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Carleton University

School of Business

**Toward a Predictive Model of
Human Resource Requirements
for White Collar Crime Investigations**

**A Thesis submitted to the Thesis
Examination Committee in fulfilment of the
requirements of the Master of Management
Studies Program.**

By

Douglas E. Ramsay B.Comm. (Honours)

Ottawa, Ontario

September 20, 1993

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"Toward a Predictive Model of Human Resource
Requirements for White Collar Crime Investigations"

submitted Douglas E. Ramsay B.Comm. (Honours)

in partial fulfilment of the requirements of the

Master of Management Studies.

Thesis Supervisor

Chair, Department of SCHOOL OF BUSINESS

Carleton University

September 20, 1993

Abstract:

This research is an empirical examination of two characteristics ascribed to a white collar crime case evaluation model, the Complexity Rating Scheme, used by the Royal Canadian Mounted Police [hereafter referred to as the RCMP] to assess the attributes of field investigations. First, the Complexity Rating Scheme reportedly predicts the amount of time, in hours, an investigator will require to complete a white collar crime investigation. Second, the scheme reportedly classifies white collar crimes on the basis of Complexity.

The analysis undertaken in this research confirms that a relationship does exist between complexity, as measured by the Complexity Rating Scheme, and investigative time. Unfortunately, the strength of that relationship precludes the Complexity Rating Scheme from being a basis for predicting investigative time. The Complexity Rating Scheme, in the limited context in which complexity was defined, does reliably classify white collar crimes.

Further, the results of exploratory analysis, designed to extend this research beyond the original research questions, suggests it may be possible to enhance the capabilities of the Complexity Rating Scheme.

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As with all academic endeavour, success is achieved with the help and support of academic advisors, mentors, peers and family. I therefore wish to thank my Thesis Supervisor, Professor George Haines and my Co-supervisors, Professors Deborah Compeau and Moses Kiggundu, of the Carleton School of Business, for their willingness to contribute their expertise.

Secondly, I would like to thank my employer, the RCMP and specifically, the Director of Economic Crime, Assistant Commissioner Norman Doucette, for providing the topic for my research. A special thanks to Dr. Angus Dalley, formerly the RCMP's Chief Statistical Officer, for his suggestions and encouragement and Garry Saunders, of the RCMP Gazette's editorial staff, for his help in editing this paper.

Most of all, I would like to thank my wife, Micheline Ramsay, who for the past fourteen years has encouraged me to continue with my education and has patiently given me the support needed to complete this research.

Statement of Confidentiality:

One of the conditions placed upon me, by my employer, was that I safeguard any proprietary information provided to me for this research. Although it was rare, there were occasions where it was necessary to vet information. Consequently, some RCMP references are referred to in general terms.

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Toward a Predictive Model of Human Resource Requirements for White Collar Crime Investigations

Chapter 1.0 Introduction:

White collar crimes are non-violent criminal acts perpetrated for economic gain "through the use of some combination of fraud, deception or collusion" (Wheeler, Weisburd & Bode, 1982). Levi (1987) observed that "investigating fraud presents a different set of technical problems from the proof of a motoring offence". The police are often "faced with high-status suspects" (Levi, 1987) who are "not only wealthier, but are also better educated and connected" than they (ibid, 1987). He [Levi] went on to say that "commercial fraud is not a homogeneous phenomenon" (ibid, 1987) thus the time needed to investigate a white collar crime poses a human resource allocation problem for police managers.

The RCMP experience confirms Levi's (1987) observations. They found that investigating white collar crimes is an expensive and time-consuming enterprise requiring the expenditure of a finite number of highly-trained human resources (RCMP, 1988 (h)). In early 1980, senior police managers postulated that if a mechanism could be found to classify white collar Crimes, on the basis of their complexity and, a means could be found to predict the human resources needed to investigate them, they could make better use of their limited human resources.

To meet this challenge, Economic Crime Directorate, the group within the RCMP responsible for the investigation of white collar crimes, embarked upon an ambitious project to develop a white collar crime classification model with predictive qualities. In 1983, the Complexity Rating Scheme was deployed in the field where it has become institutionalized as a managerial tool.

With the advent of a formalized planning and budgetary process in mid 1989, managers saw the need to re-evaluate the Complexity Rating Scheme. There was evidence it had become ineffectual. Frequently, it reported counter-intuitive results. Simple investigative tasks, that typically take little time to investigate, were found to score the same on the Complexity Rating Scale as major criminal offenses, that routinely take more time.

Both managers and investigators doubted Complexity Rating Scheme results and questioned whether the original assumptions, upon which the Complexity Rating Scheme was based, were valid. In an effort to obtain a definitive answer to this question, a research project was begun.

1.1 Problem Statement:

This paper examines the predictive and classification qualities of the Complexity Rating Scheme and evaluates its utility as a managerial tool.

1.2 Research Objectives:

The two key questions to be answered by this research are:

- 1) Is the relationship between the time required to investigate a crime and Complexity Rating Score the basis for a viable human resource prediction model?
- 2) Is the Complexity Rating scheme a reliable White Collar Crime Classification Model?

The answer to these questions will help establish the direction future research should take to improve the viability of the Complexity Rating Scheme concept.

Chapter 2.0 Literature Review:

The literature review is comprised of five parts. The first part examines organizational characteristics of the RCMP and police organizations in general. It also includes a description of the RCMP White Collar Crime Programs. It continues with an examination of the external environment police organizations face, a review of public sector productivity measurement and ends with some observations about the innovation process in police organizations. The second part consists of a review of current police management literature. The third part examines the development and use of the Complexity Rating Scheme. The fourth part explores the concept of complexity and the associated literature. The fifth, and final part, reviews the literature on building classification and predictive models.

2.1 Overview – The RCMP and White Collar Crime:

The RCMP is a federal government agency under the direction of the Solicitor General of Canada. It operates under the authority of the Royal Canadian Mounted Police Act (RCMP, 1991(g)). The RCMP is the largest and most diverse law enforcement agency in Canada employing 20,917 persons with an annual operating budget of 1.68 billion dollars (ibid, 1991(g)).

The RCMP is involved in a wide range of policing services. It provides police services under contract to ten of the twelve territories/provinces and 191 municipalities across Canada (RCMP, 1990(g)). It also provides crime laboratories, data processing and training services to other police and government agencies. (ibid, 1990(g))

The RCMP subdivides its organization into five functional activities, one of which is Criminal Operations (RCMP, 1991(f)). Criminal Operations is in turn subdivided into seven sub-activities, one of which is the Economic Crime Program (ibid, 1991(f)). The Economic Crime Program is administered by the Economic Crime Directorate which is responsible for delivering white collar crime investigative services (RCMP, 1990(f)). Actual enforcement services are delivered by 33 Commercial Crime field units strategically located across Canada to provide timely and effective service to federal and provincial government departments and the general public (RCMP, 1988(h)). The Economic Crime Program is subdivided into eight distinct programs. Each program has a specific mandate that is described in the foregoing.

1) *Bankruptcy Act Enforcement Program*: The RCMP Bankruptcy Sections act as the enforcement arm of the Superintendent of Bankruptcy. The objective of this program is the maintenance of debtor/creditor and commercial relations, within the Common Law legal framework, through enforcement of the provisions of the Bankruptcy Act (ibid, 1988 (h)).

2) *Commercial Crime Program*: The RCMP Commercial Crime Section are the Canadian Government's chief liaison between foreign police departments and major international fraud offices. They assist foreign authorities in gathering evidence in Canada and act as the coordinating agency for Canadian police agencies seeking to obtain evidence for investigations that transcend international boundaries (ibid, 1988 (h)).

3) *Counterfeit Program*: The RCMP Counterfeit Sections are responsible for the interdiction and suppression of counterfeit currencies, negotiable instruments, passports, birth certificates, marriage licenses, S.I.N. cards and driver licenses, bus and airline tickets (ibid, 1988 (h)).

4) *Computer Crime Program*: The RCMP Computer Crime Sections are responsible for the detection and investigation of crimes involving computer technology including the illegal manufacture and distribution of computer software and circuit boards, the misappropriation of satellite signals and time and, the unlawful access or use of computer facilities (ibid, 1988 (h)).

