9-1992

The Development of A Performance Measurement Concept for the Royal Australian Air Force

David R. McDonald

AFIT/GLM/LSG/92S-30

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THESIS

David R. McDonald, BA, BBus
Squadron Leader, RAAF

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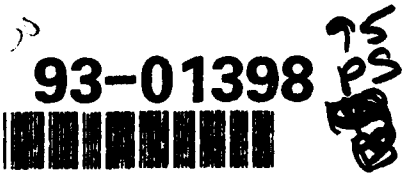

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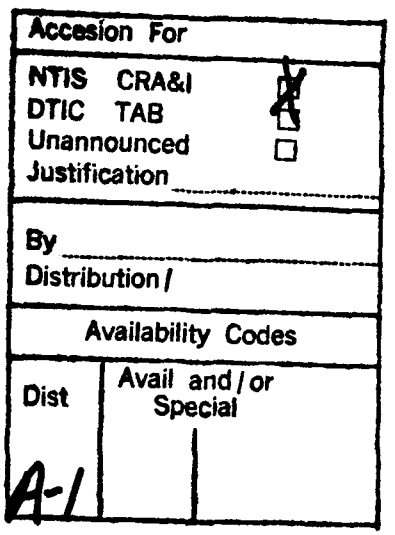

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THESIS

Presented to the Faculty of the School of Systems and Logistics
of the Air Force Institute of Technology
Air University
in Partial Fulfillment of the
Master of Science in Logistics Management

David R. McDonald, BA, BBus
Squadron Leader, RAAF

September 1992

Preface

The purpose of this research was to examine the concepts of the Theory of Constraints to see whether they could be used as a basis for developing performance measures for the Royal Australian Air Force. As this was my first major research piece, I am indebted to several people for the guidance and support they provided during the conduct of the research.

In particular, I am greatly appreciative of the support and encouragement given to me by thesis advisers LTCOL John W. Shishoff and Dr Anthony P. D'Angelo. In particular, LTCOL Shishoff's enthusiasm for exploring new ideas in cost accounting and performance measurement greatly assisted in broadening my knowledge in these areas.

My thanks also go to the many faculty members of the School of Logistics and Acquisition at AFIT who introduced me to a range of interesting management subjects. Their dissemination of information on the tools and methods of management provided the foundation for the research.

Finally, my deepest gratitude goes to my wife Lesley, who lost her husband to the "dungeon in the basement" during the 16 months of study at AFIT. I appreciate the ordeal she had to face, particularly when having to attend to the needs of three young children virtually on her own. I look forward to resuming a normal family life style.

David R. McDonald

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Abstract

The Royal Australian Air Force (RAAF) needed to develop performance measurements (PMs) to support its Program Management and Budgeting (PMB) System. This research assessed the use of the concepts of the Theory of Constraints (TOC) to develop those PMs. The literature indicated that: traditional accounting PMs were not always suitable in an environment of continuous improvement; Activity Based Costing did not provide the required measures; and non-financial PMs were supplanting these older measures. Further, governments faced unique problems in developing PMs, particularly in defining the outcomes to be measured. Using the Critical Theory and Action Research methodologies, and a case study approach, the research derived guidelines from PMB to develop the RAAF PMs, examined the possible use of TOC in government organizations, developed an example of PMs which could be used by the RAAF, and compared the developed PMs with the PMB guidelines. The research found that difficulties arose when operationally defining the outputs of the RAAF, requiring the use of proxy measures. However, with slight modifications, the TOC concepts could be applied to the development of RAAF PMs. Development would be an iterative process, requiring refinements as users gained experience with the PMs.

THE DEVELOPMENT OF A PERFORMANCE MEASUREMENT CONCEPT FOR THE ROYAL AUSTRALIAN AIR FORCE

I. Introduction

Overview

This introductory chapter provides the background to the Royal Australian Air Force (RAAF) requirement to develop metrics to support the RAAF's budgeting, cost management and performance measurement requirements both in the 1990s, and into the Twenty-First Century. Based on this background, the chapter develops a research objective aimed at providing a possible performance measurement approach to meet the RAAF requirement.

The research problem is stated and explained, and more specific investigative questions are described. The chapter concludes with a discussion on the potential benefits and the limitations of this research.

Background

The Australian Government has initiated a government wide program of financial management reform. In response to this reform, the Australian Department of Defence (DOD) has implemented a Defence Financial Management Improvement Program, part of which includes the adoption of the Government mandated Program Management and Budgeting System (PMB). These initiatives were directed at obtaining:

a. more efficient resource allocation through better budget decision-making processes,

b. improved effectiveness by focusing on results through performance measurement, and

c. greater efficiency in resource use by improved management of programs (3:2-4).

The DOD implemented PMB in 1989; however, at the time of conducting this research, PMB had only been applied as a high-level

resource allocation tool. While the DOD intends to apply the PMB process throughout all levels of the Department, definitive plans for implementing PMB at Base or Unit level are yet to be promulgated.

PMB provides the heart of the accounting requirements for the DOD. The Australian Department of Finance describes PMB as being a goal oriented program designed to identify objectives and outcomes, and provides a structured basis to plan, budget, implement, monitor, and evaluate a government department's operations. In the DOD, PMB is intended to provide the foundation for determining the cost-effectiveness and appropriateness of the DOD activities designed to provide for the defence of Australia (5:1-4).

One thrust of the full PMB system is to provide cost consciousness and cost visibility at all levels of management. Actions required to achieve this consciousness and visibility in the logistics support arena include:

a. better quantification of the links between logistics resources and logistics performance, and better expression of logistics performance in terms of operational value;

b. development of performance indicators at all levels of logistics management, which focus attention at the goal of providing effective and efficient support for operations; and

c. development of supporting management information and decision support systems to enable detailed activity costing and performance assessment at all levels. (3:2-4,5)

On 9 May 90, Assistant Chief of the Defence Force for Logistics (ACLOG), Maj Gen J. C. Grey, presented the Defence Logistics Strategic Planning Guide (DLSPG) to the Augmented Chiefs of Staff Committee. ACLOG embraced the spirit of the Government directives, and embodied the DOD accounting requirements within the DLSPG strategic planning objectives.

The DLSPG details seven strategic planning objectives for logistics development to be addressed by the Department. Each of these strategic objectives is supported by enabling objectives, and by broad strategies to achieve the objectives. Listed at Appendix A are the

DLSPG cost management related objectives and strategies which provided the motivation for this research.

Essentially, the DLSPG objectives and strategies at Appendix A address the need for:

a. the development of methodologies and models which allow effective budgeting, resource allocation and risk analysis to support logistics decision making processes;

b. the establishment of performance assessment processes and information systems that focus on weapon system availability and resource allocations against weapon system priorities; and

c. the establishment of an information architecture which enables logistics resource entitlements, availability and consumption to be linked to force elements, weapon systems, equipments and logistics activities (3:B-2,D-1,E-2).

A further consideration in developing performance measures is the RAAF's commitment to quality and continuous improvement through the RAAF Quality (RAAFQ) program -- the RAAF's implementation of total quality management. Metrics that allow the RAAF to track progress in achieving RAAFQ goals are an important part of the RAAFQ implementation and management processes.

The Problem

One of the underlying themes for the DLSPG strategies is the requirement for a conceptual framework which can be used to develop performance measurement tools. At present, such a conceptual framework does not exist within the Australian Defence Force (ADF) at the middle and lower levels of management.

Further, as depicted in the literature review in Chapter II, recent literature on the subject of performance measurement indicates that the traditional commercial performance measures based on the financial data of an organization have been unsatisfactory as a measure of day-to-day performance of the organization. In addition, the

development of performance measures for not-for-profit and government organizations presents its own problems which require the development of performance measures which are unique to each not-for-profit or government organization.

The combination of the search for new performance methodologies and the need to accommodate the unique problems of the government organization, has led the researcher to believe that there are no "off-the-shelf" performance measures which the RAAF can adopt. Therefore, the RAAF needs to develop and adopt its own performance measures to fulfil the Air Force's management requirements within the overall thrust of the Department of Defence strategic objectives.

One approach which could be used to produce a conceptual basis for these new performance measures is that provided in E. Goldratt's Theory of Constraints.

Research Objective

The purpose of this research was to assess the applicability of using the performance measurement concepts suggested in the Theory of Constraints to develop performance measures to monitor the achievement of the goals and objectives of the RAAF.

Approach Taken in Achieving Research Objective

The approach taken in this research combines "critical theory" and "action research " methodologies, using a case study as the vehicle for presenting the research analysis. In essence, the critical theory approach is to conduct research which is, at the outset, designed to facilitate change. The approach involves the use of both concrete and abstract observations, is self-reflective in nature, and is recognized as being potentially value-laden. Thus, critical theory permits the researcher to take an activist role in the research, and the bias inherent in such an activist role is acknowledged at the start of the research (34:328,333). The "action research" approach is: problem centered; "bridge(s) the gulf between theory and practice"; provides a

means of further action, by involving the members of the organization being researched in the discussion of the research; and emphasizes the actual use and dissemination of the research product (33:186).

Using these approaches allowed the researcher to reach conclusions and recommendations which provided a set of pragmatic measures to be used as the basis further discussion with RAAF policy makers.

Investigative Questions

There are four investigative questions which need to be addressed to achieve the purpose of the research:

a. What types of performance measurement indicators are required in the PMB system adopted by the Australian DOD, and what attributes do these measures require?

b. How can the performance measurement concepts of the TOC be adapted to a government organization?

c. What is an example of the TOC methodology as applied to a RAAF Force Element Group (FEG)?

d. Does the FEG example satisfy the performance measurement requirements of the PMB process?

Limitations

There are four limitations placed on the scope of the research. First, for the purposes of exploration of the TOC performance measures in the RAAF environment, the research is limited by taking only one Force Element Group, the Strike/Reconnaissance Group, as the basis for a case study. A Force Element Group (FEG) is a combat program under PMB, and under PMB, FEGs are considered to be the building blocks for corporate planning for results, as:

a. they are generally natural groupings of elements of the Defence Force for reporting purposes,

b. they can be readily related to the 1987 'White Paper' and subsequent policy initiatives, and

c. they are the basis for outcome reporting under CDF's classified Operational Readiness Directive (4:7).

Second, the research was confined to a review of the literature and an exploratory examination of one performance measurement concept. The researcher acknowledged that there are be other conceptual frameworks which could be used by the RAAF, for example, the Computer-Aided Manufacturing - International Project, or the Government Accounting Standards Board "Service Effects and Accomplishments Project" (7;15).

Third, the research was developed from a theoretical basis, adapting new approaches and philosophies to the RAAF environment. This approach was taken with the goal that the next stage of the measurement concept development would be the discussion of the concepts with the potential users of the metrics.

Finally, the surveying of potential managers to ascertain their cost management and performance measurement requirements was not considered feasible due to perceived problems associated with the potential managers' lack of knowledge of management accounting and performance measurement techniques. As the RAAF currently has no cost management and performance measurement system at the middle and lower management levels, the potential users of a new cost management and performance measurement system have had no exposure to the requirements of accountability for resource management. An education program will be required to acquaint these levels of management with the capabilities that a cost management and performance measurement system can provide.

Benefits of the Research

The major benefits of the research were:

a. the provision of insight into the difficult problem of formulating performance measurements in the RAAF;

b. the provision of a baseline for discussion on the potential use of Theory of Constraint performance measurement techniques within the RAAF; and

c. the provision of a baseline against which other conceptual frameworks for developing performance measures can be compared.

Summary

Chapter I describes the cost management reforms which the Australian Government has initiated in the Australian Department of Defence. These reforms have created a need for the Royal Australian Air Force to develop a performance measurement system to meet the Air Force's obligations under those Defence cost management reforms. The need has prompted this research to identify and outline one possible performance measurement methodology, using contemporary thought, for use within the RAAF.

To facilitate the required research, four investigative questions were formulated to obtain answers to: what type of performance measures are required by the PMB process; how can the performance measurement concepts of the Theory of Constraints be adapted to a RAAF FEG; what is an example of the Theory of constraints methodology as applied to a RAAF FEG; and does this example satisfy the performance measurement requirements of PMB?

The approach taken in the research had some limitations in its scope, these limitations being dictated by the time and distance constraints placed on the researcher. The scope of the research was limited to one RAAF FEG, and to the performance measurement concepts found in the Theory of Constraints.

The research provided three benefits: the development of insight into the difficult problem of defining performance measures for government organizations, the provision of a baseline for discussion of the concepts of the Theory of Constraints as applied to government

organizations, and the provision of a baseline against which other performance measurement concepts for the RAAF can be compared.

Thesis Organization

Chapter I provides an introduction to the research. Chapter II provides a review of the current literature on management accounting for performance measurement, specifically referring to the problems of using traditional management accounting methodologies as a basis for formulating performance measures.

Chapter III explains the methodology used to conduct the research. The methodology includes reviewing the requirements of PMB, adapting the concepts of The Theory of Constraints to a government organization, developing a set of performance measures for the one FEG, and determining whether the developed measures meet the PMB guidelines for a performance measure. Chapter IV answers the research questions, and the research conclusions and recommendations made as a result of the study are contained in Chapter V.

II. Literature Review

Overview

There were four main objectives for conducting this literature review. The first objective was to examine the reasons why many authors believe that traditional management accounting approaches are inappropriate for the formulation of performance measurements for contemporary organizations. The second objective was to examine why they believe the strong recent trend to Activity Based Costing did not fully overcome the problems of the traditional approach. The third objective was to investigate the growing preference for non-financial performance measures. Finally, the fourth objective was to identify the unique problems faced by not-for-profit and government organizations in formulating performance measurements.

The Inadequacy of Traditional Accounting Measures

Traditional cost management and performance measures had their origins in the scientific management movements of 80-100 years ago. The cost accounting model which evolved from these origins was based on the use of standard costs, and the periodic analysis of variances of actual costs from these standard costs. The model was predicated on an environment which featured the mass production of standardized products, where efficiency could be achieved by maximizing the output produced by direct labor and the machines operated by that labor. As a consequence, the accounting systems which emerged required the development of standards for, and the subsequent tracking of, efficiencies based on the individual worker and individual machines (21:16).

