour would result in a significant reduction in the number of CF personnel that can be sustainably deployed on operations. See **Appendix A2**.

The dynamics of Model #1 appears to indicate that the increased flow of personnel engendered by reducing tour lengths from six to four months could place a serious strain on the CF's strategic-lift capabilities and significantly impact

how CF-wide training activities are planned and scheduled. The discussion concerning Model #1 also raised an important question: *"Where is the evidence to support the notion that shorter, more frequent rotations would reduce individual and family stress levels and personnel 'burn-out?"*

The dynamics of Model #1 appears to impact Defence's corporate priority of "Putting People First". The 'Rotation Ratio'—as opposed to its inverse: 'Op Tempo—if defined as the ratio of CF personnel deployed on operations to total CF personnel, does not capture the total amount of time that personnel are actually deployed on operations. Therefore, it appears that a new, personnel-related measure, other than 'Op Tempo', is required to measure progress towards achieving Defence's above-cited corporate priority.

The model strongly suggests that measuring 'Personnel Tempo' would better serve the needs of the DMC. 'Personnel Tempo' would examine the total amount of time that CF men and women spend on deployed operations: "total # of personnel-months on ops/ total # of personnel-months". This new measure would also factor into its equation all of the time that CF personnel spend away from their unit/base/home (i.e. individual/collective training and domestic operations). See **Appendix A3**.

Case Model #2 is an arrayed variation of Model #1, designed to demonstrate how a relatively simple model, in terms of dynamic complexity, can be otherwise very rich in terms of the underling data sets. Although the intent was to populate the model's structure with variable data derived from the personnel-related aspects of the Force Planning Scenarios (FPS), the time constraints imposed by the Project Authority precluded this from occurring. The model's 'arrayed' nature provided the common platform, or vocabulary, required to integrate the strategic and operational conversations across Defence's various stakeholder groups. The use of an arrayed model structure provided the various audiences with a common, but discrete, view of the fundamental model structure, thereby promoting a balanced and integrated decision-making and planning framework regarding the personnel-related aspects of the COCP sub-system.

Model #2 should prove to be a very useful tool in support of the Force-Structure-Analysis process by virtue of its ability to portray the dynamic implications of the DMC's personnel-related policy decisions, across the breadth of the institution, over time. At a later date, more detailed, or granular, data elements—down to the MOC, rank, age level—could be incorporated into the model's existing structure, with minimal effort. However, with a view to supporting future strategic-planning activities related to Defence's critical MOC requirements, and the gaps therewith associated, the demographics of each specific MOC would need to be linked/integrated via Model #2's mapping structure.

Case Model #3's non-arrayed structure links Defence's operations-related deployment rates (i.e. flows) and timings (i.e. delays) with the personnel-training process. Simply put, Model #3 examines how Defence's demographic trends effect training demand and ultimately impose limits on the COCP sub-system of the Defence Services Program (DSP). The insights garnered from Model #3 largely pertain to the following three important issues: the Force Reduction Plan [FRP], Strategic Intake Plan [SIP] and COCP.

FRP

Model #3 clearly underscores the severe, but unintended, impact that the FRP has had on the CF's demographic fabric. As a result of the FRP, the fraction of recruits dropped from 15% to 8% during the 1990-2002 timeframe. The FRP reduced CF personnel primarily by reducing the rate of overall recruitment. Notwithstanding recent increases in recruitment rates, and the trends proposed in the SIP, the model appears to indicate that the overall fraction of recruits in the CF will not return to historical norms (i.e. pre-FRP levels) unless there is a sustained—meaning long-term—increase in Defence's recruitment rate. The model strongly suggests that Defence must strive to return the recruitment fraction to its pre-FRP norm, because this particular personnel-policy aspect is vital to sustaining a healthy mix of youth and energy, age and experience in the CF.

Model #3 also shows that, during the 1990's, the fraction of highly trained personnel resident in the 'Intermediate' cohort had reached an all time high: from 27% pre-FRP, to 38% in 1997, to its current level of 33%. This 'bubble' of mature, experienced and highly trained men and women enabled Defence to pursue a very high 'Op Tempo' throughout the nineties. See **Appendix C2**. However, the 'Intermediate' cohort is now in decline, thereby eroding the 'maturity-experience' factor and significantly reducing the CF's operational flexibility.

This decline in CF-wide maturity and experience was further compounded by a concomitant reduction in the training establishment cadres needed to train the recruit fraction, the latter having reached a historical low of just 3%. In addition, increasing numbers of CF men and women, who constitute the 'Intermediate' cohort, are arriving at the 20-years-of-service (YOS) gate and are requesting release in record numbers, at record release rates. The model suggests that there is an ongoing personnel-related dynamic, or "1-2 punch", that could drive the CF to significantly reduce its operational deployments in the very near future.

The downsizing, or 're-engineering', activities of the 1990's proved remarkable in another way. During this period, the CF, for the first time in its history,

significantly reduced its overall personnel strength while at the same time the number and frequency of its operational deployments significantly increased. When viewed superficially, and in the light of the numerous and successful operational deployments during the last decade, the deployment levels of the nineties appear to achieve a good 'fit' with the current force size and structure. The deployment levels appear to have been adequately sustained for a long period of time; however, upon detailed analysis it is clear that such a belief constitutes an erroneous assumption.