5) *Market Enforcement Program*: The RCMP Market Sections are responsible for the enforcement of securities-related sections of the Criminal Code of Canada. They investigate the unlawful manipulation of stocks and commodities trading together with related offenses of fraud and corruption that occur in Public Markets (ibid, 1988 (h)).

6) *Federal Statutes and Programs*: The RCMP Federal Sections are responsible for investigating criminal activity where the Government of Canada is the victim. They concentrate their efforts on the interdiction and investigation of corruption, defalcation by Federal Government Officials and externally contrived fraudulent schemes directed at Government (ibid, 1988 (h)).

7 & 8) *Enterprise Crime & Special Projects Tax - Programs*: The RCMP Enterprise Crime and Tax Sections are responsible for seizing assets and property accumulated by career criminals. They utilize the provisions of the Income Tax Act or the Enterprise Crime provisions of the Criminal Code of Canada which allow for the seizure of the proceeds of crime to do so (ibid, 1988 (h)).

All white collar crimes involve a breach of an Act of Parliament. These breaches involve either a contravention of the provisions of the Criminal Code of Canada or, a contravention of a Federal Statute that provides for criminal sanctions. In either case, the objective of these investigations is to identify illicit behaviour and institute criminal proceedings against alleged suspects.

Both investigators and managers characterize investigative tasks as unstructured in nature. The investigative process requires a variety of multi-disciplinary skills from a working knowledge of criminal and civil law, finance and accounting as well as knowledge of computer sciences. Due to their complex nature, a white collar crime investigation can often take years to investigate. The investigative process itself involves the collection, assimilation and organization of fragmented and often incomplete information by police investigators. On the basis of the available information, investigators are required to:

- 1) define the type of offence under investigation and establish a legal basis for continuing the investigative process;
- 2) set attainable objectives for the investigative process if continuance is warranted and;
- 3) develop a viable action plan that yields the evidence required to bring the investigative process to a successful conclusion.

2.1.1 Organizational Characteristics of Law Enforcement Agencies:

Law enforcement agencies are characterized as Machine Bureaucracies (Withane, 1987). Organizationally, there is a strong emphasis on a centralized vertical power component (Withane, 1987). Bureaucracies embrace the Weberian principles of specialization, standardization, hierarchy of authority, unity of command, span of control, line and staff functions and departmentalization (Withane, 1987). They rely on management processes of planning, organizing, leading, coordination through formal control, predictable structural interrelationships and formal communications to co-ordinate their activities (ibid, 1987).

Such organizations' "primary coordinating mechanism is the standardization of the work process and outputs... with the key element of the organization being the Techno-structure and Middle Management" (Withane, 1987). These "organizations are large enough to have the volume of operating work needed for repetition and standardization, and old enough to have been able to settle on the standards it wishes to use" (Mintzberg, 1979). Bureaucracies are also "fundamentally non-adaptive structures, ill-suited to changing their strategies" (ibid, 1979). "Police Forces are drawn to this type of structural configuration" (ibid, 1979). Mintzberg (1979) suggests this inclination stems from the organization's need to control variance, maintain safety considerations and operational contingencies.

Withane (1987) also observed that bureaucracies strive to improve performance through the addition of control mechanisms rather than seeking innovative solutions. The impact such structural characteristics have on innovation are profound. Quinn (1986) sums up this argument attributing the inability of bureaucracies to manage innovation to:

1)"Excessive Rationalism – Managers of big companies often seek orderly advance through early research studies or PERT [Program Evaluation Review Technique] planning" (Quinn, 1986) and;

2)"Excessive Bureaucracy – In the name of efficiency, bureaucratic structures require many approvals and cause delays at every turn" (ibid, 1986).

Quinn (1986) suggests that "rather than managing the inevitable chaos of innovation productively, bureaucrats soon drive out the very things that lead to innovation" (ibid, 1986).

Bissonnette (1980) observed that police organizations, by virtue of their structural characteristics, are generally reluctant to undertake the research necessary to yield innovative solutions to a problem, while on the other hand, they are impatient for implementation of that same solution. He adds that police organizations sometimes "fail to appreciate how long it takes to carry out high-quality research" necessary to explore possible solutions (Engstad & Liroy: Bissonnette, 1980). Paradoxically, these two factors [structural characteristics and intolerance] often inhibit the adoption of durable managerial solutions within police organizations.

2.1.2 The External and Internal Environment:

Treasury Board, the RCMP's primary funding agency, observed that "without a knowledge of an organization's performance, managers cannot accurately calculate the staff and other resources required to meet given volumes of workload" (Treasury Board, 1976). In effect Treasury Board is saying that it is difficult to establish where you are going, or to improve on performance, if you can't properly measure what you already have done.

Other researchers have observed that "police agencies operate in an environment characterized by unlimited service demands against often severe budgetary constraints" (Handberg, Hill & Daroszewski, 1985). Bissonnette (1980) suggested that "governments are fast approaching the limit of their ability to pay for police services and it is imperative that police administrators seek more cost-effective means of delivering police services" (Engstad & Liroy: Bissonnette, 1980).

Hernandez (1981) noted that Law Enforcement Funding Agencies are continually searching for ways to judge the adequacy of police funding and measure the effectiveness of services rendered. These observations are echoed by Engstad (1980) who stated that "faced with rapidly escalating costs and restraint in government spending, police officials at all levels are under intense pressure to set objectives and formulate policies aimed at maximizing the efficiency and effectiveness of their operations". Over the course of the past 7 years, the Federal Government has brought the spending of its federal programs under greater scrutiny primarily through policies enunciated by Treasury Board. One policy in particular, the Operational Plan Framework, a component of the Policy and Expenditure Management System has proven particularly effective in this regard. In summary, the Operational Planning Framework provides Treasury Board with a method of assessing productivity in the public sector. In terms of the RCMP it...

"represents a shift of emphasis, at the Corporate level of the RCMP, to results management... It provides a framework used to assess the delivery of services in terms of efficiency and effectiveness...it describes the purpose of Force Activities, the way in which the objectives are to be pursued and achieved, the deployment of [human] resources to achieve desired results, the measures which report on key results, and how the organization is arranged to deliver its services" (RCMP, 1991(f)).

This policy sets out clearly defined productivity standards and provides for a measurable results spectrum with which departments are expected to conform. It is an instrument by which Treasury Board can gauge the effectiveness of RCMP services against established norms.

On the other hand, Steward (1990) observed that when "budgets, forecasts or planning, whatever you call them, become management's main tool to gauge performance, then budgets become an end in themselves". Managers lock their radar onto the signals sent out "making the numbers become the overriding goal" (Stewart, 1990). This inclination to focus on the numbers reinforces Withane's (1987) observation that bureaucracies tend to adopt behaviours that can be fatal to the innovative process. Moreover, "higher performance levels necessitates considering more alternatives, and more variables simultaneously" (Galbraith, 1977). This means that managers need more and better information about the task at hand and a yardstick against which it can be measured. In response to these external pressures, Economic Crime program managers conceived a tool, the Complexity Rating Scheme. They believed this scheme conveyed qualitative and quantitative factors about investigations being carried out in the field. What these managers were actually trying to do was to add another information channel to provide them with a means of monitoring field productivity.

2.1.3 Productivity and Performance Measurement:

In 1981, the Auditor General observed that "the RCMP does not have criteria for calculating its staffing requirements for the various law enforcement programs... thus it [the RCMP] cannot be sure whether its limited enforcement [human] resources have been allocated and used in an efficient and effective manner" (Auditor General, 1990). By calculating its staffing requirements, the Auditor General was inferring the RCMP did not possess a tool to measure the performance of its human resources.

More specifically, the Auditor General inferred the RCMP lacked productivity norms by which they could compare performance. Performance measurement can be viewed "as a systematic way of obtaining information to help people make judgements about a specific program and, in a sense, make explicit many features of the evaluation that has long been implicit", (National Institute of Law Enforcement and Criminal Justice, 1982). When resources are limited, "the manager who knows the capabilities of an organization has the information needed to decide how far performance must be improved to cope with increases in workload" (Brown, 1981).