During the 1980s, in an environment where organizations were attempting to achieve the goals of total quality control, just-in-time production, the rapid introduction of new products produced in low volumes, and the concepts of ongoing, continuous improvement activities, the use of traditional management accounting approaches to performance

measurement of organizations came under increasing attack. According to Kaplin, the traditional cost model was accused of being a major stumbling block to many organizations' efforts to become high quality, responsive, and flexible organizations.

In many cases, despite improvements provided in the new operating environment, such as lower defect rates and reduced throughput times, unit costs and financial efficiency measures had not shown any improvement. Examples were provided of cases where these measures had shown that, contrary to reality, efficiency had even deteriorated. In other cases, the traditional financial performance measures actually inhibited quality and process improvement activities (21:2,16-17).

A seminal work in the exploration of the decline in relevance of the traditional cost model was provided by Johnson and Kaplin in their book "Relevance Lost: The Rise and Fall of Management Accounting" (19). The book described in detail the inadequacy of the traditional methods, and their findings, along with some contributions from other academics, practicing cost management and production management professionals, are discussed in the following paragraphs. The generalizations in these paragraphs were provided by the respective authors, based on their research and investigations.

Misleading Target for Managerial Attention. The traditional cost model failed to provide relevant measures that reflect the technology, products and processes in which the contemporary organization operated. Financial managers who relied exclusively on periodic financial statements for their view of the organization became isolated from the real value creating operations of the organization. Consequently, they failed to recognize when the accounting numbers were no longer providing relevant or appropriate measures of the organizations operations (20:3-4).

Inappropriate Focus. The old system was initially adapted to value both units of unsold product at the end of the period (finished and in-process inventories) and units of production sold during the

period. Inventory costing therefore provided inventory values to report on the balance sheet, and manufacturing expenses to match against revenues on the income statement. These costings did not reflect the true performance of the organization (20:130).

Adverse Consequences of Direct Labor Allocation Systems. The major distortion in the traditional cost model was caused by the use of direct labor to allocate overhead costs to products and services. This methodology prompted cost center managers and product managers to focus their cost-reduction attention solely at direct labor savings. In the contemporary environment, with overhead burden rates of 400 to 1000 percent not unusual, small savings in direct labor time had large impacts on cost distributions and product costs (20:188).

The focus on labor could result in enormous amounts of time and effort being committed to the detailed recording and processing of labor time, and it was not unusual to see thousands of dollars of management time being devoted to saving tenths of hours of direct labor time. Then, at the end of an a ›unting period, further management time was spent analyzing unfavorable labor variances that seemed to involve trivial amounts of actual labor hour variation.

Such concentration on labor hours distracted attention from the cost of overheads, the area where costs were actually increasing most rapidly. The problem of allocating overhead using labor hours was further compounded by the fact that, if a process manager succeeds in reducing growth in an overhead cost category, the benefit is distributed broadly to all cost centers and processes in the organization. This created a behavioral environment where managers, to achieve the maximum reductions in the allocated costs for their individual processes, shied away from reducing overheads, and concentrated on reducing their direct labor charges, since that was the cost driver by which all other costs were attached to their cost centers and processes (20:188).

Based on this view of management, any process that required relatively large amounts of direct labor seemed to be very expensive.

In many cases it was "cheaper" to find a supplier that could produce the labor-intense component, subassembly or service than for the cost center to produce it. Thus, subcontracting apparently lowered costs, prompting the organization to buy rather than produce (20:189).

Unfortunately, in many cases, overhead costs tended to rise with increased amounts of subcontracting. Subcontracting imposed additional demands on the purchasing department to generate specifications for the component and to investigate quality vendors; on the scheduling department to provide delivery schedules to the vendor; on the receiving and inspection department to process incoming items; on materials handling departments to place purchased components into storage and bring them out to production when needed; and on the accounts payable department to pay the vendor. All of the new support activities added to overhead costs. But the newly added costs were not traced to the purchased component because it had zero direct labor content. Instead, the higher overhead costs were shifted to the labor-intense products and processes still remaining in the plant, making the remaining products and services "more expensive", prompting further subcontracting.

Often, the direct labor allocation base also distorted product costs and introduced unintended cross subsidies by shifting costs from less labor-intense products to more labor-intense products. Even when cost centers used a flexible budget which identified and separated variable and fixed expense, the variable portion of costs was assumed to vary with direct labor activity. In addition to introducing unintended cross subsidies among products, the direct labor overhead allocation system inhibited cost planning and cost control (20:188-190).

Lack of Timeliness. Typical 1980s cost accounting systems failed to provide information in a timely manner. As a result of the various time-consuming operations required to prepare periodic costing statements, it was seldom possible to obtain cost statements of the conventional type very soon after the period has closed. Typically, an accounting report for a period would appear just before the middle of

the subsequent period, e.g. monthly reports would appear in the middle of the following month. Despite a great deal of attention being devoted to performing "fast closes", even with the fastest of closings, the cost information was produced too late to help short-term process control. Unfortunately, if a problem arises, process managers need to deal with it immediately; they cannot wait until sometime the following month to discover the process variances. Therefore, Johnson and Kaplin stated that it may be more important to make available essential interim control information for managerial purposes than to prepare overall statements. Incomplete details of an operation, obtained promptly, may be of more use than complete information made available only after a considerable lapse time (20:193).

Information Produced at Too Aggregate a Level. Apart from arriving too late to be of much use for controlling the production system, the cost management information was usually produced at too aggregate a level to be able to pinpoint the source of adverse, or even favorable, production variances (20:194). In addition, the information was too technical, and was not easily understood by non-accounting managers (11:33).

Inconsistency Between Reports and Reality. The cost data derived using the traditional costing method incorporated allocations that were inconsistent with the actual factory production process and product mix. Reports were usually produced on a cost center basis, and did not monitor adequately the costs of business processes which spanned interrelated departments or units. In addition, the reports failed to support the information requirements of modern techniques such as Just-In-Time and Total Quality Management (11:33; 20:194).

Capacity for Manipulation of Results. Problems with managing for short-term financial objectives arose because operating managers learned that there were a variety of ways to meet profit and return on investment goals. Managers discovered that profits could be "earned" not just by selling more or producing for less, but also by engaging in

a variety of nonproductive activities, such as: exploiting accounting conventions, engaging in financial entrepreneurship, and temporarily reducing discretionary expenditures. Historical cost accounting procedures and "generally accepted accounting principles" (GAAP) provide ample opportunities for executives to manage their income and investment measures. As one example, considerable discretion existed for the timing of revenue and expense recognition so as to exhibit steady earnings growth or to meet budgeted income or expense goals for the current period (20:196).

External Reporting Bias. Traditional cost accounting systems attempted to satisfy three goals: to allocate certain period costs to products so that financial statements can be prepared monthly, quarterly, and annually (external focus); to provide process control information to cost center managers (internal focus); and to provide product cost estimates to product and business managers (internal focus). Typically, only a single cost system was used for these three quite different goals. Because financial accounting considerations had been dominant, only the first of the three goals was accomplished well (20:231).

Other comments on the external reporting bias included:

a. Traditional cost systems were meant primarily to value inventory and provide data for profit and loss statements and balance Sheets (27:36).

b. Reports tended to be pre-occupied with bottom-line profits and did not focus on the critical success factors, such as increasing efficiency, better quality, improving customer service and product flexibility (11:33).

There were numerous other articles which directed criticism at the traditional cost model. The thrust of their criticisms echo the comments of Johnson and Kaplin (10:38; 11:31-33; 13:56; 22:36; 23:11; 25:42; 28:28; 32:20).

Conclusions in the Literature. The literature reviewed above drew a number of conclusions regarding traditional performance measures. First, Kaplin stated that the traditional summary measures of local performance -- such as direct labor and machine efficiencies, and absorption ratios -- "are harmful and probably should be eliminated." Instead direct measurement was needed of quality, process times, delivery performance, and any other operating performance criteria that organizations may want to improve.

Kaplin went on to say that actual resource consumption and aggregated cost figures should be compared not to cost standards, but to trends of past actuals. The standards for today's organizations should require improvement from the levels established by outputs from activity in previous operating periods. Results should be presented graphically in the form of trends of output and resource consumption, with these simpler measures replacing "the myriad of numbers currently reported in aggregate monthly financial summaries".

In contrast to current usage, financial summaries should be informational, and not control, measures. The summaries would be attention-getting and aggregate score-keeping in nature, and perhaps computed only semi-annually or annually, to provide a comprehensive, interorganizational measure of financial activity for key activities (21:35-36).

As for the design of new performance measures, Kaplin states:

> Just how to design a hierarchical, comprehensive system of local shop-floor measures, departmental and plant measures and divisional performance measures remains a task for future research and experimentation (21:10).

The conclusion from reviewing this literature is that traditional cost measures may not be the correct measures for adoption by the RAAF.

A Shift to Activity Based Costing

Many of the articles that criticized the traditional cost model offer Activity Based Costing (ABC) as the preferred alternative method

to the old model (11; 13; 22; 23). Cooper describes the ABC system as follows:

> Activity-based cost systems are distinguished from their conventional counterparts by the cost drivers, or allocation bases, they use to relate the consumption of inputs to products. Conventional systems rely solely on unit-level cost drivers, such as direct labor hours or dollars, machine hours, and materials dollars. A unit-level cost driver assumes that inputs are consumed in direct proportion to the number of units produced. Activity-based systems, while retaining unit-level drivers, also use nonunit-level ones. Nonunit-level drivers assume that costs are not consumed in direct proportion to the number of units produced. These drivers include the number of part numbers, number of vendors, and number of setups. (9:304)

However, the shift to ABC was perhaps not the answer for the operational performance measures required by an organization. While Johnson supported the move to ABC, he did not believe that ABC in itself was a tool for continuous improvement. In a recent article he stated:

> The belief that activity-based cost information improves a company's performance is a delusion. No accounting information, not even activity-based cost management information, will help companies achieve competitive excellence. As a tool to improve cost accounting information ABC is impeccable, beyond that it is snakeoil (19:13).

Johnson contended that all management control information comes from customers and processes, in real time, and the aggregation of cost accounting data did not reflect customer expectations or process capabilities. As such, Johnson advocated that more attention be given to Statistical Process Control (SPC) charts maintained by both workers and managers alike. All members of the organization should understand how to translate information from these SPC charts into actions which result in continuous improvement of the organization as a whole.

To be able to respond quickly to the need for change required a flexibility in not having to wait for accounting-based instructions from above. Both internal and external customers would offer new types of information on how they do or don't like what they get, and real-time instructions would come from processes, customers, and from problem solving teams (19:13).

ABC had the problem that it was not real-time. ABC was really only reconstituted accounting information, and it would not help workers

maintain competitive processes, or help satisfy customers quickly. According to Johnson, "no accounting information -- not even new and improved ABC -- ever indicated if a customer was satisfied, if a process were in control, or what time it takes to accomplish a job."

Further, ABC did not identify the changes that must be made to become a truly flexible producer. It simply identified steps that reduced costs or raised margins, while doing business as usual. Activity-based cost information did nothing to change old style management behavior.

Johnson concluded by recommending organizations to invest in customer focused problem-solving initiatives to remove constraints that cause variation, delay, and excess in processes. A focus on the reduction of variation and leadtime, he believes, will lead to an almost automatic reduction in costs (19:13-14).

Johnson was not the only critic of the rush to ABC for the purpose of providing performance measures. Piper and Walley stated that ABC was inappropriate at the strategic level, and that at the operational level, management could be better motivated by physical measures, e.g. delivery speed, delivery reliability etc, without a dubious cost being ascribed to them, or if a cost was ascribed, its behavioral and operational role was clearly delineated. They concluded that the analysis of activity was definitely a worthwhile activity, but that ABC may not be (25:44,54).

The general thrust of the Johnson and Piper arguments was that neither ABC, nor any other purely accounting-based set of measures, will provide the types of performance measures required in the contemporary environment of continuous improvement. These arguments were in accord with another recent trend towards the use of more non-financial based indicators of organizational performance.

Increased Use of Non-Financial Data

The retreat from using purely accounting based information was supported by a growing number of academics and practicing management advisors. Johnson and Kaplin contended that measuring and reporting a variety of non-financial indicators was more important than measuring monthly or quarterly profits. Organizations should be developing indicators based on the key measures of performance success, with organizations wanting to become lower cost producers developing productivity measures which show trends in their ability to produce more with less (20:256-7).

Puxty and Lyall argued that non-financial data had a greater impact on the organization's performance than financial data (26:46), while Sheridan observed that the Japanese approach was to use non-financial indicators, particularly on the shop floor, and that UK companies too were adopting these types of indicators. The reason for this trend was that these non-financial indicators did have costing implications, and that an improvement in these indicators nearly always resulted in a better ability of the organization to meet cost and profit targets (32:24).

Providing a slightly different point of view was Ostrenga. He argued that performance measures should represent a mix of financial and non-financial measures, with a pronounced increase in the use of non-financial measures at the middle management level. Such performance measures assisted in the continuous improvement philosophy by focusing on the significant activity levels, and measuring the drivers of those activities. Further, while operational in nature, these measures must still be aligned with the organization's goals and critical success factors to ensure that management behavior was pointed in the right direction, and to prevent situations where the manager optimized an individual area, department or function at the expense of sub-optimizing the whole organization (24:46).

Citing his experience with clients, Ostrenga recommended developing a set of measures which provided a balance between:

a. Effectiveness. Was the organization doing the right thing? This involved a comparison of planned output with actual output.

b. Efficiency. How well was the organization achieving its output? This involved comparisons of planned input with actual input.

c. Productivity. How much output was the organization getting for a given input?

d. Utilization. How was the organization using its resources such as inventory, asset turnover, etc?

The goal of this set of measures was to assist management by tying controllable cost measures to a more comprehensive view of managing the organization's resources (24:47).

Performance Measurement in Government Organizations

For the for-profit organizations, the allocation of resources to produce output was guided automatically by the market structure. A cost benefit for any resource allocation alternative was provided through a market determined value of output, and this output value could be compared to the cost of the inputs to provide that output. The dollar value of sales could be treated as output, while the dollar value of the cost of sales could be treated as input. This allowed the use of the concept of profit as a measure of both efficiency and effectiveness in the allocation of resources.