Model #3 suggests that the principal reason why Defence was able to deploy so many CF personnel during the 1990s was that the FRP freed many experienced men and women (i.e. the Intermediate cohort) who would have otherwise been engaged in CF-wide recruiting, education and training activities. Moreover, the FRP skewed the CF's maturity-experience mix to produce all-time-high fractions of Intermediate (i.e. 9-20 YOS) personnel who were ideal candidates for operational deployments. Consequently, Defence has been able to deploy CF personnel well above truly realistic and sustainable limits. The underlying dynamics of Model #3 seems to indicate that this era has ended, for two reasons:

- Experienced personnel (i.e. the Intermediate cohort) will be required to implement the objectives of the SIP; and

- Increasing numbers of people from this 'bubble' of experienced men and women are arriving at the 20-YOS gate and many are choosing release as their preferred career option.

The model strongly suggests that Defence could be compelled to significantly reduce operational deployments, in order to focus the energy and experience of the CF's Intermediate cohort on the critical task of training and educating the swelling ranks of the Recruit and Junior cohorts that would flow from the SIP. To do otherwise might jeopardize the long-term viability of the CF.

Model #3 also shows that the fraction of CF personnel arriving at the 20-YOS gate has increased from 3%, pre-FRP, to 7% today. Furthermore, the trend in the attrition rates for the Intermediate-age cohort does not augur for a return to pre-FRP levels: the rate was 9%, but now appears to have levelled off at 12%. When taken together, the above insights would suggest that the exit flow—measured in personnel/year—of these experienced, men and women is more than double pre-FRP historical values, notwithstanding that the overall size of the CF has been significantly reduced.

The model again suggests that the above '20-YOS/Intermediate-cohort' issue is one that requires the immediate attention of the DMC. Personnel policies that

result in the retention and sustainment of this particularly important group of CF men and women are absolutely central to achieving the short-&-mid--term objectives of the SIP and the long-term goals of Defence Strategy 2020.

In summary, Model #3 indicates that the FRP has generated, to this point in time, more than double the historical fraction of CF personnel arriving at the 20-YOS gate. Moreover, for a variety of reasons beyond the scope of this project (i.e. personnel tempo, quality of life, etc) a rising fraction of these men and women are choosing to release from the CF, thereby increasing the overall 'outflow' of CF maturity and experience. This CF version of the so-called 'brain drain' could prove very costly to the Defence institution. This departing cohort would take with them all the military knowledge and operational experience that they have acquired over two decades—know-how that would not be passed on to the Recruit and Junior cohorts.

SIP

Model #3 appears to suggest that the SIP could place extra demands on the CF's Junior and Intermediate cohorts. This would be particularly true for those men and women approaching the 20-YOS gate and could thereby exacerbate the release rate for this crucial cohort.

In order to implement the SIP, Defence's recruiting-education-&-training capability would need to be re-energized after a decade of FRP-related downsizing. However, it is precisely those men and women who would form the backbone of a reinvigorated CF training establishment who are indicating that they plan to release at the approaching 20-YOS gate. The model suggests that the DMC should first give priority attention to formulating personnel policies that result in increased retention and job satisfaction across the CF's Junior and Intermediate cohorts, because it is they who would make or break the SIP. Obviously, the men and women who would constitute the two above-cited cohorts would not be available for operational deployments, as were their predecessors during the 1990s.

The model also indicates that the CF's recruiting-education-&-training system (CFRETS) would take time to ramp up after a decade of relative inactivity, and that, without a slow, but deliberate increase in training activity, delays and bottlenecks would increase many fold across the breadth and depth of the CFRETS. The model leads one to believe that an immediate, large influx recruits, as suggested by SIP, could actually result in abnormally high levels of attrition during the early stages of the recruit/basic-training program. The model also predicts long delays and backlogs (or 'accumulations') as new personnel wait for subsequent stages/phases of training, possibly exacerbating problems related to moral and job satisfaction. See **Appendix C3**.

Model #3 provides one particularly interesting insight regarding the SIP's planned inflow of recruits. The model would indicate that, if the SIP succeeds in recruiting 7000 recruits/year over the course of the next three years, the CF's preferred manning level (PML) should increase to around 60 000 personnel. However, the SIP would fail to return the overall percentage of CF recruits to its pre-FRP level of 15%. With a percentage of recruits forecast at 10%, the model appears to indicate that, notwithstanding a trouble-free SIP, the demographics of the CF has been inextricably changed, for the foreseeable future. See **Appendix C4**.

The key issue is one of demography: *How will Defence achieve and sustain a stable demographic age-maturity-experience cohort mix that supports the training program and operational deployments?* After running various scenarios, the model suggests that Defence would be much better served by establishing and maintaining an inflow of recruits that is significantly less than that proposed in the SIP. The dynamics of Model #3 indicates that the inflow of CF's Recruit cohort should be as stable as possible, and that it should be equal to the attrition/release rate + basic training losses, irrespective of any fluctuation in Defence's overall budget.