Even among their own ranks, police executives see "heretics emerging ... questioning what we [police agencies] are doing, the way we are doing things and how well we are doing them" (Engstad & Liroy: Hofley, 1980). Police managers agree that fiscal constraints has imposed on police management a responsibility of optimizing the public's investment in their services (RCMP, 1983 (c)). Managers have come to the realization that they cannot possibly respond to every call for service. They concede that with fewer resources investigations of lesser priority will have to be set aside in favour of more serious ones (RCMP, 1983 (d)). They resolved themselves to develop a tool that would enable them to evaluate the productivity of police services (RCMP, 1983 (b)).

But the question remains: how do police managers determine their cost effectiveness, productivity or efficiency? Moreover, the question of how productivity, in the public sector is defined, becomes important.

Lunney (1980) defined police productivity as "the relationship between resources used and the results produced" and went on to say that "increasing productivity means getting more and better results from resources consumed, or using fewer resources to maintain a basic level of output" (Engstad & Liroy: Lunney,1980).

Scicluna & Foot (1981) describe productivity as "the measure of efficiency with which physical inputs are transformed into physical outputs". Both Scicluna & Foot (1981) and Mehay & Shoup (1977) condemn the use of the current crop of police productivity measures [i.e. clearance rates, response times, number of calls for service etc.] as useless in determining what police are actually doing on the street. Both contend that these measures are an inaccurate portrayal of police productivity.

For example, there is the productivity and performance measurement model used by Orange County Florida Police Department to assess its police service's productivity and to forecast future resource demands (Handberg, Hill & Daroszewski, 1985). It is a relatively simple standard based on two variables:

- 1) calls for service or the number of requests for police services divided by;**
- 2) the number of officers available.**

Logically, the development of productivity indicators leads to the development of standards, in terms of performance and in term of products or services delivered. In this case the resulting productivity standard is the average number of calls each field officer responds to in a given year.

The standard chosen by Orange County was 343 calls per field officer per year. The standard is evaluated against the projected growth rate in calls for service, based on population growth, using a regression model. Resource levels are varied to maintain the standard or conversely, the standard increased to reduce overall cost per response. Scicluna & Foot and Mehay & Shoup would argue that this particular measure of police productivity is meaningless. Handberg, Hill & Daroszewski (1985) would disagree. They stress the importance of making the productivity measure and the standard chosen must be "unambiguous and built on existing departmental procedures" if they are to be effective and relied upon by police managers.

Scicluna & Foot (1981) suggest the difficulty in measuring public sector productivity stems from the fact that public sector outputs are multi-dimensional in nature, with no single unit of *output* attributable to a specific organizational entity. Public service outputs involve joint production from different areas of an organization. They observed that the construction of quality-adjusted output measures are the only valid measure of public sector outputs.

Their solution is the use of both quantitative and qualitative factors in a *Production Function* of police productivity. They concede that the measurement process in the public sector is exacerbated by the fact that government priorities are seldom stable and involve multiple objectives. This lack of homogeneity makes aggregation of public sector outputs difficult.

They [Scicluna & Foot] concluded that productivity gains in the public service sector may be best reflected in improvements in the quality of the output rather than the actual number of units produced because it is highly unlikely that "each physical unit of input and output is identical" (Scicluna & Foot, 1981). The "real problem in measuring public sector productivity is identifying a meaningful unit of output" (Scicluna & Foot, 1981).

In summary, the Orange County model is a logistical deployment model based on an assessment of the total number of calls for service, irrespective of the type of service rendered, over a given time period. Alternately, the Complexity Rating Scheme categorizes white collar crimes into seven types of service. The standard for each service is based on the average time required to investigate similar cases (RCMP, 1988 (h)). Operational Units burdened with too many investigations for their personnel to manage can thus be easily identified. Any field unit unable to achieve productivity norms can be identified and remedial action taken. Thus, in addition to being a predictive and classification model, the Complexity Rating Scheme was also perceived as the basis for productivity norms.

2.2 Present State of Research:

Police management literature is dominated by three major themes, two of which are directly applicable to this research. The first theme, shall be referred to as the Information Processing & Productivity Model. It envisions the criminal investigative process as an information acquisition and processing activity. It suggests that productivity in law enforcement can be improved through the effective collection and use of information.

The second theme is referred to as Resource Allocation Models, proposes that police expenditures and resource allocation can be evaluated through the application of macro-economic principles. The third theme focuses on Queuing Theory and scheduling patrol cars or assigning detectives in response to calls for service. Noticeably absent in the literature is a contribution by Canadian researchers. As such, the American literature will be heavily relied upon for this research.

One Information Processing & Productivity Model often cited in the literature is the Investigation Control and Management System [hereafter referred to as [ICAM]. Developed by Charles Crabtree of the Sunnyvale Department of Public Safety in 1973, ICAM gauged productivity of police officers by comparing the time spent on investigative activities that yielded information and the effect that information had on the apprehension rate of suspects (Crabtree, 1973). The intent of the model was to identify those activities, and the time they took to complete, that led to the arrest of a suspect. The objective was to focus police officers solely on those fruitful activities. Conceptually, ICAM portrays the investigative process as a series of activities which generate information all of which contributes to the apprehension of criminals. Crabtree (1973) considered information to be the primary resource police have to apprehend a criminal. Thus information has value and must be used effectively.

Glick and Ricco (1979) expanded on Crabtree's model. They considered the investigative process as a function of "information acquisition and generation" where the goal is to "recognize, gather and organize information for case disposition" (Glick & Ricco, 1979).

They did so by weighting or assigning a value to the type and source of the information processed by police officers and thereby added another dimension to Crabtree's model. To do this, Glick & Ricco (1979) employed a case decomposition mechanism: the Case File and Review Instrument. In summary, the tool qualified information: the more novel and timely the information was received by police, the greater the relevance to the apprehension process.

Simms and Petersen (1989) describe the investigative process as a "sensing, learning and solving" exercise. They mapped out the activities associated with the information acquisition process, for a variety of crimes, from the initial call for service to the final outcome. They then calculated the probabilities for a successful apprehension of the suspects based on the type of investigative activity and the number of human resources dedicated to that task. Their findings indicate the probability of successful apprehension can be increased by dedicating more human resources at the early stages of the investigative process and by employing comprehensive information collection techniques. This literature implies that timely police intervention results in better information, which in turns increases the probability of suspect apprehension. It could be argued that the more timely the police response, the less complex the investigation becomes. Resource Allocation Models, on the other hand, focus on the allocation of police resources at the macro level using various forms of Cost Benefit Analysis and production functions. While informative, they are intended to measure productivity on an aggregate basis. Consequently, they are of little relevance to this research.

Finally, there are the Queuing Models. One example of a Queuing Model is Gray & Heitzman's (1976) Detective Allocation Model for deploying detectives. It was designed to provide a systematic method of deploying detectives to do routine investigative work [i.e. burglary, theft etc.] in a confined geographic location [i.e. precinct] based on the aggregate number of calls for service over a specified time period. They predicted a greater number of cases could be disposed of by allocating additional human resources in advance of a predicted workload. However, before the model can be used, two specific conditions must be met. First, the detective's work must fall into a specific category [i.e. Theft, Burglary etc.] and second, the crime must have occurred within a defined geographic locality. Gray & Heitzman (1976) acknowledged the fact that their model could not be used for any specialized investigative unit, such as a dedicated white collar crime investigative units, because such crimes are seldom limited by geographic boundaries.

The Police Models examined for this research typically focused on the logistics of police deployment, not the attributes or the classification of crime types. While meaningful information was gleaned from the literature, no models comparable to the Complexity Rating Scheme was found.

2.3 The Development of the Complexity Rating Scheme:

The developmental history of the Complexity Rating Scheme was reconstructed from an examination of the Economic Crime Directorate's Complexity Rating internal working file.

This summary was compiled from original material found in those documents. While not complete, it is a good representation of the model's development and intended use (RCMP, 1983).