In contrast, for most government organizations, there were no monetary based markets in which to value output in dollar terms. Accordingly, there was no single indication of performance comparable to profit to measure the "value" of services provided, and managers were driven to some combination of judgement and input cost minimization as a means for searching for optimum performance (2:6; 8:50). A corollary to these points was that for many of the most important decisions in a

government organization, there was no accurate way of estimating the relationship between inputs and outputs (2:40).

As Drebin stated, the situation is further complicated when considering the products of governmental agencies. Many of the products of these agencies were often regarded as being subjective and not being susceptible to measurement. However, this perception of subjectivity should not interfere in satisfying the urgent need to develop useful measures for evaluating governmental programs and services. (12:3) Anthony and Herzlinger concurred that, in many government organizations, no good quantitative measure of output existed (2:5).

Unfortunately, current practice had a tendency to focus on the amount of activity, or the production of some intermediate product, rather than focusing on final results. These activities and intermediate products were easy to measure, but the use of the associated measures often caused managers to lose sight of the real purpose for the activities being managed (12:3).

A further problem with measurement in government organizations was that there may be a general agreement on the direction a program was to follow, but no agreement about how a favorable result should be defined. Obviously, how success was defined had an important influence on measuring program results (12:7).

In many cases, performance may not be able to be measured in absolute terms, but could be measured in relative terms which permitted interjuristictional and interperiod comparisons. While it may not be possible to identify outcomes in precise values, it may be possible to say the results are better or worse than the results of a previous period, or for a similar program in another jurisdiction (12:7).

One method for achieving these relative measures was through the use of proxy measures which could provide quantifiable indications of performance when direct measurement was difficult or impossible. A proxy measure was correlated with the desired outcome, but was more easily measured. Naturally, the credibility of any proxy depends on how

closely correlated the proxy is to actual outcomes. Drebin offered a warning about the use of proxies, stating that correlation did not necessarily prove a cause and effect relationship. While it was reasonable to assume that employees would be motivated to maximize performance as it was measured, and although there may have been a correlation between results and the proxy in the past, emphasizing the proxy could cause the relationship between the proxy and the desired outcome to change as efforts were made to improve measured rather than actual performance (12:4).

Drebin concluded that, given the need for developing performance measures that reflected the actual results of government programs, much work remained in establishing useful measures, and there was likely to be considerable controversy surrounding the adoption of any specific measure (11:7).

The search for appropriate measures for a government organization was not an easy one. In his review of budgeting developments in five industrialized countries, Schick provided examples of the difficulties being faced by governments in addressing performance measures.

In Canada, the Auditor General of Canada in his 1987 annual report stated: "The concept is simple -- objectives, results, and resources should all be linked. The application is difficult." He also found that "managers have considerable difficulty translating (budget) objectives into clear, measurable and attainable statements of purpose" (31:28).

In addition, under the Increased Ministerial Authority and Accountability (IMAA) reforms being undertaken by the Canadian Government, the IMAA guidelines recognized that developing precise quantitative results statements was not always feasible, and therefore, where appropriate, qualitative or proxy measures should be used instead (31:28).

In relation to PMB in Australia, Schick stated that government departments had difficulty in defining policy aims and in using

performance indicators to measure results. An official Australian Government report found that progress in developing indicators had been confined to the more easily measurable efficiency and workload targets. The report concluded that the development of performance measures to appropriately measure outcomes would require prolonged effort by government agencies, and that developing useful performance indicators would be a challenging task (31:29).

In the case of the British Government, a 1986 Treasury Report defined budgeting as:

> ... a means for delivering value for money against a background of aims, objectives and targets ... Budgeting will only fully realize its full potential if there are strong connections between budgets outputs and results. (18:8)

Based on case studies issued by the British Treasury, indications were that behavior had fallen short of this ideal, and, in many areas, objectives had not been expressed with sufficient precision to allow assessment of whether the desired objectives have been achieved. These performance measurement problems had been noted by the British Government in its response to a critique of the British Financial Management Initiatives by the Parliament's Public Accounts Committee (31:27; 15).

PMB, TOC and the RAAF Performance Measurement Environment

The literature review also covered references pertaining to Program Management and Budgeting, the Theory of Constraints, and the RAAF performance measurement environment. However, as the researcher believed that the review of these topics also involved part of the research analysis, this literature review information was included in Chapter IV.

Summary

Chapter II examined traditional management accounting approaches, Activity Based Costing, the trend towards non-financial performance measures, and the unique problems associated with performance

measurement in not-for-profit and government organizations. As a result of the examinations the following observations were provided from the literature:

a. The traditional accounting model was not always suitable in today's operating environment.

b. Activity Based Costing provided a better rearrangement of financial accounting data, but did not have the capacity to provide timely performance measures for process control.

c. There was an increasing trend towards the use of non-financial performance measures for organizations pursuing a continual process improvement objective. However, there were no definitive answers, and a challenge existed to develop measures that suit each organization.

d. The unique challenges facing government organizations in the design of their performance measures showed that performance measurement for these organizations was not a trivial problem. The literature indicated that there is a pressing need for research and experimentation in the development of performance measures for non-for-profit and government organizations.

Based on the review of this literature, there was no currently obvious foundation on which to base a set of performance measures for the RAAF. Therefore, pursuing this research was a worthwhile objective.

III. Methodology

Overview

To propose a suitable performance measurement concept for the Royal Australian Air Force (RAAF), the "critical theory" and "action research" methodologies to research were employed. In addition, a case study was employed to develop a set of measures to be used as the basis for the discussion of the concept. The methodology resulted in four phases of research being undertaken.

Phase 1 determined the requirements that the RAAF has for its future performance measurement, based on the requirements of the PMB system adopted by the Australian DOD.

Phase 2 involved a review of the performance measurement techniques used in the Theory of Constraints (TOC). The aim of the review was to provide a framework for the development of a set of performance measures for the RAAF Strike/Reconnaissance Force Element Group (FEG). These measures provided the foundation for the case study.

Phase 3 involved the development of the performance measures for the Strike/Reconnaissance FEG. The development provided a case study demonstrating the manner in which the TOC could be adapted to the RAAF.

In Phase 4, a comparison of the proposed performance measurements against the criteria determined in Phase 1 was made. The aim of the comparison was to determine whether the proposed methodologies satisfied the guidelines set out by PMB.

The Critical Theory and Action Research Approaches to Research

The critical theory approach to research is based on an attempt to facilitate change, rather than being based on the derivation of "natural laws" as found in the empirical-analytical science approach to research. In pursuing a change in an organizational process, the critical theory explicitly recognizes that the researcher has a motivating interest in conducting the research. Thus, the researcher must identify the fact

that his observations were not value-free, or totally objective in the empiric-analytic sense of objectivity (34:336).

As Steffy and Grimes stated:

> Critical theory assumes that the "worldview" of the researcher constitutes a third level construct. Theorists and researchers are not assumed to be objective and value free, but are seen as laden with beliefs and values obtained through training, peer group influences, and the goals and structures of the research enterprise itself. (34:328)

Critical theory requires a commitment to change, and it is this commitment to change which most clearly distinguishes critical theory from other approaches. The researcher is not a passive observer or even a participant. Instead, the researcher is viewed as a "reconstructionist", or even an "activist". The job of the researcher is to increase, for the members of the organization being analyzed, the understanding of their current condition, and subsequently, establish conditions for organizational change. The researcher is defined as a catalyst whose responsibility is to ensure that the conditions were present for organizational change. The conclusions reached in such research should result in the recommendation of a pragmatic approach to changing the organization's behavior (34:333).

Similarly, the action research approach is problem oriented, having the objective of providing a result which can be directly used by the organization being researched. According to Sommer, tne relationship between the researcher and the client shifts from that of the academic model of separation of the client organization from the results, and eventual "trickle down" of results through professional journals, to that of the direct collaboration of the researcher with the client organization. Action research is inherently client directed as the problem formulation and subsequent research steps are taken using the client, who is the potential user of the research results, as the basis of the research (33:197).

As the researcher in this research paper was to be actively involved in developing future performance measures for the RAAF, the use

of the critical theory and action research approaches was considered to be the most appropriate framework for the research. The researcher acknowledged that he was attempting to become a catalyst for change, and that the research was centered on providing a solution to a problem that faced the organization in which the researcher was working.

The Use of the Case Study

As described by Yin, the case study is a legitimate form of research, and is but one of several ways in which research can be conducted. In particular, case studies can be the preferred strategy when "how" or "why" questions are being posed, when the investigator has little control over events, and when the focus of the research is on a contemporary phenomenon within a real-life context (36:13,18-20).

Case studies, as a form of research contribute uniquely to our knowledge of individual, organizational, social, and political phenomena. The distinctive need for case studies has its origins in the desire to understand complex social phenomena, with the case study allowing an investigation to retain the holistic and meaningful characteristics of real-life events -- such as found in organizational and managerial processes (36:14).

According to Yin, the case study strategy can be used for three purposes -- exploratory, descriptive or explanatory research. In particular, the strategy may be used to explore those situations in which the subject of the research being evaluated has no clear, single set of outcomes. This is especially so when the case study is examining contemporary events where the relevant behaviors cannot be manipulated. In these cases, Yin stated that the case study was the preferred method for conducting the research (36:15-16,19,25).

A major rationale for using a single case study is when the study represents a revelatory case. This situation arises when the investigator identifies an opportunity to analyze a phenomenon previously inaccessible to investigation. Further insights into the

single case can be obtained when attention is being also given to a subunit or subunits within the system being investigated. Finally, Yin states that case studies do not always need to include direct, detailed observations as a source of evidence (3:25,43,47).

The case study approach was considered to be applicable to the research being conducted on performance measures in the RAAF. The research was exploratory in nature, and addressed the ideas expressed in a contemporary set of management concepts. Having only been developed during the late 1980s, the concepts of the Theory of Constraints have not been widely examined, especially in the government environment. A search of the literature revealed no mention of the detailed use of these concepts in the government environment.

In addition, with the RAAF only beginning to examine performance measures in the light of the PMB initiative, there was no data to draw "from the field". The concepts involved in the research were in fact postulating a new set of measures for use in the future. In this vein, the research was revelatory, as it showed the possibility of using a new approach for developing performance measures in the RAAF. The new environment created by PMB, and the use of new concepts also indicated that there would be no clear cut single set of outcomes relating to the choice of performance measures to be used in the RAAF. Thus, the combination of factors surrounding the research made the case study the ideal vehicle for the conduct of the research, and complemented the critical theory and action research approaches employed in the research.

Specific Research Methodology

To accomplish the research objective, four investigative questions were formulated. From these questions, specific methodologies were developed to provide the data to answer the four investigative questions.

The four investigative questions, and their associated methodologies, were:

Investigative Question 1. What types of performance measurement indicators required in the PMB system adopted by the Australian DOD, and what attributes do these measures require?

Methodology 1a. Examine the performance measurement requirements of the Department of Defence Program Management Budgeting System.

Investigative Question 2. How can the performance measurement concepts of the TOC be adapted to a government organization?

Methodology 2a. Conduct a review of the TOC performance measurement concepts.

Methodology 2b. Using the TOC concepts based on the for-profit organization, apply the concepts to a government organization.

Investigative Question 3. What is an example of the TOC methodology as applied to a RAAF FEG?

Methodology 3a. Identify the operating environment for one FEG.

Methodology 3b. Using the concepts obtained from answering Question 3, formulate a set of global performance measures which can be used by that FEG Commander to monitor the FEG's performance.

Investigative Question 4. Does the FEG example satisfy the performance measurement requirements of the PMB process?

Methodology 4a. Compare the FEG performance measures developed in the answer to Question 3, to the guidelines formulated in answer to Question 1.

Research Phase 1

Research Phase 1 encompassed Investigative Question 1, and Research Methodology 1. The aim of this phase was to obtain the basic requirements for the performance measurement system sought by the RAAF, thereby providing the criteria against which a suggested methodology could be compared.

Research Phase 2

Research Phase 2 involved Investigative Questions 2 and Research Methodologies 2a and 2b. Phase 2 reviewed the performance measurement

aspects of the TOC, explaining the rationale behind the performance measures. As the TOC concepts were developed in a profit making environment, the concepts needed to be slightly modified to adapt them to a government organization. The TOC was chosen as the basis for the performance measures because the concepts in the TOC were only derived in the mid 1980's, and had not been evaluated in the Australian Government environment. The research goal was see whether the TOC concepts were suitable for use in the RAAF.

Research Phase 3

In Research Phase 3, Investigative Question 3, using Research Methodologies 3a and 3b, was addressed. This phase required the selection of one FEG and the identification of the structure of a set of performance measures for that FEG, the objectives of the FEG, and where these objectives fit into the overall goals for the RAAF. Based on this operating environment, a set of performance measures were developed using the concepts of the TOC. As the Strike/Reconnaissance FEG was the first RAAF FEG to incorporate its own Logistics Support Management Squadron, and as the other FEGs were to follow this trend, the Strike/Reconnaissance FEG was chosen to be the basis of the case study.

Research Phase 4

Research Phase 4 dealt with Investigative Question 4, and Research Methodology 4a. This was the analysis phase of the research where the performance measurements constructed in Phase 3 were compared to the guidelines developed in Research Phase 1. The comparison detailed those areas where the methodology met the guidelines.

Methodology Limitations

The problem focus for the research was exploratory in nature. The objective was to examine whether the performance measurement concepts of the TOC could be applied to a RAAF FEG. Unfortunately, time and resource constraints did not permit the research to be carried "in the

field". Hence, the research has been restricted to a review of the applicable literature, and the development on the researcher's part of a set of performance measures that could form the basis for further discussion and research into performance measures in the RAAF.

Data collection to answer the investigative questions was provided through literature research. Thus, the research was descriptive in format, with no formal cause and effect relationships being examined.

With potential RAAF FEG Commanders having little experience with cost management and performance measurement, the research was unable to elicit the management requirements of these Commanders. Therefore, the research relied on DOD policy makers' guidance on the requirements for performance measurement as detailed in the PMB Reference Manual (5). The performance measures developed in the research were only provided as a basis for discussion, and modifications should be made to the measures as FEG Commanders become more familiar with their cost management role and develop an understanding of the performance measurement requirements for their areas of responsibility. The amendments to the system should essentially be to the manner in which the performance variables are operationally defined, rather than amendments to the underlying performance measurement methodology.