Model #3 also provides some interesting insight into how deceptive the 'numbers' can be when viewed in isolation. The numbers alone could easily mask the need for the DMC to place more emphasis on developing plans, implementing military personnel policies, and establishing performance measures that are specifically designed to achieve the right blend of age, maturity and experience necessary to sustain all five of Defence's capability programs. From this perspective, the model clearly indicates that a 'surge' in recruiting, like the 7000 recruits per/year over two years proposed in the SIP, could a risky course of action for the DMC to adopt. Such an approach could make the personnel-related sub-system unstable, and introduce another 'oscillation'—like that induced by the FRP—into the personnel dynamic, one from which the CF may have great difficulty recovering.

In summary, Model #3 strongly suggests that the DMC needs to plan and implement a steady and sustained recruiting program that is commensurate with the overall attrition rate. The reasons for doing so would be fourfold:

- Qualified 'trainers' are in short supply and if they become over-stressed, they may be more likely to release at the 20-YOS gate.

- If the CF's personnel system is subjected to another 'surge', it is very likely that, 10 or 15 years hence, yet another large, combined cohort (i.e. Juniors and Intermediates) would arrive at the 20-YOS gate and recreate a similar, or

perhaps worse, dynamic in terms of lost knowledge, experience, skills and competencies.

- Another 'surge' could result in increased attrition rates for the SIP-related cohort because of the inevitable, but unintended, reduction in promotion and career-advancement possibilities that are normally engendered by such a personnel-management approach.

- To maintain the quality of its NCMs and officer corps, the CF needs to have a limited number of men and women 'competing' for its pool of promotions and appointments. The model seems to suggest that 'stability' leads to 'quality', and that a fine line exists between too few personnel (i.e. low quality) and too many personnel (i.e. decreased job satisfaction, increased attrition rates, and loss of training investment & knowledge capital) accumulating at the various promotion gates.

- The model indicates that the increased training requirements associated with the SIP would also dictate that increased numbers of experienced CF personnel are diverted from the 'Conduct Operations' to the 'Generate' and 'Sustain' capability sub-programs for several years to come.

Conduct Operations Capability Program

With regard to Conduct Operations, the model clearly suggests that the SIP should not be structured in a manner that results in yet another 'surge' the CF's personnel system. Such an approach would most likely place an unmanageable strain on the existing CFRETS and generate severe oscillations across the CF's personnel sub-system. These fluctuations would probably undermine any attempts to rebuild the critical age-maturity-experience mix that is central to achieving a sustainable CF demographic profile, one that serves the needs of the Conduct Operations sub-program and caters to the exigencies of Defence Strategy 2020. Rather, the SIP should promote a slow and deliberate personnel-management approach that would be sustained over an extended period of time.

The model seems to indicate that the critical success factors governing the rejuvenation of the Generate and Sustain sub-programs would be policies and incentive programs designed to retain experienced personnel who are arriving at the 20-YOS gate

In summary, the insights derived from the dynamic inter-play of Model #3 strongly suggest that Defence (i.e. the PMCAT) develop a plan to research the following topics:

- Is there a direct link between 'surges' in the demographic profile of the CF and shortages in specific MOCs? If the answer is "yes", dynamic models could be used to forecast such shortages and thereby avoid them.

- What pattern of structural behaviour is causing the release of those personnel arriving at the 20-YOS gate to remain double its pre-FRP level?

What personnel-related policies need to be designed and implemented to ensure that the people who comprise the CF's current Recruit and Junior cohorts do not choose release upon reaching the 20-YOS gate?

Conclusion

As was the case with the proof-of-concept pilot project, this project again demonstrated that a SD-based, quantitative model is a very useful and powerful approach to developing insights into the cause-effect relationships that govern Defence's capability-based program. The team's success in mapping the 'Personnel' aspects of the Conduct Operations sub-system appears to have established a solid foundation of knowledge, understanding and collaboration amongst the PMCAT members. This again augurs well for future quantitative modeling activities related to Defence's four remaining capability-based 'sub-systems': Command & Control; Sustain Forces; Generate Forces; and Corporate Policy & Strategy.

Appendices

Appendix A: Case Model #1

Appendix A1: Stock & Flow Diagram
Appendix A2: Comparing Personnel Flows—6 & 4-month Tour Lengths
Appendix A3: Comparing 'Op Tempo' to Time Fraction on Missions

Appendix B: Case Model #2

Appendix B1: Stock & Flow Diagram
Appendix B2: Deployment Types—'Spike', 'Surge' & 'Sustain'
Appendix B3: Deployment View—Regular Force 'Surge' (Army)

Appendix C: Case Model #3

Appendix C1: Stock & Flow Diagram ('Ageing Chain' only)
Appendix C2: Total CF Personnel & Relative Experience Level (Graph)
Appendix C3: Number & Fraction of Total Personnel in Training (Graph)
Appendix C4: Fraction of Recruits & Intake Generated by the SIP (Graph)

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