It was evident that the developers viewed investigating white collar crime as an exercise in information collection and processing which would lead to a specific course of action and results similar to theoretical frameworks suggested by Crabtree (1973) and Glick & Ricco (1979). Its development was also influenced by the work of Eck (1979) as evidenced by the references to his research in the working papers. He proposed a theoretical model for predicting the outcome of Burglary Investigations based on the elapsed time between the actual burglary and police intervention.

In his model Eck (1979) considers the organizational characteristics of police, their information acquisition and processing mechanisms, the number of police officers, individual skills and investigative results attained. In essence, he found that reducing the time between the criminal event and police intervention meant a greater probability of apprehending a suspect. That finding is similar to those of Simms & Petersen's (1989). Of particular interest to the developers of the Complexity Rating Scheme was the list of investigative activities Eck (1979) planned to include in his future research.

Eck (1979) proposed to expand the Burglary Model by adding more variables. Specifically he [Eck] proposed including the number of:

- 1) victim and witness interviews;
- 2) times lab analysis was required to expose evidence;
- 3) undercover operations;
- 4) written reports;
- 5) informant interviews;
- 6) arrests or persons charged and;
- 7) search warrants issued.

Complexity was postulated to be a function of complicating factors. Co-incidentally the complicating factors chosen matched the variable set suggested by Eck. Complicating factors, as described by a Focus Group of senior managers, were elements or activities in an investigation that required either expertise to manage or time to accomplish. Developers assumed that if such complicating factors could be identified, then ranked and weighted relative to the degree to which they complicated investigations, a relationship could be inferred between them and the hours required to successfully complete an investigation. However, uncovering the constituent environmental elements and the specific investigative activities in white collar crimes that led to the expenditure of investigative time was critical to the viability of this ambitious effort. Intuitively, they [police managers] reasoned that the complexity of investigating a white collar crime was a function activities and elements. Thirteen elements and activities, commonly associated with white collar crimes investigations, were considered as potential indicators of complexity. An element, by definition, is a state or condition that may exist during the course of an investigation. Elements are not directly responsible for the expenditure of investigative time. Rather, they are a reflection of the investigative environment that must be managed during an investigation.

Activities, on the other hand, do require investigators to undertake specific activities that involve the expenditure of time. The complicating factors were sub-divided into two major groupings, Primary and Other factors. Primary factors were considered the most influential and dominant in the scheme. Thus, they would account for the majority of the variance in investigative time. Other Factors were considered less influential.

The developers assumed that complicating factors were a proxy for measuring the information processing demands of the task and, indirectly, its complexity. The Focus Group hypothesized that the amount of time required to complete an investigation was directly proportional to the number of complicating factors field investigators were confronted with during an investigation. Managers believed that the Complexity Rating model would enable them to assess the type of white collar crimes their personnel were confronted with and predict the amount of hours required to complete the investigation.

The basic premise was that a causal relationship existed between the Complicating Factors, the Complexity Rating Score and investigative time. Hypothetically, the greater the number of complicating factors, the greater the amount of time required to investigate white collar crimes. The actual measurement of the complicating factor depended on the variable type. Activities were objectively counted whereas elements were subjectively evaluated.

Table 1.0 depicts the Classification of 13 Complicating Factors measured by the Complexity Rating Work-sheet by variable type and measurement protocol.

Classification of Complicating Variables

Table 1.0 Description of Variable	Variable Type	Variable Measurement
Primary Complicating Factors 1) Number of Entities under investigation. 2) Number of Witnesses Interviewed. 3) Number of Search Warrants executed. 4) Number of Hours spent analyzing evidence. 5) Number of Entities prosecuted.	Element Activity Activity Activity Element	Objective Objective Objective Objective Objective
Other Complicating Factors 6) Use of Wiretaps. 7) Legal challenges to police methods. 8) Use of Informants to gather evidence. 9) Use of Undercover operations. 10) Sensitivity of investigation. 11) Priority of investigation. 12) Travel Requirements. 13) Unspecified Factors.	Activity Activity Activity Activity Element Element Activity Element	Objective Objective Objective Objective Subjective Subjective Objective Subjective

No evidence was found to indicate exploratory research was conducted to determine whether or not causal relationships between time and the complicating factors existed. Neither was any evidence available for the development of a scale to measure the subjective attributes of Sensitivity, Priority or Unspecified Factors (RCMP, 1983 (c). A measurement scheme was devised to aggregate all complicating factors in a white collar crime investigation which yielded a Complexity Rating Score.

Complicating factors were weighted relative to the number of times they occurred in an investigation. The Primary Complicating Factors, factors 1 to 5, were weighted by factors of one, two or four depending on the actual number of complicating factors. The greater the frequency of Primary Complicating Factors, the more they contributed to the Total Factor Rating [the sum of all the weighted & unweighed Complicating Factors]. The actual weighting scheme is best understood by examining the Complexity Rating Worksheet on p.99. The Other Complicating Factors, factors 6 to 13, received no special weighting. Their presence, in an investigation, was simply noted each time they occurred and assigned a weight of one per factor. The resulting Total Weighted Factor score for an investigation ranged from one to a maximum of twenty eight. Based on the Total Weighted Factor score, investigations are sub-divided into seven groups. Each group, depending on the number of Total Weighted Factor score, was assigned a Complexity Rating Score. Table 2.0 outlines how the Complexity Rating Scoring Regime worked.

Complexity Rating Scoring Regime

<u>Table 2.0</u> Total Weighted Factor	Resulting Complexity Rating Score
0 - 5	1
6 - 8	2
9 - 11	3
12 - 14	4
15 - 17	5
18 - 20	6
21 - 28	7

An empirical basis for the aggregation and weighting scheme could not be found in the documentation. Neither was there any evidence of research to validate weights assigned to the Primary and Other Complicating Factors or to assess the reliability of the aggregation scheme. While a trial run of the Complexity Rating Scheme was conducted March, 1983 (RCMP, 1983(a), the experiment was limited to the analysis of white collar crimes that were routinely reported to the Economic Crime Directorate by field units. This sample was limited to a relatively small number of cases which by virtue of their legal significance were reported to the Directorate.

By reviewing the content of the crime reports, directorate personnel completed the Complexity Rating Work-sheet. A subjective analysis was performed to determine whether or not the perceived complexity of the investigation was reflected in the Complexity Rating Score. The analysis seemed to support the assumption that investigations with a greater number of Complicating Factors took more time to complete. Thereafter, all white collar crime investigations undertaken by Economic Crime Directorate's operational units were subjected to analysis on a Complexity Rating Work-sheet before and during the investigative process.

The resulting score was a number, from one to seven. One represented the simplest investigation which should require the least amount of time, seven the most complex investigation requiring the most time.

The Complexity Rating Score was then used to classify investigations undertaken by operational field units and to estimate the time required to complete an investigation subject to normal variances. For example, if a white collar crime had a Complexity Rating Score of 3, the investigation would take X number of hours to complete.

2.3.1 The Dependent Variables:

Two dependent variables that were examined in this research are:

- 1) Investigative Time – the time required to complete the investigative process and;
- 2) Complexity Rating Score [Case Classification] – the score ascribed to a white collar crime investigation based on the number of Complicating Factors and their weights.

2.3.2 The Independent Variables:

Thirteen Complicating Factors [independent variables] were believed to contribute to the amount of time needed to investigate a White Collar Crime and form the basis for classifying white collar crimes. These two groups of Factors were subdivided into:

Primary Factors:

- 1) The **numbers of entities** under investigation – the number of persons or companies believed to have perpetrated the crime who are, based on the evidence, potential suspects in the alleged crime.
- 2) The **number of witnesses** – the number of persons who must be interviewed by police in their quest to establish sufficient grounds to prosecute suspects.

3) **The number of search warrants** – the number of Warrants to Search, issued by the Courts to police under the provisions of Part XV, Section 487 of the Criminal Code of Canada, in the process of gathering evidence to support criminal prosecution.

4) **The number of hours required to analyze evidence** – the amount of time an investigator must expend examining physical and documentary evidence provided to police by witnesses or through the execution of a Warrant to Search.

5) **The number of entities prosecuted** – the number of persons or companies actually charged with a breach of criminal law.

Other Factors:

6) **The presence of Wire Tap Applications** in the investigative process – the number of court orders issued to police under the provisions of Part VI, Section 184 of the Criminal Code of Canada for legal authority to intercept private communications.