Summary

Chapter III explains the approach taken in conducting the research and details the methodologies required to provide the answers to the investigative questions posed in Chapter I. The research used the critical theory and action research approaches to conduct the research, utilizing a case study as the vehicle to present the concepts examined. The methodologies used were: the examination of the PMB guidelines for determining the format of a performance measure; a review of the performance measurement concepts of the Theory of Constraints, and their adaption to a government organization; the development of a set of performance measures for the RAAF Strike/Reconnaissance FEG; and a

comparison of those performance measures against the guidelines for performance measures provided in the PMB Reference Manual. The limitations of the research methodology were also discussed.

IV. Findings and Analysis

Overview

This chapter details the results of the examination of each of the investigative questions. The chapter provides the Program Management and Budgeting (PMB) guidelines by which any performance measure adopted by the RAAF should be assessed, discusses how the performance measurement concepts of the Theory of Constraints can be adapted to the non-profit environment, discusses and develops a set of performance measures for the RAAF Strike/Reconnaissance FEG, and compares the performance measures developed to the PMB guidelines.

Program Management and Budgeting

The examination of the requirements of PMB was undertaken to provide an answer to the first investigative question.

Investigative Question 1. What type of performance measurement indicators are required in the PMB system adopted by the RAAF?

As the PMB system adopted by the Australian Department of Defence (DOD) must form the cornerstone of any performance measurement system used within the RAAF, an overview of the PMB environment was obtained.

PMB had been developed as a comprehensive management philosophy to focus attention on the assessment of the effectiveness of programs against objectives, and on the efficiency of resource use. A prime tenet of PMB was that managers' knowledge of their effectiveness and efficiency was not sufficient -- they must be able to demonstrate their efficiency and effectiveness to others. Further, PMB was much more than just an accounting process, and was developed to allow performance and effectiveness to be expressed in both financial and non-financial terms (5:1-1,1-9).

The stated thrust of PMB was to concentrate on a more outcome oriented and strategic approach to decision making. The PMB process sought to improve management efficiency and effectiveness through:

a. the setting of objectives;

b. the development of hierarchical program structures to achieve those objectives,

c. the allocation of resources to those programs, and

d. the evaluation of program performance. (5:1-3)

With these goals in mind, the following design principles were included in the DOD PMB system:

> The (PMB) structure should support assessment of performance in terms of outcomes. Since, in Defence, the major outcomes are combat forces at appropriate degrees of readiness, the emphasis is on reporting in terms of FEGs.
>
> The emphasis on visibility of outcomes means that reporting and information systems need to be developed. These will need to support programs and FEGs.
>
> FEGS performance and resource consumption will need to be captured for internal analysis, and also to develop performance indicators for public presentation. (5:4-2)

Thus, a major requirement of the DOD implementation of PMB was the need for visibility of outcomes, both for internal and external purposes, with a treatment of performance in terms of FEGs (4:6).

The DOD recognized that it would be inappropriate to require all Program Managers to adhere to a standard level of reporting, since complexities of intra-program arrangements, performance indicators and resource implications differed substantially between programs. Thus, the independent development of performance measures for each FEG was acceptable (5:5-4).

Under the DOD PMB system, the management of the DOD was broken up into eight programs. One of these programs is the RAAF, with the Chief of the Air Staff (CAS) acting as the program manager. The program manager's responsibilities, among others, were to:

a. develop strategies, implement plans, activity targets, activity indicators and other measures of assessment of performance against endorsed guidance;

b. monitor and review program performance in terms of outcomes against objectives and the efficient use of resources;

c. provide and maintain information appropriate to the effective and efficient management of sub-programs and subordinate elements; and

d. develop and refine resource attributions, objectives, performance and outcome information for lower level program elements, particularly for evaluation and program development purposes (5:2-7).

These defined responsibilities reinforced the PMB focus on the effective achievement of results against objectives and, on the efficient use of resources, rather than focusing solely on the achievement of expenditure.

When examining the proposals for Defence's sub-program structure, the Defence Force Development Committee agreed that the sub-program structures in each program should support assessments of performance in terms of outcomes. For the three armed Services, the major outcomes of their individual programs were combat-ready forces. Consequently, the emphasis was to be placed on PMB planning, management and performance reporting in terms of FEGs as identified in the Chief of the Defence Force's (CDF's) Operational Readiness Directive (CORD) (5:4-6).

FEGs were seen as the key factor in relating the chain of command/line management oriented program structure to results and outcomes. Consequently, it was envisaged that FEGs would:

a. provide the basis for public presentation of performance information on outcomes of the Defence Program, and

b. become the basis for corporate planning and review of ongoing activities and expenditure. (5:4-6)

Finally, the DOD PMB process would be based on guidance from the Government and on guidance from the CDF. An example of the planning guidance to be used was the classified CORD. Such guidance would provide the planning objectives against which program managers could test the outcomes of their processes, their achievements, the appropriateness of exercises and training programs, the level of stockholdings, personnel availability etc (4:9).

PMB Guidelines for a Performance Measurement System

Based on the PMB Reference manual and the foregoing discussion, 12 guidelines were extracted for developing performance measures for the RAAF. These guidelines were:

a. The performance measures must assess the effectiveness of programs against objectives.

b. The performance measures must assess the efficiency of resource use.

c. Performance and effectiveness could be expressed in both financial and non-financial terms

d. The performance measures should concentrate on an outcome oriented and strategic approach to decision making.

e. Performance reports were to be in terms of FEGs.

f. Performance indicators may differ between FEGs.

g. Different methods of reporting can be undertaken at different management levels.

h. Performance measurement was to be achieved using cost effective means.

i. Attribution of resources to FEGs was to assist analysis, program evaluation and presentation rather than provide accounting accuracy.

j. There was to be an emphasis on the effective achievement of outcomes against objectives, and on the efficient use of resources, rather than solely emphasizing expenditure achievement.

k. PMB requirements should not impose a burden on operational effectiveness or impose a high resource overhead on combat units.

l. FEGs needed to participate in the self-evaluation of their individual performance.

In designing a set of performance measures, some consideration also needed to be given to the method to develop these performance measures. For this research, guidelines were adopted from the AFSC

handbook, entitled The Metrics Handbook (1). These guidelines were summarized in Appendix B.

A Review of TOC - The Profit World

The research concentrated on developing performance measurements based on the measurement concepts suggested by E. Goldratt in his Theory of Constraints (TOC). One of Goldratt's main approaches to performance measurement was the use of measures based on his definitions of throughput (T), inventory (I), and operating expense (OE).

Before performance measurements based on T, I, and OE could be developed, these elements needed to be defined, and the derived metrics needed to be described. The initial review of TOC examined some critical concepts in the production/ capacity component of TOC, with the examination being conducted on the basis of a profit seeking organization. Having described TOC measures in commercial terms for the sake of exposition, a transfer of the concepts to the not-for-profit world was undertaken. The transfer involved the substitution of the goals of a non-profit government organization in the place of the profit goal of the commercial organization.

The result of this review provided the answer to the second investigative question:

Investigative Question 2. How can the performance measurement concepts of the TOC be adapted to a government organization?

In the production/capacity concept of TOC, every aspect of the organization was designed to focus on the goal of the organization. In the profit world, Goldratt defined the goal of the firm to be to make money, both now and in the future. To this end, performance measures must reflect the organization's progress to achieving this goal, and all measures should influence employee behavior towards achieving that goal (16:19-26).

In TOC, T, I and OE had different definitions than those used in traditional cost performance measures. These new definitions were:

a. Throughput -- the rate at which the system generated money through sales, e.g. dollars generated per day, dollars generated per hour, etc.

b. Inventory -- All the money the system had invested in purchasing things the system intends to sell, e.g. raw materials, productive assets (productive assets can be sold at a later date by the company to produce money).

c. Operating Expense -- All the money the system had spent in turning inventory into throughput, e.g. direct labor, indirect labor, depreciation of assets, and other overheads (16:19-29).

These three measures provide answers to the questions: at what rate is the company generating money; how much money is captured within the company; and how much has to be spent to operate the company (16:16-18)?

There were four important interpretations attached to these definitions. First, throughput was not achieved until a product of the company had permanently left the company. Thus, in the commercial sector, throughput is not achieved until a product produced by the company had been sold, such that the products are not subject to return to the company. For example, finished goods inventories, consignment stocks, serviceable spares, etc, could not be considered to be throughput because they had not been converted to money through a cash transfer from the customer to the manufacturer. Care must be taken in determining when the throughput was actually achieved, and a sale should be recorded only when an irrevocable transaction has occurred with the final consumer (16:21-22).

Second, throughput was calculated as the selling price minus:

a. amounts paid to vendors for items that went into the product sold, no matter when these items were actually bought; and

b. the costs of services provided by organizations outside the organization's system -- commissions to external salesmen, subcontracting expenses, customs duties, transport charges for non-organization owned transport, etc.

Thus, throughput was the actual outcome generated by the company, which in this case was the generation of additional cash -- the difference between revenue and the direct inventory costs for the product (not including operating expenses).

Third, inventory encompassed all raw materials and other materials input into the system's process. The "other materials" included items that have been traditionally referred to as assets such as buildings and machinery. These items were recorded at their original cost plus any other inventory investment attached to them. For example, a finished good in a warehouse had the following cost: the actual dollar amounts (paid to vendors for raw materials and other externally supplied goods and services) required to produce the finished good. This cost did not include costs related to the "added value" provided by the system. Thus, direct labor and depreciation were not attributed to the product, but were treated as a period operating expense. The new definition contrasts with the traditional costing methods which value finished goods using such techniques as FIFO inventories and absorption costing (16:23).

Finally, Operating Expense included all money spent to convert the inventory into throughput. This included direct labor, indirect labor, overheads, and depreciation of assets.

The importance of these new definitions was that, by adopting definitions for throughput, inventory, and operating expenses based on the principles in the Theory of Constraints, there was no need to undertake the time consuming task of preparing costs based on absorption costing or other overhead cost allocation techniques.

Further, as all these elements were denominated in dollars, the combination of these three measures provided the following performance measurements:

a. Net Profit: NP = T - OE;

b. Return on Investment: ROI = NP/I;

c. Inventory turnover = T/I; and

d. Productivity = T/OE (16:32).

Using these measures, management could see that the way to improve performance was to increase throughput, decrease inventory, or decrease operating expense. Of course, in many circumstances, increasing throughput could require an increase in operating expense. However, the manager could immediately see that if the increase in throughput is greater than the increase in operating expense then the decision to increase throughput would be a correct decision.

TOC in the Government Environment

In the government environment, the goal was not necessarily to make money. Therefore, money gained from sales was not a critical activity, although the generation of money may have been a necessary condition for continuing operations. In the government organization the goal was something other than earning a profit for its owners, and usually, that organization's goal was to provide services. Many of these organizations are designed to always breakeven, e.g. the Department of Defence (2:31).

Thus, the government organization could not necessarily define throughput in terms of money generated by the organization, and alternative definitions for T, I and OE were required. For the government organization, these terms could be defined as follows:

a. Throughput -- the rate at which the system achieved its goal(s).

b. Inventory -- everything the system had invested to produce throughput.

c. Operating Expense -- All the money the system had spent in turning inventory into throughput (35).

The concept of throughput also needed to be modified from the concept found in the commercial version of the TOC. In the commercial world, the rate of throughput refers to the generation of money in a given period of time, for example, the money generated in one year of production. An increase in throughput would be the result of the

generating more money in a one year time span, with the potential for further increases in throughput being theoretically unlimited.

However, in many government organizations, ceilings are placed on the organization's budget, or on the amount of throughput that can be achieved, e.g. the number of flying hours which can be flown by the RAAF has a ceiling fixed by higher Defence management. Therefore, the emphasis in the government environment would be to achieve the required, fixed throughput with the highest degree of effectiveness and efficiency. Throughput then becomes the rate that effective output is achieved per unit of output produced by the organization. The desired level of throughput becomes the achievement of 100% of the output defined in terms of the organization's objectives.

Where profit provided both a measure of effectiveness and a measure of efficiency for the commercial organization, such a single overall measure of performance did not exist for the government organization. However, in the government organization it may be feasible, and useful, to develop and classify performance measures relating either to effectiveness, or to efficiency. A combination of effectiveness and efficiency measures could then be used to assess the organization's performance. These measures would not be based on money as the only unit of measurement, as the organization's output could not be measured in monetary terms (2:6).

Since TOC was originally based on the commercial world, this research had to establish new criteria to monitor performance. The following performance measures were therefore developed:

a. Effectiveness -- The rate defined within the definition of throughput. Performance could be monitored by establishing a Statistical Process Control (SPC) control chart which would indicate changes in performance, and could be used to set quantifiable goals for the organization.

b. Efficiency -- there are two efficiency measures which can be used:

(1) throughput divided by inventory to provide throughput per dollar invested in inventory; and

(2) throughput divided by operating expense to provide a measure of productivity.

These efficiency measures could be monitored using appropriate run charts.

The performance measures represented "global measures" for the organization. However, their construction allowed for the breakdown of the measures for use by sub-units of the organization. This breakdown was examined in greater detail during the development of the performance measures for the RAAF Strike/Reconnaissance FEG.

The RAAF FEG Performance Measurement Environment

The examination of the RAAF FEG cost management environment, and the development of performance measures for the Strike/Reconnaissance FEG provided the answer to the third investigative question:

Investigative Question 3. What is an example of the TOC concepts as applied to a RAAF FEG?

To begin to use the concepts of TOC performance measurements in the RAAF environment, that environment was examined. First, the mission and goals of the RAAF were listed at Appendix C. Of the goals listed, goals 1a(iv), 1b, 2e, and 3a could be monitored for an FEG using the measures proposed in this research.

Discussion of RAAF Goals. Goal 1a(iv) sought to provide quality logistics support for all RAAF operations. Such a goal was fairly broad in its interpretation, and it was difficult to define a way of directly measuring the achievement of this goal. For example, how is quality logistics support to be operationally defined, and then subsequently measured? In this situation, the goal could be operationally defined using the following surrogate measure.

For a flying squadron, quality logistics support could be defined as that level of logistics support which allows a squadron to achieve

95% (say) success in launching missions at the scheduled time, with the individual aircraft reliability being such that the aircrew was able to complete its mission successfully. A surrogate measurement of the outcomes of activities directed at achieving this "operationalized" goal could be to measure the proportion of aircraft in the squadron which were able to take-off at the scheduled time and for which the aircraft's crew were able to successfully undertake their scheduled mission.

Goal 1b sought to maintain operational readiness by achieving the targets specified in the CORD. In the absence of direct access to the CORD, owing to its classified nature, the objectives of the CORD could be operationally defined in a similar manner to the operational definition provided for goal 1a(iv). Thus, the outcomes of activities directed at achieving both goals 1a(iv) and 1b could be measured using the same, or similar surrogate measures.

Goal 2e sought to ensure timely and effective maintenance and logistic support. This goal, when couched in such broad terms, was very similar to goal 1a(iv). While a direct measure of the required timeliness and effectiveness of maintenance and logistic support is not readily identifiable, a surrogate measure is. If maintenance and logistics support was to be timely and effective, then operational aircraft should be able to take-off at their scheduled departure time, and the aircraft crew should be able to successfully undertake their scheduled missions. Thus, the surrogate measures identified for goal 1a(iv) was also a suitable surrogate for measuring performance against goal 2e.

Finally, goal 3a sought to search continuously for better ways to do the job. Direct measurement of the attainment of this goal was difficult to achieve. What constituted searching? Are the number of searches to be counted to provide a measure of the level of search? In this case, a surrogate method for measuring the achievement of this goal was required. One possible surrogate was to monitor the trends

exhibited by the performance measures used to measure the attainment of the other RAAF goals. For example, the surrogate measure defined for goal 1a(iv) can be monitored to ascertain whether the measurements observed were showing a trend which reflected a continuous (an operational definition of continuous would be required) improvement in performance. Regular increases in effectiveness, coupled with decreases in operating expenses and inventory, could be taken to reflect the achievement of the goal of searching continuously for better ways to do the job.

From the foregoing discussion, the need to be able to operationalize the RAAF goals became clear. Without such operational definitions, and their associated surrogate measures, measuring performance became next to impossible in the RAAF environment where, in peace time, the end product of all RAAF activity was an intangible service -- deterrence against aggression by foreign forces, and provision of an insurance policy to provide protection for the nation should aggression actually be applied against Australian interests.

The next major factor in the development of performance measures for the RAAF related to the prospect of military threat against Australian interests. The stated Australian military environment was that there were no discernable major military threats for the foreseeable future (6:24-26). The future management emphasis was therefore to be based on peacetime operations. Accordingly, the outcome of the RAAF program became the RAAF flying hour program, which takes into account the CORD, national tasks, and approved levels of training. This flying hour program became the focus for managerial attention for monitoring the effectiveness and efficiency of RAAF activities (30:14).

Thus, the goal of the FEGs could be considered to be the achievement of their flying hour program in the most effective and efficient manner possible. Therefore, this research proposed that a definition for throughput for the FEG should relate to these flying

hours. More specifically, a first operational definition for this throughput was:

> The rate at which the FEG achieves "effective hours" per scheduled flying hour.

The definition of "effective hours" would be:

> The achievement of scheduled flying hours for a mission, such that the mission took place on-time, and achieved the objectives of the mission.

For example, assume a training mission was planned to take two hours to complete, that planned take-off was at 1000hrs, and that the mission was to complete a photographic run over an army exercise area. If the mission took off on time, and completed the required photography then two "effective hours" have been achieved. However, if the aircraft departed late (late needs to be operationally defined e.g. at least 10 minutes after the scheduled take-off time), or the mission could not be completed due to equipment failure or pilot error, then two scheduled effective hours have not been achieved.

The on-time requirement acts as a surrogate for assessing the readiness component of the preparedness goal, and the achievement of mission objectives indicates the capacity to complete missions the FEG. The combination of these two attributes indicates the effectiveness of the FEG to complete missions in the timescales for which the missions were planned. The penalty inherent in deducting the total scheduled flying hours from the performance rating reflects a weighting for loss of effectiveness on longer missions. This reflects the importance of being able to effectively complete the longer missions required to be undertaken by a strike/reconnaissance force.

To provide the required performance measures, operational definitions of inventory and operating expense were also required. Inventory was considered from two aspects. First, from the aspect of total inventory including all assets, and second, from the aspect of inventory excluding major assets.

The first, and overriding, definition of inventory was the dollar amount of investment in all assets (aircraft, buildings, facilities, etc), support equipment, spares inventory on hand, and materials the FEG uses to produce the defined throughput. This encompassed all investment in the FEG.

However, as the investment in aircraft, buildings, and major support equipment was relatively "fixed", and not in the control of the FEG Commander, a second, reduced, definition of inventory was proposed to provide a view of performance trends of variables over which the FEG Commander had some control. The reduced definition was therefore the dollar amount invested in spares, equipment (excluding large capital support equipment -- which needs to be operationally defined), and raw materials required to produce the defined throughput. The reason for this reduced definition of inventory was to provide a measure which gives a more obvious indication of trends in terms of change in the "variable inventory", as opposed to changes in the larger, more static, baseline or "fixed" inventory. Both definitions would provide useful insights for the FEG Commander, but would be used in different situations. The full definition could be used for decisions involving capital investment, while the reduced definition could be used for day-to-day monitoring of FEG performance.

Aggregate values for fixed assets belonging to the FEG could be provided from the Defence Asset Register, while aggregate values for weapons, support equipment and inventory items for the FEG could be provided from the supply computer system being developed in the Supply System Redevelopment Project (SSRP).

Operating expense was defined as all the money the FEG spent in turning the inventory into throughput. This would include labor costs, cost of utilities, consumption of consumables and spares, depreciation and other "overhead expenses" related to operating the FEG. The "consumption" of reparable spares would be operationally defined in terms of the cost of the materials, and the services obtained from

"outside" the FEG, required to convert these spares back to a serviceable level. In practice, all these definitions would require further "operationalization" to allow users to accurately understand the components of each definition and performance measure.

Data for the materiel consumption should be obtained from the supply computer system being developed under the SSRP, data for non-materiel goods and services should be obtained from the new financial computer system being developed under the Finance System Redevelopment Project, and manpower and associated labor overhead data should be obtained from the new system being developed in the Manpower System Redevelopment Project.

The final element of the RAAF management environment was the composition of the Strike/Reconnaissance FEG. In broad logistic support terms, the composition of the FEG was as follows:

a. Two Squadrons of F-111 aircraft -- 22 Aircraft tasked for strike, reconnaissance, and training roles.

b. One Intermediate Level Maintenance Squadron -- Tasked primarily to provide repair support at the LRU level.

c. One Depot Level Maintenance Squadron -- Tasked primarily to provide repair support at the SRU level, and to provide depot overhaul of major F-111 aircraft systems.

d. One Supply Squadron -- Tasked to provide for the storage and issue of spares and consumable items to the two flying squadrons, and to the two maintenance squadrons.

e. One Logistics Management Squadron -- Tasked to provide the engineering management, configuration management, reliability management, repair pipeline management, spares management, and aircraft repair and modification management for the F-111 aircraft.

Performance Measurement at FEG Level

To the above preliminary operational definitions for the goal, throughput, inventory and operating expense, the following definitions need to be added:

a. Scheduled flying hours were those hours planned on a daily/weekly basis.

b. Budgeted Flying hours were those annual flying hours allocated by Higher Defence Authority in fulfillment of FEG role.

From these definitions, the proposed FEG performance measurements were then defined.

Effectiveness. Effectiveness has been defined as the ability of the organization to produce the quantity and quality of output the environment demands, and effectiveness measures should relate directly to the output consumed by the organization's customers (14:36-37). In the case of the Strike/Reconnaissance FEG, the output consumed would be "effective hours". This output also provided the foundation for developing the definition of throughput for the FEG. Maximum effectiveness would be achieved when the FEG was able to launch all missions on time, and when the aircrew were able to fulfill all their mission requirements during the mission flight.

Proposed Measures of Effectiveness. The proposed performance measures for the effectiveness of the FEG were as follows:

a. The number of scheduled flying hours for missions actually started on time, and completed as "effective hours", as a percentage of total scheduled flying hours.

b. The number of "effective hours" completed as a percentage of planned/budgeted flying hours.

c. The number of "effective hours" completed as a percentage of actual flying hours flown.

The FEGs Commander's aim would be to have the above derived percentages exhibit an increasing trend, reflecting an improvement in performance. If the percentage was already at an acceptable level, then

the Commander would monitor the associated SPC chart to ensure the "process of generating effective hours" remained in control. Alternatively, if the FEG is always obtaining 100% effective hours, a new definition for throughput could be developed which promoted other personnel behaviors which contributed to the achievement of the FEG's goals. Note also that the non-achievement of an effective hour equates to the loss of throughput for the FEG.

Each of the performance measures described above would provide different information on the effectiveness of the FEG Commander in achieving his objectives. The first measure would provide an indication of how the FEG meets its day-to-day flying objectives, showing the FEG's "readiness" to meet scheduled taskings. The second measure would provide an indication of how effectively the FEG transformed its budgeted flying hours into "effective hours". The third measure would provide a further indication of the FEG's capability to maximize the number of "effective hours" per actual hour flown.

These measures would be computed on a weekly basis, with an SPC chart being used to track whether the overall process was in statistical control, and to identify activities which were forcing the logistics support process out of control. The SPC chart would also provide evidence of improvements in performance, or otherwise, resulting from decisions by FEG management to improve the overall FEG process. Cumulative figures for each of these measures could also be maintained to provide evidence of the FEG's overall performance to date during the budget year.

In addition to these overall FEG measures, the following examples of global measures for the components of the FEG were also proposed:

a. For Aircrew: (Scheduled Flying Hours minus Flying Hours missed due to aircrew problems [lack of crew]) divided by Scheduled Flying Hours.

b. For the Flightline: (Scheduled Flying Hours - Flying Hours missed or delayed because of lack of aircraft)/Scheduled Flying Hours

c. For the Intermediate Level Maintenance Squadron: (Scheduled Flying Hours - Flying Hours missed or delayed through lack of an LRU)/Scheduled Flying Hours.

d. For the Depot Level Maintenance Squadron: (Scheduled Flying Hours - Flying Hours missed or delayed through lack of an SRU, or through aircraft delayed in depot level maintenance)/Scheduled Flying Hours.

e. For the Supply Support Squadron: (Scheduled Flying Hours - Flying Hours missed or delayed through lack of any reparable item, or consumable stores item)/Scheduled Flying Hours.

f. For the Logistics Management Squadron: (Scheduled Flying Hours - Flying Hours missed or delayed through the lack of any reparable or consumable stores item, or mission aborted)/Scheduled Flying Hours.

Each of these component measures would provide an indication of the component's performance in attaining the FEG goals. For example, the measure for the Flightline would indicate the ability of the Flightline to meet the FEG goals, and the measure for the Logistics Management Squadron would reflect on a combination of the reliability of aircraft components and the effectiveness of the engineering management, repair pipeline management and spares management functions performed by that Logistics Management Squadron.

The measures would rely on the identification of the primary cause of a failure to accomplish an "effective hour". The delay or loss of throughput would be a significant event in preventing the FEG from meeting its goal, and therefore would warrant immediate identification of the primary cause of the delay or loss. Once identified, this cause of delay or loss of effective hours would be used to allocate the loss of effective hours to the appropriate logistic support elements which "participated" in creating the loss.

However, these performance measures were not designed to apportion blame, even though the cause of any problems might be "down the line".

Instead, the measures were designed to instill more communication between all elements making up the FEG. In many cases, all areas will share some of the blame for "failures to fly on time".

For example, if a flight was delayed due to the unavailability of an LRU, then the FEG's components' individual performances would be affected for the following reasons:

a. The Flightline -- the scheduled flight did not depart on schedule.

b. The Supply Support Squadron -- the Flightline was not provided with the required LRU.

c. The Intermediate Level Maintenance Squadron -- the required LRU was not available for issue into the Supply Support Squadron at the required time.

d. The Logistics Management Squadron -- the LRU pipeline failed to provide sufficient serviceable LRUs to allow the scheduled flying hours.

Having been "saddled" with a "failure to perform", each area would have a basis for seeking out the causes for their "poor" performance. However, detailed investigations of these losses would only need to be undertaken when the SPC chart indicated that the process of generating effective hours was out of statistical control. Correction of out of control performance would require the logistics support components to liaise with the other components of the FEG to improve the coordination of requirements to meet future scheduled flying hour commitments.

Note was made that the performance indicators would not be comparable between FEG components, e.g. the Flightline would always have a "poorer" performance rating than the maintenance depot because the Flightline was at the top of the support pyramid. The important point here was to measure relative changes in component performance rather than measure absolute levels of component performance. These relative changes in performance would then be used to indicate whether the support component's performance was exhibiting continuous improvement.

Using the proposed performance measurement approach, individual FEG components would have the incentive to improve their performance, within their total operating environment, as a means to improving their effectiveness rating. One avenue for improving performance would be for a support component to liaise with the other support components to improve logistics processes such that all components see an increase in individual component effectiveness, as well as an increase FEG effectiveness as a whole.

A hypothetical example of how these measures would be used was provided at Appendix D.

Efficiency. Efficiency is generally defined in terms of the ratio of output to inputs. Two types of efficiency measures would be used for the Strike/Reconnaissance FEG:

a. effective hours per dollar of operating expense (or for reporting purposes, dollars of operating expense per effective flying hour); and

b. effective hours per dollar of inventory investment (or dollars invested in inventory per effective hour).

In general terms, the FEG Commander's aim would be to see the dollars of operating expense per effective hour, and the dollars of inventory per effective hour, exhibit a declining trend. This would indicate an improvement in the efficiency of FEG operations.

Proposed Efficiency Measures. Based on the foregoing discussion, examples of the proposed efficiency measures were:

a. For the FEG:

(1) The operating expense for the whole FEG per effective hour.

(2) The inventory investment for the whole FEG per effective hour.

b. For the Flightline:

(1) The operating expense for the Flightline per effective hour.

(2) The inventory investment for the Flightline per effective hour.

c. For the maintenance squadrons:

(1) The operating expense for the maintenance squadron per effective hour.