7) **The presence of legal challenges** to any Court Orders granted by the Courts – the number of challenges the investigators experienced when they applied to the courts for Search Warrants, Retention Orders and Wire Tap applications.

8) **The use of Informants** to generate evidence – the use of police informers to obtain evidence in support of the criminal investigation process.

9) **The use of Undercover operations** – the use of clandestine police operations to secure evidence by using a ruse to cause suspects to reveal evidence.

10) **The sensitivity of the investigation** – the subjective evaluation of the investigator with respect to adverse community reaction stemming from the public's knowledge of an investigation and how this would impede the investigative process. This attribute was measured by way of proxy. Whenever extraordinary reporting procedures were invoked by senior management, the investigation was deemed sensitive.

11) **The priority of the investigation** – the subjective evaluation of the investigator of the importance of the investigation to the community sense of law and order. This attribute was measured by way of proxy. Whenever the investigation involved Extradition, the gathering of evidence in a foreign jurisdiction or was part of a Joint Police Force Operation [more than one police department participating], it was deemed to be a priority.

12) **The presence of travel requirements** – the number of trips to jurisdictions outside normal work-area to collect evidence.

13) **Other Unspecified Factors** – the investigators subjective evaluation of unspecified factors which complicate the investigative process and impede investigative progress.

2.4 Complexity:

A review of the literature reveals that "little consensus exists among researchers concerning properties that make a task complex" (Campbell, 1988). Campbell (1988) goes on to say that complexity has been examined primarily in three bodies of literature; Information Processing and Decision Making; Task and Job Design and; Goal Setting literature. He observed that the literature treats task complexity either as:

- 1) a personal psychological experience;
- 2) an interaction between task and personal characteristics or;
- 3) purely as a function of objective task characteristics.

In support of his observations, Campbell (1988) cites the work of Taylor (1981) and Hackman et. al. (1969–1986). While both Taylor & Hackman emphasized the importance of the psychological dimensions of the task, Campbell (1988) noted these researchers are concerned with the subjective reactions of individuals to a task, such as job enrichment factors, task challenge and task stimulation and arousal, rather than objective task characteristics.

Campbell (1988) also examined the work of March and Simon (1958) who "defined complexity in terms of the abilities of the task doer" (Campbell, 1988). They [March and Simon] suggested that complex tasks are characterized by unknown or uncertain alternatives and involve activities that cannot be subdivided into distinct sub-tasks suggesting that "tasks are more or less complex relative to the capabilities of the individual who performs the task" (ibid, 1988).

Campbell (1988) observed that March, Simon & Hackman et. al. were concerned with task difficulty and focused on the performers' familiarity or the experience with the task, their interest and capabilities and the cognitive demands placed on the person by the task itself. Campbell (1988) warns that task difficulty should not be confused with task complexity. While a task may be difficult, due to environmental constraints, the task process may be well known. As such it is not complex. Campbell (1988) summed up March, Simon and Hackman et. al. by suggesting that "complexity cannot be examined independently of short term memory, of attention span, computational efficiency, and so forth".

Schwab and Cummings (1976) saw complexity somewhat differently. They "defined task complexity purely in terms of objective task qualities" (ibid, 1988). Frost and Mahoney (1976) distinguished between tasks having prescribed activities [completely defined processes], as simple as those that have non-prescribed activities [incompletely defined processes with alternative outcomes], and defined them as complex tasks. Steinmann (1976) equated complexity with "the absolute amount of information involved in the task, the internal consistency of the information, and the variability and diversity of the information itself" (ibid, 1988).

Hammond (1986) attributes complexity to be a function of the physical way in which the information is presented to the task doer. Campbell (1988) concluded that since individuals are expected to generate their own response hierarchy and to test responses until an appropriate one is found, complexity is both a function of incompletely defined alternatives [i.e. task] and the response hierarchy of the task doer [i.e. individual].

Campbell (1988) noted that Frost, Mahoney, Steinmann and Hammond focused on the information relationships involved in the task and were primarily concerned with the rate, load, variability and diversity of information associated with the task, the number of conflicting sub-tasks and alternative outcomes or ends states for the task. Campbell (1988) concludes by proposing that complexity is "directly related to the task attributes that increase information load, diversity or rate of change" and imposes "high cognitive demands on the task doer" (ibid, 1988).

Campbell (1988) proposed a framework for analyzing the complexity of a task based on the presence or absence of four basic task characteristics:

- 1) Multiple Paths – the number of potential ways of a task doer can arrive at a desired outcome;**
- 2) Multiple Outcomes – the number of desirable outcomes that must be satisfied during the task process;**
- 3) Conflicting Interdependence Among Tasks – the number of negatively correlated and competing relationships that exist within a task processes and;**
- 4) Uncertain or Probabilistic Linkages – the inability of task doer to develop linkages between potential path activities and desired outcomes.**

Campbell (1988) suggests each type of task exhibits a different set of his four characteristics as depicted in Table 3.0 – Campbell's Taxonomy of Complexity. He suggests the greater the number and intensity of these four characteristics the more ill-structured the task and the greater its complexity.

He [Campbell] claims his analytical framework yields four basis types of tasks:

- 1) Decision Tasks;**
- 2) Judgement Tasks;**
- 3) Problems Tasks and;**
- 4) Fuzzy Tasks.**

Campbell's Taxonomy of Complexity

<u>Table 3.0</u>	Decision Task	Judgement Task	Problem Task	Fuzzy Task
Multiple Paths	X		X	X
Multiple Outcomes	X	X		X
Uncertain Probability Links		X	X	X
Conflicting Interdependencies			X	X

Although Campbell (1988) has yet to test his framework, it does provide a good theoretical framework for identifying the constructs that comprise complexity. The practical problem still remains: How do managers construct a model which can capture the essence of complexity?

2.5 Model Building:

The decision science and model building literature provides some insights into the construction of such models.

The problem facing Economic Crime Directorate managers concerned constructing a model that would satisfy these stakeholders while serving their own managerial needs. The scheme would have to capture the attributes of complexity and provide a mechanism to aggregate and categorize white collar crimes while preserving some level of descriptiveness. The scheme would also be required to incorporate the opinions and judgments of experts whose observations are indispensable to task understanding.

Oddly enough, what I have just described conforms very closely to the quality-adjusted productivity standards proposed by Scicluna & Foot (1981) recommended for measuring public sector productivity and approximates the goals of the Complexity Rating Concept as it was first conceived within the RCMP. Lastly, the model needs predictive qualities when considering resource requirements. Davis, Duane & Cosenza (1988) suggest that there are five basic reasons managers have for building business models:

- 1) Classification;
- 2) Description and Explanation;
- 3) Prediction;
- 4) Optimization and;
- 5) Control.

The objectives of the Complexity Rating Scheme were classification and prediction. Classification models are "synonymous with taxonomic models... they are used to categorize events, entities or data for the purposes of decision-making" (Davis, Duane & Cosenza, 1988).

Predictive models "answer a question: what will happen in the future" (ibid, 1988).

Davis, Duane & Cosenza (1988) have purported seven rules for developing models:

- 1) Specification – explicitly specify the decision problem;
- 2) Investigation – investigate the underlying decision process;
- 3) Validation Criteria – establish criteria to validate the model;
- 4) Development – develop the model;
- 5) Evaluation Criteria – evaluate the validity of the model;
- 6) Testing – test the model and;
- 7) Implementation – Develop implementation strategies.

Davis, Duane & Cosenza (1988) note that models are integral parts of the decision-making process in an organizations. They decrease uncertainty levels associated with a decision and provide the decision maker with an objective and rational course of action which should lead to better decision-making (ibid, 1988). Models are not without their drawbacks. Davis, Duane & Cosenza (1988) also observed that there is generally a trade-off between a model's complexity and its ease of implementation. Modelling the subjective perceptions of experts to arrive at a classification and prediction model which is both functional and practical is thus a daunting task. Saaty (1980) proposes a framework, the Analytic Hierarchy Process, to do exactly that.

The Analytic Hierarchy Process breaks a decision problem down into separate components using a systematic, hierarchial, pairwise comparison methodology, and applies mathematical procedures to synthesize a decision model. The focus of Saaty's process is to develop a model to address specific problems in planning and resource allocation through a technique called pairwise comparisons.

Saaty (1980) claims the Analytical Hierarchy Process model "provides a methodology for modelling unstructured problems in economic, social and management sciences" (Saaty, 1980), and it is a "framework which incorporates both philosophy and mathematics" (ibid, 1980) measuring both qualitative and quantitative elements of a decision problem. He quite aptly points out "decision problems have suffered from an overabundance of patent medicine techniques without any holistic cure" (ibid, 1980). These "patent medicine methodologies fail to approach decision problems in a systematic way, linking the structure and functions of a specific decision problems" (ibid, 1980).

Saaty (1980) suggests "we stop making simplistic assumptions to suit our quantitative models and deal with the complex situations they are" (ibid,1980). He proposes that decision problems, such as the one confronted by police managers, can be rendered down into hierarchies consisting of subsystems. He describes a hierarchy as "an abstraction of the structure of a system to study the functional interactions of its components and their impacts on the entire system" (ibid,1980).

Saaty (1980) points out that the "right conditions must exist for people to structure their problems". In fact what he is suggesting is that group participation is important to the successful application of the Analytical Hierarchy Process. He claims that "group interaction sharpens peoples' judgement skills and that bargaining among competing priorities" (ibid,1980) improves the quality of decision-making.

The concept of consistency and the degree to which judgements violate consistency is critical to the understanding of Saaty's (1980) methodology. Saaty's (1980) model measures the degree of consensus that can be achieved within the elements of a decision hierarchy. The degree of inconsistency, in terms of those judgements, alerts us to the degree to which we can expect the model's outcome to deviate from predicted outcomes. The mechanism Saaty (1980) uses to measure consistency is pairwise comparison and eigenvalue priority vectors. Pairwise comparison is a process of comparing one element within a hierarchy against another and assigning a measure of the strength and direction of their interrelationships.

Saaty (1980) developed a number of validating coefficients which measure the tendency of decisions to violate consistency. Saaty (1980) strives to "demonstrate that it is not whether we are inconsistent on particular comparisons that matters, but how strongly consistency is violated in a numerical sense in the overall problem being studied". This seems to suggest that Saaty's model is based on an underlying utility function which accommodates some inconsistency in preferences.

Other literature suggests that the Analytical Hierarchy Process, and schemes like it, are not representative of the real world decision process. It casts doubts that such a process can actually produce a scheme that properly capture human behaviour. It posits that any models that rely on rigid assumptions about preferences, are suspect.

This literature implies that "we [humans] construct, manage, suppress, confound, change and avoid our preferences" (March, 1988) and that rationality cannot be represented by utility functions. March (1988) in response to a paper by Simon (1987) reports other forms of rationality are equally plausible. Specifically, he [March] cites the concepts of limited rationality, contextual rationality, game rationality, process rationality, adaptive rationality, selected rationality and posterior rationality (March, 1988).

By design the Analytical Hierarchy Process is a normative decision analysis model, fashioned after Social Choice Models (Bell, Raiffa & Tversky, 1988). Such models "posit that if the decision agent prefers alternative A to alternative B, and prefers B to C, then they will also have a preference for A over C" [referred to as transitivity of preference] and that different presentations of the same choice problem, should yield the same set of preferences [referred to as invariance of preference] (Bell, Raiffa and Tversky, 1988). This logic set implies an underlying utility function. Evidence indicates that "people are often intransitive and there is a divergence between those normative conceptions of choice, that posits transitivity and observed behaviour" (Bell, Raiffa and Tversky, 1988). Tversky and Kahneman (1988) suggest the "failure of invariance is explained by the framing effect" (ibid, 1988) or how the choice is posed to a decision-maker.

Bell, Raiffa & Tversky (1988) also claim there is evidence that both of these assumptions are violated in the real world. Peterson and Beach (1967) agree and point out that "there are systematic discrepancies between normative and intuitive preferences".

Tversky & Kahneman (1988) observed that transitivity assumptions in a normative model are often relaxed "in order to retain its status as a descriptive model". Ostensibly, descriptive models concern themselves "with how and why people think and act the way they do" (Bell, Raiffa, Tversky, 1988).

Descriptive models are "highly empirical" (ibid, 1988) and "rewarding if the mathematical implications are profound or aesthetically pleasing" (ibid, 1988). Descriptive models are evaluated by their "empirical validity, that is, the extent to which they correspond to observed choices" (ibid, 1988) or reality. Tversky and Kahneman (1988) "argue that the deviations of actual behaviour from the normative model are too widespread to be ignored, too systematic to be dismissed as random error, and too fundamental to be accommodated by relaxing the normative system".

Despite this, Saaty (1980) claims descriptive properties for the Analytical Hierarchy Model as evidenced "by results that are mathematically consistent with reality" (Saaty, 1980). As observed by Tversky and Kahneman, to achieve descriptive properties, Saaty (1980) relaxed the normative precepts of his model. This relaxation is evident in Saaty's (1980) model as measured by Saaty's (1980) Validity Coefficient which accommodates and measures how often transitivity is violated. Saaty (1980) mutes his critics and argues convincingly that it is possible to actually measure the intensity of the intransitivity preference and how consistently preferences are maintained.

Saaty proposes that it is possible to model the preferences of experts, recognizing that group judgements are based on a subjective social experience and fraught with a great many influences that could render the model ineffective. Controlling for these influences would make the Analytical Hierarchy Process workable. Not surprisingly, organizational characteristics and structure are a potential threat to the viability of the Analytical Hierarchy Process. The conflicting goals of actors within the bureaucracy show little tendency for consistency. While this complicates the establishment of preferences and judgments it does not preclude it.

Predicting the time required to investigate a white collar crime is quite a different of problem which may require an entirely different modelling technique. Makridakis & Wheelwright (1978) would have described the predictive attributes of the Complexity Rating Scheme as a "formal quantitative model" relying on the statistical principles associated to the Regression [Causal] Model. Causal models assume "that the factor to be forecast exhibits a cause-effect relationship with one or more independent variables" (Makridakis & Wheelwright, 1978). They go on to point out that forecasting is not without its risks. Errors in one set of projections can trigger a series of subsidiary errors in other areas of the organization which rely on them (i.e. errors in budgets and the hiring of personnel). They outline three conditions for successful predictions:

- 1, there is information about the past;
- 2) this information can be quantified in the form of data and;
- 3) the assumption of constancy, that is the patterns of the past will continue.

Finally, they [Makridakis & Wheelwright] suggest that forecasting requires unprecedented ability to predict uncertainty and suggest that "causal models can be used with great success in policy and decision making". They consider causal models to be "geared towards intervention, influencing the future through decisions made today" a concept that is evident in the Complexity Rating Scheme. In closing this literature suggests that inappropriately designed model are fraught with risks that extend beyond the boundaries of the problem being modeled.

3.0 Research Methodology:

This chapter details the methodology used in this research. It is presented in four parts: the first section describes research design; the second, describes operational procedures used to collect data; the third describes the data collection process and sample selection procedures and; the fourth outlines the analytical techniques to be used in the research.

3.1 Research Design:

The researcher obtained the data for this study from the RCMP's Economic Crime Directorate. The collection processes and procedures used in gathering the data for this research was sufficiently rigorous to permit the researcher to address the questions posed by Economic Crime Directorate's managers.

3.2 Operational Procedures:

At any one given time approximately 2,000 white collar crimes investigations are actively being pursued by the RCMP's Commercial Crime personnel. Economic Crime Directorate targeted fifteen percent of these for sampling. After investigations were completed, the data for each white collar crime was collected from three sources:

- 1) the Complexity Rating Data was collected from the Complexity Rating Work-sheets in the working file;
- 2) investigative time expended on an investigation was derived from the time logs associated to the working file and;
- 3) the absolute value of complicating factors was catalogued from notes on the working file.

Eventually the data associated with 284 white collar crimes investigations was collected. This information was then aggregated into a single data set for analysis.