(2) The inventory investment for the maintenance squadron per effective hour.

d. For the Supply Support Squadron:

(1) The operating expense for the Supply Support Squadron per effective hour.

(2) The inventory investment for the Supply Support Squadron per effective hour.

With the use of appropriate "cost records" obtained from the FEG Commander's financial controller, managers of FEG support components should be able to identify reasons for any change in efficiency, and should be able to determine what action, if any, would be required to correct any decreases in efficiency. Note that the efficiency measures used for FEG components are relative measures, and should be used to assess trends in efficiency improvement or decline.

The measures proposed in this research were "global" measures for use by the FEG Commander, as they related principally to an assessment of the performance of the FEG as a whole. Other "internal" performance measures should be developed for each organization within the FEG. Each of these internal performance measures needs to be constructed so that it "dovetails" into the global measures. That is, these internal measures should be designed in such a way that they encourage personnel to use behaviors which support the goals of the entire FEG. The development of these internal measures was beyond the scope of this research.

Comparison of Performance Measures to PMB Guidelines

A comparison of the performance measurements, derived in the previous section to the guidelines determined in answer to Investigative Question 1 was undertaken to answer Investigative Question 4.

Investigative Question 4. Does the Strike/Reconnaissance FEG example satisfy the performance measurement requirements of the PMB process?

An assessment of the developed performance measures against each of the guidelines determined in answer to Investigative Question 1 was provided in the following paragraphs.

Assessment of Effectiveness of Programs Against Objectives. The proposed measures provided a surrogate measurement of performance for use in assessing RAAF goals 1a(iv), 1b, 2e and 3a, as listed in Appendix C. The effectiveness measures provided would show the number of "effective hours" achieved against scheduled operations, against budgeted hours, and against actual hours flown. These measures provide an indication of the FEG's readiness, and of the FEG's capability to meet the operational targets set by the CDF. While the measures do not provide an exact measurement of readiness, the measures as designed encourage organizational behavior to be directed towards meeting the objectives of the RAAF program under PMB.

Efficiency of Resource Use. The measures as proposed did not provide a measure of absolute efficiency of the FEG. However, they did provide the basis for assessing trends in efficiency. Tracking of these trends would allow the FEG Commander to determine the relative efficiency of the FEG against its past performance. This type of measurement was considered to be ideal for an organization which was pursuing a policy of continual process improvement. As the RAAF had adopted RAAF Quality (RAAFQ) as its version of Total Quality Management, the proposed efficiency measures would provide the FEG Commander with the tools to monitor continuous cost improvement under RAAFQ.

Performance in Financial and Non-Financial Terms. The proposed measures were couched in a combination of financial and non-financial variables. The proposed measures were therefore in accord with the PMB process.

Outcome Orientation. By defining the required outcome of the FEG activities to be the attainment of effective hours, the concentration of the measures on "effective hours" provided the required orientation to measuring the "outcomes" of the FEG's efforts.

Performance in Terms of FEGs. The measures all relate to the performance of the FEG. Some of measures relate to the whole FEG directly, e.g effective hours per scheduled flying hour for the whole FEG, while the remainder measure FEG logistics support component performance in terms of total FEG performance, e.g. the operating expense per "effective hour" for the Supply Support Squadron.

Indicators May Differ Between FEGs. The indicators were developed specifically for the Strike/Reconnaissance FEG. The same set of indicators may not be directly applicable to, for example, the Strategic Transport Group, since the definition of throughput would probably be different for the strategic transport activity. However, with an appropriate definition of throughput, similar performance measures could be developed using the concepts adopted in this research. This difference between performance measures for different FEGs would be acceptable under the PMB guidelines.

Different Measures at Different Levels. The indicators were not uniform across components within the FEG owing to the hierarchical nature of the measures. This should not provide a problem as each component being assessed is performing against itself. The aim of each component should be to continually improve its own performance through appropriate interaction with other support elements. This difference in measures between support components was permitted under the PMB guidelines.

Emphasis on Program and Evaluation. The whole focus of the proposed performance measures was on the outcomes produced by the Strike/ Reconnaissance FEG. The proposed measures would therefore provide the vehicle through which the FEG outcomes could be evaluated. Thus, the proposed measures would be in accord with the PMB guidelines.

Concentration on Outcomes Rather than on Expenditure Achievement. Targets for the proposed performance measures were directed at producing the required output at the minimum cost. The emphasis on trends which show continuous improvement in performance at a decreasing cost could mean that the FEG will produce its output at a cost lower than budgeted cost. This emphasis on improvement and cost reduction does not allow a mentality of expenditure achievement, as expenditure just for the sake of expenditure achievement will result in either stagnant or poorer efficiency performances. Thus, the proposed measures support the concentration on outcomes rather than supporting a concentration on expenditure achievement.

No Burden on Combat Units. The collation of operating expense and inventory investment data for the proposed efficiency performance measures could be undertaken by the FEG Commander's financial controller through on-line access to the databases provided the SSRP, MSRP, and FSRP systems. Thus, no actual collation of data needs to be undertaken by the components of the FEG except for the recording "effective hours" against scheduled flying hours, and the recording of reasons for the inability to achieve scheduled flying hours -- the data required for the effectiveness performance measure. The first of these two tasks for the FEG components would not be particularly onerous, while the second task would be a necessary process which should be undertaken if process improvement was sought. The proposed performance measures would require that there be more communication between the flying squadrons and all their logistic support elements to allow these support elements to be more attuned to the daily scheduling needs of the flying squadrons. This communication would be a necessary condition is a necessary condition which needs to be fulfilled if the whole process of producing effective hours is to show continual improvement. Thus, the proposed performance measures provide no unnecessary new burdens for the combat units.

FEGs to Participate in the Self-Evaluation of Performance. The use of the proposed performance measures would provide a valuable tool for allowing the FEG Commander to evaluate his FEG's performance. The performance measures would form the basis which would allow the FEG Commander to identify when problems have occurred, and to identify the possible source of problems. By measuring the performance of the FEG, the FEG Commander would be able to participate in the evaluation of his FEG's performance, thus meeting the PMB guidelines.

Based on the above comparison of the proposed performance measures with the PMB guidelines derived in answer to Investigative Question 1, the proposed performance measures were within the guidelines specified by the Australian DOD PMB process

Limitations of Proposed Performance Measurements

Being a first attempt to use TOC measures for assessing FEG performance, the proposed measures may need some further refinement. Identifiable limitations of the measures include:

a. The measures did not address sustainability performance. These would have to be couched in terms of the rates of effort detailed in the classified document DI(AF) ASD208.

b. The emphasis of the measures was on the effectiveness and efficiency of logistics support. No attempt was made to factor in other support, such as medical and general administrative support. This could be achieved at FEG level, through modifications to the definitions of inventory and operating expense, to include the investment and operating expense associated with these facilities.

c. The research did not use the definitions of operational readiness as provided in CORD owing to classified nature of the document, and the lack of access to document at the remote location of the researcher (remote in terms of proximity to HQADF).

d. The paper did not provide a treatment of how depreciation of military equipment should be handled.

e. The performance measures developed were surrogate measures. Therefore, managers must be careful in their analysis of the measures.

f. Following on from sub-para e, the definition of effective hours was provided by the researcher. The acceptance of this definition would require input from senior RAAF managers as to their perceptions of "effective hours".

g. An underlying assumption in these performance measures was that an aircraft behaved in a serial fashion, that is, all aircraft components required for a scheduled mission are equally necessary for the mission to be accomplished. This was a valid assumption in terms of treating the aircraft as being configured to perform a specific mission -- all systems on the aircraft may not be 100% serviceable; however, all systems required to perform the mission need to be serviceable.

h. Part of the operating expense of the FEG would be services consumed which were provided by elements of the RAAF outside the FEG. These services would not have an explicit cost similar to those costs for services provided by outside vendors. Therefore, an internal transfer cost would need to be applied to those services. This research did not addressed how this internal transfer cost should be computed.

i. The need for an accrual accounting approach for the consumption of externally provided services, e.g. monthly utility payments, was not been addressed in the research.

Despite these limitations, the measures as proposed do provide the FEG Commander with an indication of the relative FEG performance, over time, against RAAF goals.

Summary

Chapter IV provided answers for Investigative Questions 1 to 4. In answer to Investigative Question 1, a review of the Australian

Defence Department Program Management and Budgeting System provided 12 guidelines which should be used in developing a performance measurement system for a Force Element Group in the Australian Defence Force. These guidelines were later used to evaluate the set of performance measures developed for the Strike/Reconnaissance Force Element Group.

The answer to Investigative Question 2 involved the examination of some of the principles of the Theory of Constraints. Relevant principles relating to the measures of throughput, inventory operating expenses were addressed, and these principles were adapted for use in a not-for-profit organization.

Performance measures for the Strike/Reconnaissance FEG were developed in answer to investigative Question 3. The performance measures were surrogate measures designed to provide an indication of the FEG's attainment of the RAAF goals 1a(iv), 1b, 2e, and 3a set out in Appendix C. The performance measures were developed as global measures for the use of the FEG Commander, and each measure developed could be classified as one of two types of measure, either a measure of effectiveness or a measure of efficiency. The former type of measure was designed to provide an indication of how well the FEG met the RAAF's goals, while the latter type of measure provided an indication of resource utilization whilst achieving those goals. Both sets of performance measures were designed to show trends in performance, rather than provide absolute measures. This approach allows the FEG Commander to assess whether improvements in performance are in fact being obtained under the RAAFQ philosophy of continuous improvement.

The answer to Investigative Question 4 was achieved by comparing the attributes of the performance measurements developed in answer to Investigative Question 3 to the guidelines provide from the answer to Investigative Question 1. The comparison showed that the developed performance measures fell within the guidelines obtained form the review of the PMB Reference Manual.

The chapter concluded with an examination of the potential limitations of the measures which were developed. These potential limitations provide fertile ground for further investigations into the performance measures for the RAAF.

V. Conclusions and Recommendations

Overview

The purpose of this research was to examine the use of the performance measurement concepts adopted in the Theory of Constraints, and assess the applicability of their use as a performance measurement methodology for the RAAF to monitor the accomplishment of its organizational goals. The research was undertaken as a response to the requirements of the Department of Defence Program Management and Budgeting initiatives for an "outcomes based" performance measurement system, and as response to the requirement of the DLSPG to develop appropriate performance indicators.

The research process began with a review of traditional cost accounting based performance measures. As presented, the review showed that these traditional measures were no longer relevant in today's environment where organizations were striving for continuous process improvement. In many cases, these traditional measures were seen to be a hindrance to organizations seeking improvement in their organizational processes.

Many of those authors criticizing the traditional measures suggested Activity Based Costing (ABC) as an alternative. The literature review examined the applicability of using ABC systems to provide performance measures. The examination found that, while ABC provided a better basis for accounting and reporting on past performance, it was still not responsive enough to provide information to monitor the day-to-day performance of the organization. However, ABC provided a good basis for semi-annual or annual reporting purposes to allow cost comparisons with other organizations.

The literature review showed that the current trend for performance measures was the adoption of measures which were based on both financial and non-financial data. This was particularly so for

government organizations which were confronted with unique problems when measuring organizational performance. Unlike for-profit organizations, many government organizations were unable to use the concepts of profit and loss as a measure of effectiveness and efficiency. Instead, many government organizations had to find alternative definitions of what constituted satisfactory organizational outcomes. The intangible, service oriented nature of the services of these organizations meant that surrogate or proxy measures of performance needed to be derived to allow performance assessment of these organizations. The literature review concluded that much research and experimentation needs to be undertaken to develop performance measures for government organizations.

To examine whether the concepts of the Theory of Constraints were applicable to the RAAF, four investigative questions were addressed. The answers to these investigative questions provided the basis for the following conclusions and recommendations.

Conclusions

As a result of the research, five conclusions were drawn. First, the development of performance measures in the government environment was not a trivial task. Difficulties arose when trying to operationally define the intangible outputs of the organization such that these outcomes could be adequately measured. In many cases, managers had to resort to the use of proxy measures. However, the use of proxy measures must be approached with much care since the measure defined to represent performance would result in driving behavior towards the achievement of performance in terms of the proxy outcome. The objectives of these measures must be to provide performance measurements that not only reflect the goal of the organization, but also provide the incentive for personnel to modify their behavior to support the organizational goal(s).

Second, PMB allowed a large degree of flexibility in the selection of performance measures. The main criterium was that the measures

developed had to provide a reasonable assessment of the outcomes of activities compared to the objectives of the Department of Defence.

Third, the concepts of the Theory of Constraints provided a possible foundation for developing performance measures for the RAAF. The TOC concepts placed a heavy emphasis on defining the goals of the organization, and then developing performance measures which indicated the achievement of those goals. The use of such measures, combined with the analysis of statistical process control charts based on these measures, provide a vehicle for the adoption and the monitoring of a RAAF process of continual improvement.

Fourth, the definition of performance measurements for the RAAF will be an ongoing task. Experimentation with definitions for surrogate measures will have to be undertaken until the appropriate measures are found that result in the promotion of personnel behavior directed at achieving the objectives of the RAAF. These definitions will need to be refined, initially through management discussion, then through experience from using the new definitions. The success of any performance measure for the RAAF will be heavily dependent on the selection of appropriate measurable definitions of outcomes or throughput.

Finally, the definitions proposed in the case study were not considered to be perfect, and throughput for the Strike/Reconnaissance FEG may need to be more precisely defined. However, the measures do provide a starting point for development of RAAF FEG performance measures. The concepts presented by TOC provide a useful framework for the development of performance measures which reflect the goals of the FEG and the RAAF.

Recommendations

This research has established that, with the appropriate definition of throughput, the performance measurement concepts of the

Theory of Constraints can be applied to the Force Element Groups of the RAAF. The recommendations following from this research are:

a. for the RAAF to consider the adoption of the performance measurement concepts of the Theory of Constraints as a basis for developing performance measures for use by the RAAF Force Element Group Commanders;

b. for the RAAF Force Element Group Commanders to identify appropriate definitions of throughput for their FEGs -- definitions which reflect the goals of their individual Groups in terms of meeting overall RAAF goals; and

c. for the project leaders of the Supply, Manpower, and Finance System Redevelopment Projects to ensure that FEG Commanders have on-line access to data which allows the FEG Commander to easily compute his performance measurements.