3.3 Data Collection:

Data collection was directed by the administrative section of the Economic Crime Directorate as was the choice of the Sampling Elements, Sampling Units and Time Frame. The sampling procedure was one of convenience, the result of budgetary constraints. The Sampling Elements included all members of the Royal Canadian Mounted Police Commercial Crime Sections across Canada. Sampling Units consisted of six major [units with an investigative staff of sixteen or more persons] and six smaller units [units with an investigative staff of 15 persons or less].

3.4 Analytical Design:

To address the two original research questions posed by managers of Economic Crime Directorate, confirmatory analysis was employed. The objective was to evaluate the utility of the Complexity Rating Scheme as a managerial tool. To do this, Simple Regression was used to confirm if a predictive or causal relationship existed between Investigative Time and the Complexity Rating Score. Reliability Analysis was then used to establish if the measurement instrument, the Complexity Rating Work-Sheet and the resulting score it yielded, is a reliable mechanism to classify white collar crimes. The next logical step in this research was to extend the analysis beyond the two original research questions: to ascertain whether or not the Complexity Rating Scheme performance as a human resource predictive model can be improved.

3.5 Extrinsic Variables:

The literature reveals that complexity is not associated with task difficulty or environmental constraints. Rather, it is directly related to the cognitive demands and skills of the task and the amount of training and experience possessed by the performer. It suggests complexity is related to the linkages that exist between task elements and its goals, the information processing demands of the task and the cognitive demands of the task. These observations are supported by the work of Campbell (1988), March and Simon (1958), Frost and Mahoney (1976), Hammond (1986), Schwab and Cummings (1976) and Steinmann (1976) who have all contributed to the literature on complexity. Only a few of these variables were either measured or controlled for by the complexity Rating Scheme and this reduces the likelihood that the model will yield consistent results.

4.0 The Analysis:

The analysis was performed in two parts using SPSS for Windows Version 1.0 (1992) supplemented by Statsgraphics Version 5.0 (1991). Confirmatory analysis yielded the answer to the two original research questions:

- 1) Is the relationship between the time required to investigate a crime and the Complexity Rating Score the basis for a human resource prediction model?
- 2) Is the Complexity Rating Scheme a reliable White Collar Crime Classification model?

The objective of this study was to evaluate the utility of the Complexity Rating Scheme as a managerial tool in the same context as it was used by the business managers. Farrar & Glauber (1967) describe the Regression Model as "an old and trusted friend, tried and true" for economists and decision-makers alike. Therefore to examine this relationship Simple Regression was used to establish the nature of the relationship between investigative time [hereafter referred to as INV_HRS] and the Complexity Rating Score. Reliability Analysis then established whether the measurement instrument, the Complexity Rating Work-Sheet and the score yielded, is a reliable mechanism to classify the complexity of white collar crimes. The expected results, of the confirmatory analysis were:

- 1) That the Complexity Rating Scheme is not a valid predictive model for White Collar Crime Investigations and;
- 2) That the Complexity Rating Scheme does not consistently classify white collar crimes.

Principal Component Factor Analysis and Multiple Regression were used to extend the analysis beyond the original research questions and explore whether the Complexity Rating Scheme's performance as a human resource predictive model can be enhanced.

As outlined Regression Analysis was the primary statistical tool used in this analysis.

For this research, two basic forms of Regression Equations were used:

- 1) Simple Regression^{Confirmatory} – $Y = a + Bx$ and;
- 2) Multiple Regression^{Exploratory} – $Y = a + b_1X_1 + b_2X_2 + \dots + b_nX_n$.

where a and b are constants and a is the point at which the line intercepts the Y axis and b is the slope of the line. Analysis involves fitting a Least Squared Regression Line to the observed values of INV_HRS expended per investigation in relation to their Complexity Rating Score. The two functional forms of the regression equations that were fitted to the observations were:

- 1) Investigative Time^{Confirmatory} = $Y^{\text{intercept}} + (\text{slope}) (\text{Complexity Rating Score}) + \text{Error}$ and;
- 2) Investigative Time^{Exploratory} = $Y^{\text{intercept}} + (\text{slope}) (\text{Principal Component Complicating Factors}_n) + \text{Error}$.

Makridakis & Wheelwright (1978) note that characteristics associated to the unexplained error of the regression line fit is critical to the interpretation of regression results. Collectively, the unexplained error represents all factors not included, measured or controlled for in the model. The unexplained error manifests itself in the form of residuals. Residuals are that portion of the model's dependent variable that do not fit within parameters of the least squared regression line.

As such, their distribution and properties are very important in estimating the characteristics of the unexplained error and assessing the applicability of regression techniques. Makridakis & Wheelwright (1978) suggest that before Regression Analysis can be fully leveraged as a business tool the:

- 1) unexplained error should, like the universe should be normally distributed;
- 2) the mean value of the unexplained error should be equal to zero – on average the unexplained error should tend to cancel itself out, thus having a minimal effect on the model;
- 3) the variance unexplained error should be constant – the magnitude of the error should not increase or decrease within the observed range and;
- 4) the unexplained error of independent variable Y should be randomly distributed.

Stevens (1986) observed that the Studentized Residual is particularly well suited for assessing potential problems with regression modelling. He goes on to suggest that the Studentized Residual reflects more precisely the differences in the true error variances from point to point than the Standardized Residual. He notes that "any systematic pattern or clustering of the Studentized Residuals suggests a model violation" (ibid, 1986). Thus a visual inspection of Studentized Residuals plot was used to determine whether the residuals exhibit any peculiar characteristics.

In the absence of any peculiarities it was assumed that the unexplained error satisfied the requirements for successful regression analysis.

If the plot of the residuals exhibited unusual characteristics, tests were performed to quantify the two of the possible sources of bias associated to regression techniques Auto-correlation and Multi-collinearity.

Regression analysis is premised on the absence of Auto-Correlation which stems from strong trends in the data (Makridakis & Wheelwright, 1978). Makridakis & Wheelwright (1978) recommend a Durbin-Watson test to establish whether or not auto-correlation is an impediment to meaningful analysis. The test reports the extent of serial correlation among the residuals. If no serial correlation is observed, the Durbin-Watson statistic can be expected to be 2. Values close to 0 indicate positive auto-correlation, values close to 4 indicate negative auto-correlation.

The other potential source of bias in regression analysis, Multi-collinearity, results when two or more independent variables are highly correlated. Makridakis & Wheelwright (1978) warn that where Multi-collinearity exists "regression results can be highly erroneous" (Makridakis & Wheelwright, 1978).

That sentiment is echoed by Farrar & Glauber (1967) who point out the purpose of the regression model is to test dependency, not interdependency. Multi-collinearity is exposed by an examination of a Correlation Matrix of the independent variables. Items which exhibit an inter-item correlation of .7 or greater are considered to be collinear and a potential threat to regression analysis (ibid, 1978).

Erickson and Nosanchuk (1977) suggest three statistics, commonly associated with regression modelling, are valid means to test the strength of the linear relationship between Investigative Time, principal Complexity Factors and Complexity Rating Score:

- 1) the Pearson Product Moment Correlation Coefficient (*denoted as Multiple R*) – a scale-free interrelatedness of the Complexity Rating Score and investigative time or its proxy;
- 2) the Coefficient of Determination (*PPMC²*) sometimes referred to as *R Squared (denoted as r^2)* – the proportion of variance in investigative time or its proxy that can be associated with the change in the Complexity Rating Score and;
- 3) The *Unexplained Error* of the regression model, $(1 - r^2)$.

In addition to examining the descriptive statistics associated with the dependent variables, Erickson and Nosanchuk go on to suggest ways to test the utility of the model by performing:

A) a test (*t-test*) to determine if the values of the Regression Coefficients b_n (the slope of the Regression Line) are significantly different than 0 or whether their values are simply due to chance and;

B) a test (*F-test*) to determine if the Coefficient of Determination (r^2) is significant or simply due to chance. Alternately, it can be described as a test (*F-test*) to determine the **usefulness of the predictors or the goodness of fit** of regression line, $Y = a + b_1X_1 + b_2X_2 + \dots + b_nX_n$ or $Y = a + Bx$, is significant or is simply due to chance.