In addition to these recommendations, five areas have been identified for further research:

a. the development of the concept of depreciation in a military environment;

b. the development of a basis for establishing transfer prices in a military environment;

c. the development of simple techniques to account for the consumption of resources other than those resources accounted for in the RAAF supply system e.g. the consumption of utilities;

d. the investigation of the use of the Theory of Constraints performance measurement concepts to develop internal performance measurements for the FEG sub-components; and

e. the comparison of the Theory of Constraints concept of performance measurement with alternative performance measurement concepts such as provided in the Computer-Aided Manufacturing-International Project and the GASB Service Effects and Accomplishments Project.

In closing, it is the researcher's studied opinion that the concepts of the Theory of Constraints can be applied to the Force

Element Groups of the RAAF. However, considerable attention must be given to defining throughput such that definition provides a reasonable measure of the outcomes of activities in terms of the goals and objectives of the RAAF.

Appendix A: Defence Logistics Strategic Planning Guide Objectives and Strategies

Objective I: Express logistics requirements and capabilities in readiness and sustainability terms.

Enabling Objective I.2: Develop processes to determine logistics requirements from operational needs and express logistics capability in operational terms.

Strategy I.2.3: Support logistics decision making processes by developing methodologies and models which:

a. tie logistics requirements computations to preparedness objectives;

b. express the levels of logistics performance achievable from given resources in operationally meaningful terms; and

c. allow effective budgeting, resource allocation and risk analysis.

Strategy I.2.4: Organize logistics data by employing a logistics information systems architecture which links:

a. equipments to force elements;

b. hierarchical relationships within equipments;

c. logistics activities to specific equipments and force elements; and

d. entitlements, availability and consumption of resources to specific activities, equipments and force elements.

Objective III: Achieve weapon system and equipment operational availability targets.

Enabling Objective III.1: Emphasize weapon system management principles in all aspects of logistics.

Strategy III.1.5: Establish organizational structures, performance assessment processes and systems that focus on weapons systems availability and resource allocations against weapon system priorities.

Objective IV: Field integrated logistics information systems to provide responsive decision support and improve logistics performance.

Enabling Objective IV.2: Progressively integrate logistics information systems.

Strategy IV.2.4: Interface logistics information systems with operational and resource information systems to facilitate performance measurement and resource allocation.

Strategy IV.2.5: Establish an information architecture which enables logistics resource entitlements, availability and consumption to be linked to force elements, weapon systems, equipments and logistics activities.

Objective VII: Improve the quality and management of logistics operations.

Enabling Objective VII.4.1: Improve programming, budgeting and management of resources.

Strategy VII.4.1: Ensure that logistics inputs to PMB processes are structured to attribute financial estimates and budgets to preparedness objectives.

Strategy VII.4.2: Ensure that resources management processes are structured to attribute the costs of logistics activities directly to preparedness objectives.

Strategy VII.4.3: Improve methods of identifying cost to users and explore means of making users accountable for goods and services consumed.

Strategy VII.4.4: Develop the capability to devolve resource management authority to the unit and work center level.

Strategy VII.4.5: Devolve financial commitment and expenditure authority to the lowest level of responsibility at which accountability can be effectively maintained and controlled.

Strategy VII.4.6: Ensure that financial guidelines and procedures are introduced to facilitate the adoption of commercial practices.

Appendix B: Guidelines for the Development of Metrics

The Metrics handbook offers advice on the attributes of a good metric and on the detail required in the operational definition of a metric. A summary of the attributes and detail required are given in the following paragraphs.

Attributes of a Good Metric

1. The metric is accepted as meaningful to the customer.
2. The metric tells how well organizational goals and objectives are being met through processes and tasks.
3. The metric should be simple, understandable, logical and repeatable.
4. The metric shows a trend.
5. The metric is unambiuously defined.
6. Data is economical to collect.
7. The metric can be produced in a timely fashion.
8. The metric drives the appropriate action. (1:2-1)

Detail Required in Operational Definition of a Metric

1. An unambiguous descrition of the metric.
2. The population that the metric will include.
3. The frequency of the measurement.
4. The source of the data.
5. Any equations required in doing the measurement.
6. Precise definition of key terms.
7. A desription of the graphic presentation that will eventually be used to display the data.
8. The customer of the metric.
9. the accountable process owner.
10. The desired outcome expressed in terms of positive or negative trend (not a numerical goal).
11. The link between the process being measured, the organization's goals, and the higher command goals. (1:3-2)

Finally, a metric presentation has two parts: the metric descriptor, and the graphic presentation of the data (1:3-2).

Appendix C: Stated Mission and Goals of the RAAF

Mission: conduct effective strategic and tactical air operations as an independent force, or as part of a joint or combined force in the pursuit of Australia's defence and national interests. (29:5)

Goal 1: Preparedness

a. Develop and maintain air forces capable of conducting and sustaining effective defensive and offensive air operations by:

(i) Accurately assessing our capability shortfalls and planning to update or acquire the required improvements.

(ii) Ensuring our air power doctrine tactics and procedures maximize our combat potential.

(iii) Ensuring that we can operate effectively with the Navy and the Army.

(iv) Providing quality logistics support for all our operations.

b. Maintain operational readiness by achieving the targets specified by CDF's Operational Readiness Directive.

c. Continue surveillance and intelligence gathering.

d. Maintain and develop airfields, and combat oriented facilities and infrastructure, (bases, facilities, communications networks etc) particularly in likely areas of operations.

e. Develop the RAAF Reserve, including the Ready Reserve and the Aircrew Contingency Reserve Scheme, to provide an operational surge capability.

f. Be able to operate with our friends and allies by participating in international defence forums such as the Air Standardisation Coordination Committee - Australia/USA/ New Zealand/Canada/UK.

g. Develop and maintain operating and support procedures with our allies to enable rapid build-up of equipment if the need arises.

h. Develop policies to increase our level of self-sufficiency through active association with Australian industry.

Goal 2: Operational Excellence

a. Strive for excellence in independent air operations.

b. Ensure combat-oriented training.

c. Develop joint doctrine and procedures to ensure timely and effective support for the Navy and Army.

d. Participate in Australian Joint Service and Combined International exercises.

e. Ensure timely and effective maintenance and logistic support.

Goal 3: Productivity

a. Search continuously for better ways to do the job.

b. Introduce better management and work practices through the application of RAAF Quality (RAAFQ).

c. Devolve responsibility to the lowest appropriate level.

d. Selectively incorporate advanced technology systems, particularly in relation to information systems.

e. Ensure that our training prepares us for our jobs.

f. Be receptive to new ideas, however different or novel they may appear.

g. Nurture technological excellence and innovation

Goal 4: Our People

a. Continue our commitment to our members and their families.

b. Maintain a responsive approach to career management and postings.

c. Continue to improve our Conditions of Service.

d. Maintain a committed, strong and caring command chain.

e. Recognize achievement and encourage enterprise.

f. Maintain our commitment to quality in all aspects of our Service.

Goal 5: Community Relations

a. Encourage cooperation and involvement in community activities.

b. Provide timely support to the civil community in times of crisis and natural disasters.

c. Assist in search and rescue operations.

Goal 6: International Relations

a. Continue exchange postings and visits.

b. Contribute to the Defence Cooperation Program (DCP).

c. Participate in airman-to-airman talks with allies and regional neighbors.

d. Contribute to United Nations peace-keeping activities.

Appendix D: An Hypothetical Example of the Use of the Proposed Effectiveness Metric

To demonstrate the use of the proposed effectiveness measures, an hypothetical example relating to the Strike/Reconnaissance FEG was constructed. Table 1 represented the flying hour program for week 30 of a 52 week budget period. The table provided details of: the flying hours scheduled for week 30; the actual hours flown for each scheduled mission; a statement "yes" or "no" as to whether the aircraft departed on time; and a statement "yes" or "no" as to whether the mission was successfully completed. A letter was placed after each entry with a "no" statement to indicate the reason for the "no" statement. These notes were as follows:

(A) The aircraft was refueled late.

(B) The inertial navigation system failed before the mission could be completed.

(C) The maintenance by the Flightline crew was delayed by the late arrival of an LRU, sourced from the Intermediate Level Maintenance Squadron.

(D) The camera on the aircraft malfunctioned before the aircrew could complete their reconnaissance mission.

These causes for the non-completion of effective hours were used to attribute lost effective hours to the appropriate support component. The refueling problem was attributed to the Flightline for failing to coordinate the required fuel supply. The inertial navigation system failure was attributed to the Logistics Management Squadron because they had responsibility for maintaining reliability levels for the aircraft and its systems. The delayed LRU was attributed to the Flightline, Supply Support Squadron, Intermediate Level maintenance Squadron, and the Logistics Management Squadron because:

a. the Flightline was unable to get the aircraft to launch on time;

TABLE 1: HYPOTHETICAL FLYING PROGRAM FOR WEEK 30

Flight Number	Scheduled Hours	Hours Flown	On-Time Departure	Completed Mission	Effective Hours Lost	
1	3	3.0	Yes	Yes		
2	3	2.9	Yes	Yes		
3	4	4.2	Yes	Yes		
4	2	1.9	Yes	Yes		
5	3	3.1	Yes	Yes		
6	3	2.8	Yes	Yes		
7	4	3.8	No	Yes	4	(A)
8	2	2.0	Yes	Yes		
9	4	4.1	Yes	Yes		
10	4	4.2	Yes	Yes		
11	3	3.1	Yes	Yes		
12	4	3.8	Yes	Yes		
13	3	3.1	Yes	Yes		
14	4	4.3	Yes	Yes		
15	1	1.0	Yes	Yes		
16	4	4.2	Yes	Yes		
17	2	1.9	Yes	No	2	(B)
18	3	2.9	Yes	Yes		
19	2	1.0	Yes	Yes		
20	1	1.1	Yes	Yes		
21	1	0.9	Yes	Yes		
22	2	2.2	Yes	Yes		
23	2	2.1	Yes	Yes		
24	2	1.9	Yes	Yes		
25	1	1.2	Yes	Yes		
26	1	1.1	Yes	Yes		
27	2	1.8	Yes	Yes		
28	3	3.2	No	Yes	3	(C)
29	2	2.0	Yes	Yes		
30	3	3.1	Yes	Yes		
31	1	1.0	Yes	Yes		
32	2	2.2	Yes	Yes		
33	1	1.3	Yes	Yes		
34	3	2.4	Yes	No	3	(D)
35	3	3.1	Yes	Yes		
36	3	2.9	Yes	Yes		
37	1	1.1	Yes	Yes		
38	4	4.3	Yes	Yes		
39	3	2.8	Yes	Yes		
40	3	2.9	Yes	Yes		
41	1	1.0	Yes	Yes		
42	3	3.2	Yes	Yes		
43	3	3.4	Yes	Yes		
44	2	2.1	Yes	Yes		
45	3	3.1	Yes	Yes		
Totals	114	114.7			12	

b. the Supply Support Squadron was unable to supply the LRU requested by the Flightline on time;

c. the Intermediate Level Maintenance Squadron failed to have sufficient LRUs returned to a serviceable condition in time for the Supply Support Squadron to issue the LRU to the Flightline; and

d. the Logistics Management Squadron had overall responsibility for managing the LRU reparable pipeline and allowed the pipeline to fail in its support of aircraft operations.

The allocation of lost effective hours was summarized in Table 2. The week 30 flying hour program for the whole FEG was then summarized in Table 3, and this summary was transferred to the year-to-date summary in Table 4.

Three graphs were derived from Table 4. Figure 1 showed the proportion of effective hours achieved against the scheduled flying hour program. This proportion appeared in the form of a run chart from which any obvious trends could be determined. Naturally, as with any process, this chart would indicate a degree of variability within the process of generating effective hours. Figure 2 showed a graph of the proportion of effective hours per scheduled hours on a year-to-date basis. This provided an indication of the likely year-end proportion of effective hours, allowing the FEG Commander to see if he was likely to meet the performance targets that may have been set for him. Finally, Figure 3 provided a comparison of effective hours against the actual hours flown, showing the shortfall of effective hours against actual hours flown -- an indication of the quality of the flying hour program in terms of FEG effectiveness goals.

As the use of the effective hours data was difficult to adapt to an Statistical Process Control (SPC) chart, an SPC chart was adopted to monitor the number of effective flights, an effective flight being a flight which represented the achievement of effective hours. This allowed the data to be treated on the basis of the attribute of the

TABLE 2: EFFECTIVE HOURS FOR EACH FEG COMPONENT

	Scheduled Hours	Attributed Losses	Effective Hours	Effective Percentage
Flightline	114	7	107	94
Supply Support	114	3	111	97
Intermediate Maintenance	114	3	111	97
Depot Maintenance	114	0	114	100
Logistics Management	114	8	106	93

TABLE 3: WEEKLY SUMMARY -- WEEK 30

Budget Hours	110
Scheduled Hours	114
Hours Flown	114.7
Effective Hours Lost	12
Effective Hours Flown	102

TABLE 4: YEAR-TO-DATE PERFORMANCE FOR WHOLE FEG

Week	Budgeted Hours	Scheduled Hours	Hours Flown	Effective Hours	Effective Percentage
1	60	52	50.7	47	90
2	60	60	62.3	60	100
3	60	63	61.9	58	92
4	80	82	83.4	77	94
5	110	114	114.4	103	90
6	110	106	105.3	101	95
7	110	110	110.9	98	89
8	110	111	111.1	104	94
9	110	115	114.5	102	89
10	110	92	93.1	81	88
11	110	112	112.4	99	88
12	110	112	112.2	103	92
13	110	108	107.2	101	94
14	110	109	109.4	97	89
15	110	113	112.7	98	87
16	110	108	107.6	101	94
17	110	110	110.2	108	98
18	110	111	111.8	103	93
19	110	103	103.1	87	84
20	110	107	106.4	93	87
21	110	115	113.2	106	92
22	140	145	147.3	137	94
23	110	102	103.1	87	85
24	110	109	106.7	101	93
25	110	112	112.3	106	95
26	110	116	117.1	106	91
27	110	110	109.7	100	91
28	110	108	107.6	96	89
29	110	107	106.4	94	88
30	110	114	114.7	102	89
Totals	3150	3136	3138.7	2856	91

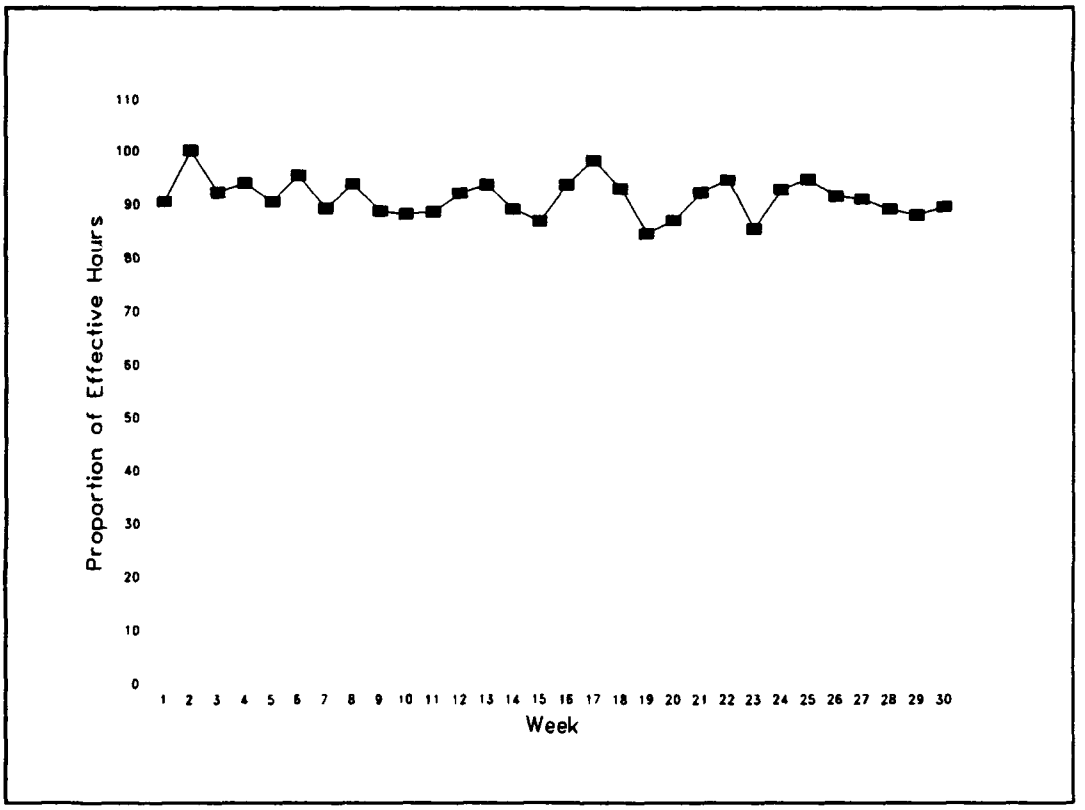

Figure 1. Effective Hours as a Proportion of Scheduled Hours

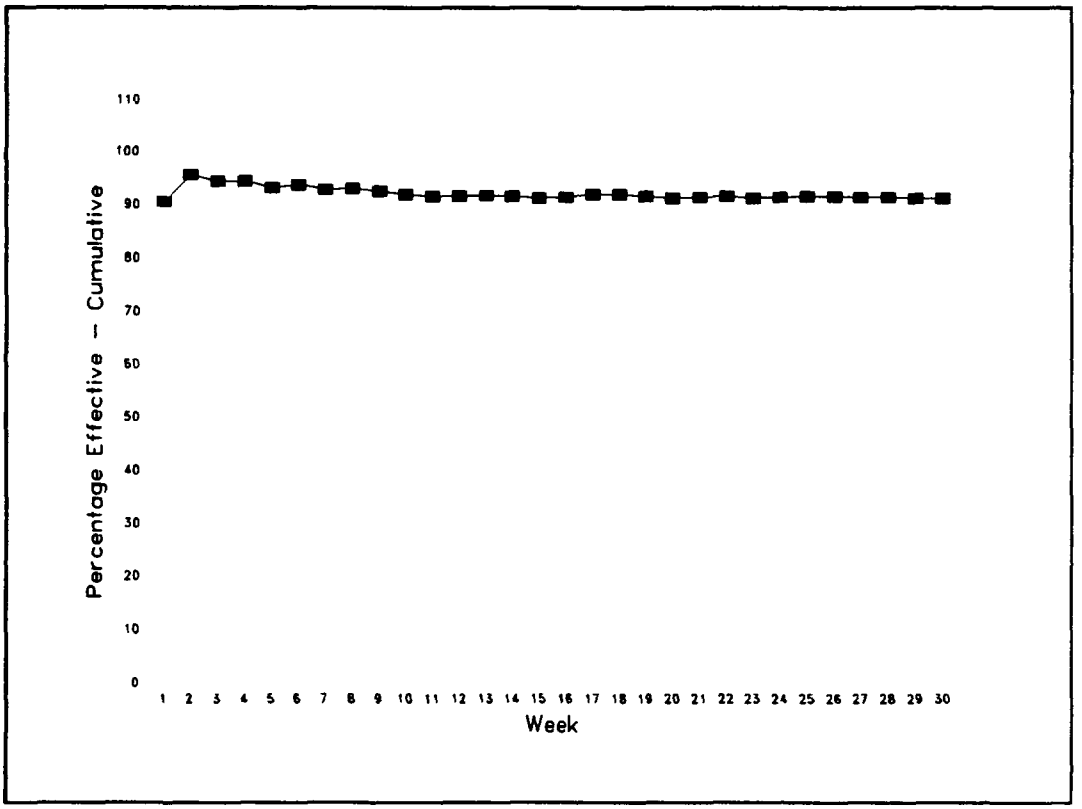

Figure 2. Cumulative Effective Hours as a Proportion of Cumulative Scheduled Hours on a Year-To-Date Basis

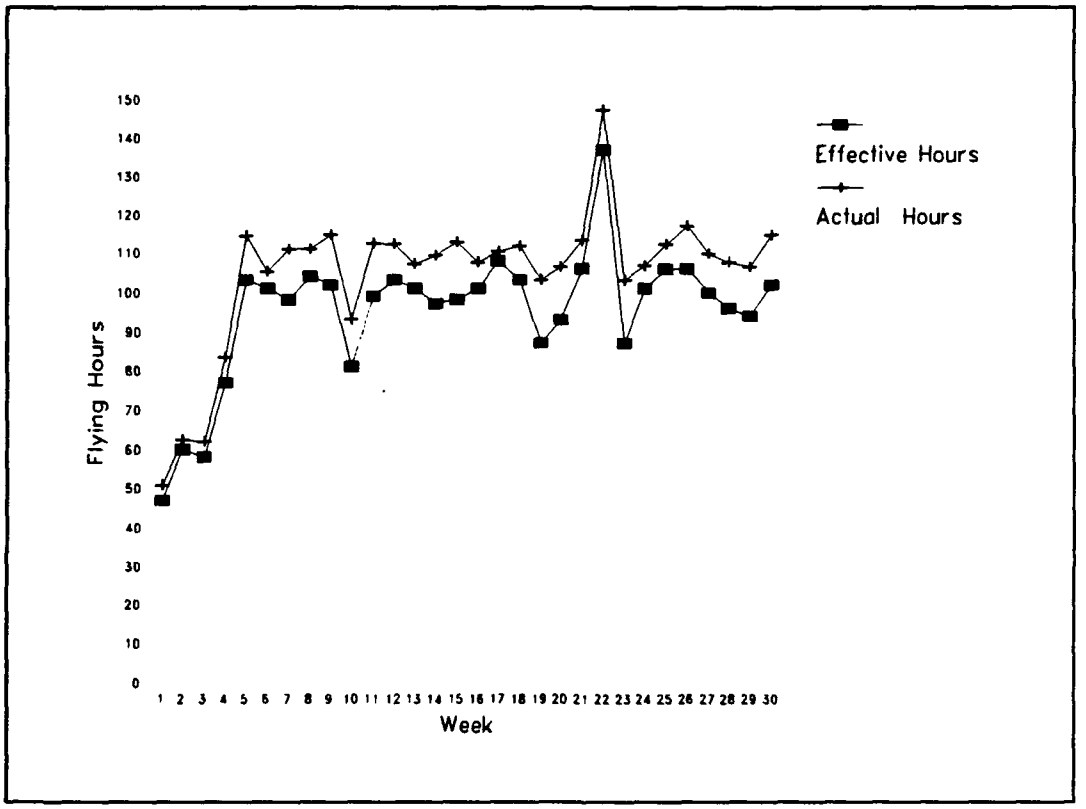

Figure 3. Comparison of Effective Hours Against Actual Hours Flown

effective hours being gained or lost. The hypothetical data for these effective flights were given in Table 5. The resulting SPC P-chart, using a 100% variable sample size of the scheduled flights, was provided in the graph in Figure 4. The graph indicated that the process was in control. However, the FEG Commander could be concerned with the degree of variability in the process, and could start to identify management initiatives which could reduce this variability, and perhaps improve the overall level of effectiveness.

TABLE 5: DATA ON EFFECTIVE FLIGHTS

Week	Scheduled Flights	Effective Flights
1	21	18
2	22	22
3	28	26
4	33	31
5	46	42
6	44	42
7	44	40
8	44	41
9	46	40
10	36	32
11	45	40
12	48	43
13	43	40
14	44	40
15	40	35
16	43	40
17	44	43
18	47	43
19	41	35
20	43	37
21	46	42
22	58	55
23	39	34
24	44	41
25	45	43
26	48	45
27	44	39
28	39	35
29	42	36
30	45	41
Total	1252	1141

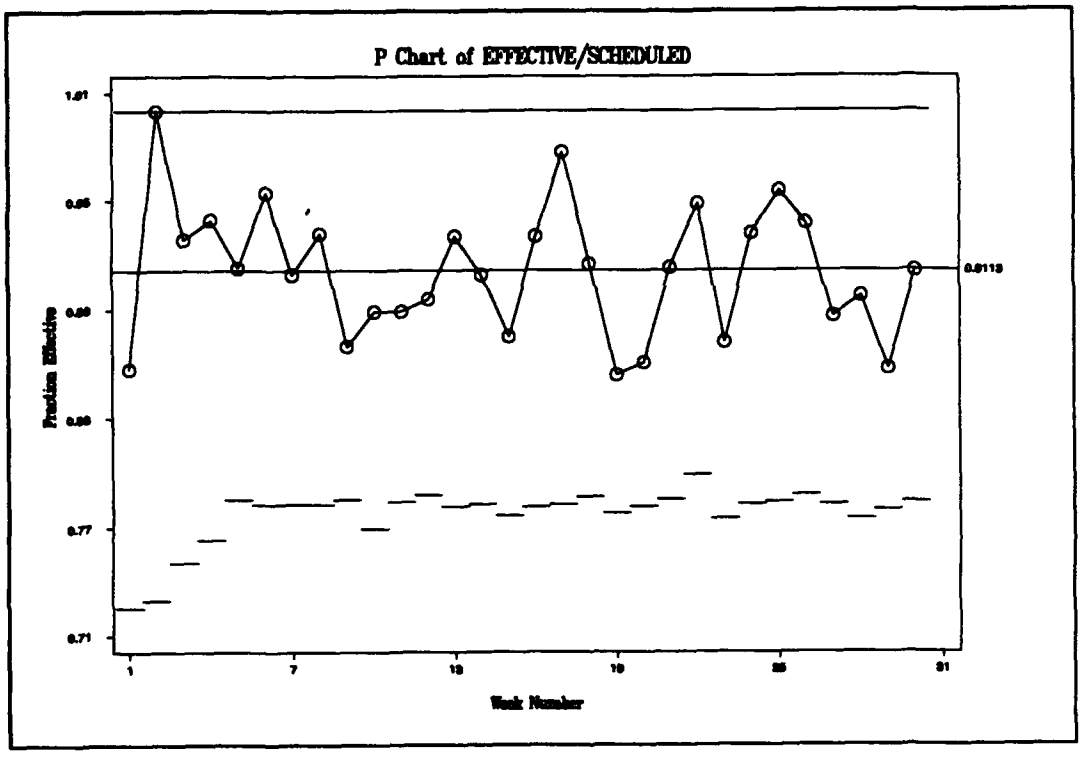

Figure 4. P-Chart Showing Effective Flights as a Proportion of Scheduled Hours

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REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	September 1992	Master's Thesis

4. TITLE AND SUBTITLE
THE DEVELOPMENT OF A PERFORMANCE MEASUREMENT CONCEPT FOR THE ROYAL AUSTRALIAN AIR FORCE

5. FUNDING NUMBERS

6. AUTHOR(S)
David R. McDonald, Squadron Leader, RAAF

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Air Force Institute of Technology, WPAFB OH 45433-6583

8. PERFORMING ORGANIZATION REPORT NUMBER
AFIT/GLM/LSG/92S-30

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)

10. SPONSORING / MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION / AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

12b. DISTRIBUTION CODE

13. ABSTRACT (Maximum 200 words)

The Royal Australian Air Force (RAAF) needed to develop performance measurements (PMs) to support its Program Management and Budgeting (PMB) System. This research assessed the use of the concepts of the Theory of Constraints (TOC) to develop those PMs. The literature indicated that: traditional accounting PMs were not always suitable in an environment of continuous improvement; Activity Based Costing did not provide the required measures; and non-financial PMs were supplanting the older measures. Further, governments faced unique problems in developing PMs, particularly in defining the outcomes to be measured. Using the Critical Theory and Action Research methodologies, and a case study approach, the research derived guidelines from PMB to develop the RAAF PMs, examined the possible use of TOC in government organizations, developed an example of PMs which could be used by the RAAF, and compared the developed PMs with the PMB guidelines. The research found that difficulties arose when operationally defining the outputs of the RAAF, requiring the use of proxy measures. However, with slight modifications, the TOC concepts could be applied to the development of RAAF PMs. Development would be an iterative process, requiring refinements as users gained experience with the PMs.

14. SUBJECT TERMS	15. NUMBER OF PAGES
Logistics Management, Resource Management, Availability, Efficiency, Accountability	95
	16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	UL

AFIT Control Number AFIT/GLM/LSG/92S-30

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