4.1 Confirmatory Analysis – Simple Regression:

The successful application of the regression techniques assumes the dependent variable is Normally Distributed. A Normal Probability Plot of INV_HRS can be found on Figure 1.0 [page 56]. It revealed the observations are not normally distributed. Using Statsgraphics' Version 5.0 (1991) distribution fitting utility, the distribution was identified as a Lognormal distribution. An examination of the descriptive statistics associated with INV_HRS, depicted on Table 4.0 [page 57] revealed two observations of note, a positive skewness 10.165 and kurtosis of 124.139.

Skewness reveals the symmetry of a distribution. A distribution with a significant positive skewness has a long right tail while a distribution with a significant negative skewness has a long left tail. Specifically, it indicates whether or not the tail of the distribution is skewed or extends to the left or right. A normal distribution is symmetric, and has a skewness value of zero. Skewness is used, along with the kurtosis statistic, to assess if a variable is normally distributed.

Kurtosis is a measure of the extent to which observations are clustered in the tails. For a normal distribution, the value of the kurtosis statistic is 0. If a variable has a negative kurtosis, its distribution has lighter tails than a normal distribution. If a variable has a positive kurtosis, a larger proportion of cases fall into the tails of the distribution than into those of a normal distribution.

Normal Probability Plot of INV_HRS

Figure 1.0

Descriptive Statistics

Statistic	INV_HRS
Mean	242.771
S. E. Mean	69.168
Std. Deviation	1165.638
Variance	1358712
<i>Kurtosis</i>	124.139
S. E. Kurtosis	0.288
<i>Skewness</i>	10.165
S. E. Skewness	0.145
Minimum	1
Maximum	16000
# Observations	284
# Outliers	4
# Influential Observations Cooks-D > 1.0	
	1
<i>Distribution</i>	<i>Lognormal</i>

Table 4.0

Stevens (1986) observed that regression analysis is very sensitive to data points that are different from the rest of the observations. He recommends identifying outlier and influential data points before undertaking regression analysis.

A more thorough examination of the characteristics of INV_HRS, using SPSS's BoxPlot indicated the presence of 4 Outliers. To determine if the outliers were distorting the distribution's characteristics, Cook's Distance was calculated for each observation. This exposed one outlier [i.e. Cook's Distance greater than 1.0] that had the potential to materially affect the distribution's characteristics. Steven (1986) suggests that influential outliers, can at the option of the researcher, and with caution, be removed from the analysis. Because this one observation is unique, as compared with its counterparts [i.e. the scope of the investigation transcended the bounds of what is commonly referred to as a White Collar Crime and exhibited unique characteristics] it was excluded from the analysis. A recalculation of descriptive statistics with the influential outlier removed can be found on Table 4.1 [page 59].

It resulted in diminished Skewness and Kurtosis. Collectively these descriptive statistics suggest that the distribution remains positively skewed with a large proportion of observations in the tails. Despite obvious impediments to successful regression analysis, a regression line was plotted through the distribution of INV_HRS in the same way the developers of the Complexity Rating Scheme had intended. For them, it was a simply a matter of applying this simple relationship regardless of any regression model violations.

Descriptive Statistics

Statistic	INV_HRS Influentials Removed
Mean	187.092
S. E. Mean	41.182
Std. Deviation	692.789
Variance	479957.3
<i>Kurtosis</i>	52.587
S. E. Kurtosis	0.289
<i>Skewness</i>	6.813
S. E. Skewness	0.145
Minimum	1
Maximum	7100
# Observations	283
# Outliers	n/a
# Influential Observations Cooks-D > 1.0	n/a
<i>Distribution</i>	<i>Lognormal</i>

Table 4.1

Regression Results

Statistic	Simple Regression
Multiple R	0.3929
R-Squared	0.15437
<i>Unexplained Error</i>	<i>0.84563</i>
Adjusted R-Squared	0.15138
Durban-Watson	1.90766
Goodness of Fit	F=51.29 Significance=.0000
Significance of Regression Coefficients t-test	Constant t= 7.16 Significance=.0000
Complexity Rating Score [CRS]	t=-3.810 Significance=.0002
Mean Studentized Residual	0.0004
<i>Do Residuals Reveal Violation of Model</i>	<i>Yes</i>

Table 5.0

Using the Simple Regression equation: $INV_HRS^{Confirmatory} = Y^{intercept} + (slope) (Complexity\ Rating\ Score) + Error$, the strength of the relationship between INV_HRS and Complexity Rating Score was explored. The results are summarized on Table 5.0 [page 60]. They revealed a number of interesting findings. Specifically, a Durbin-Watson Statistic of 1.90766 was calculated indicating the absence of serial correlation among regression residuals. Of particular note are: the Model fit statistics; Multiple R, r^2 and the Unexplained Error. They revealed:

- 1) a **Multiple R** of .3929 indicating that a correlation does exist between INV_HRS and Complexity Rating Score;
- 2) a r^2 of .15437 indicating that about 15% of the variation observed in INV_HRS is associated to the changes in the Complexity Rating Score and;
- 3) an **Unexplained Error** of .84563 suggesting that about 85% of the variation in INV_HRS is not accounted for by the model.

To determine the utility or fit of the regression equation to the observed values of the dependent variables, significance testing was performed on the equation's Regression Coefficients, the Constant and the Coefficient of Determination [r^2]. This revealed:

- a) a Regression Coefficient [b] of 225.697 for Complexity Rating Score. A *t-test* for the Regression Coefficient of Complexity Rating Score, resulted in a *t* score equal to 7.16 with a Significance of .0000, at a .95 Confidence Level. This indicates that the value of the regression coefficient in the equation is not simply a matter of chance and;

b) a Constant [a] of -293.810 for the equation was calculated. A t -test for the Constant, resulted in a t score equal to -3.810 with a Significance of .0002, at a .95 Confidence Level. This indicates that the value of the constant in the equation is significantly different than zero and not simply a matter of chance.

c) a F -test statistic of 51.29 for the fit of the regression line was calculated. This suggests that the value of r^2 is significantly different than zero and that relationship [or fit] between the Dependent and Independent variable is not simply a matter of chance.

Based on these calculations the confirmatory Simple Regression Equation can be written as:

$$\text{INV_HRS} = -293.81^{\text{Intercept}} + (225.697) (\text{Complexity Rating Score}) + .85\%^{\text{Error}}$$

Lastly, of most importance is the examination of residuals associated to the fitted regression line. As noted, a residual is the difference between the actual value of the dependent variable and the value predicted by the model. They are the differences between observed values of a series and values predicted by a model. When plotted, the Studentized Residuals should not exhibit any recognizable pattern. Rather, they should be randomly distributed. Observe Figures 2.0 [page 63] and 2.1 [page 64]. In particular note the clustering of the residuals in Figure 2.0 and the absence of normality in the Studentized Residual derived from the confirmatory analysis. These results indicate a possible underlying pattern in the residuals and represents a violation of the regression model.

Simple Regression – Studentized Residuals

Normal Probability Plot of Studentized Residuals

Simple Regression INV_HRS

Figure 2.1

Summary:

Davis & Cosenza suggest that models with an Unexplained Error in excess of 30% are not useful as business tools. The error associated with the Complexity Rating Scheme exceeds that criteria. Findings suggest that about 85% of the variation in the time expended on white collar crimes is not associated with changes in the Complexity Rating Score. Only 15% of the variance in INV_HRS is attributable to the change in the Complexity Rating Score.

Secondly, there are major violations of the Regression Model as evidenced by the unusual distributions of regression residuals. So, while the relationship between investigative time and the Complexity Rating Score is substantiated in gross terms, the predictive capacity of the Complexity Rating Scheme is dubious.

4.2 Confirmatory Analysis – Reliability Analysis:

Reliability analysis was used to determine if the Complexity Rating Scheme is a reliable tool for classifying White Collar Crime investigations. Carmines & Zeller (1985) present a concise discussion of Reliability Analysis. They suggest that Reliability Analysis is "the first step to understanding the complex issues of measurement in any theoretical and applied research settings" (Carmines & Zeller, 1985). Measurement is described as the assignment of numbers to objects according to a set of rules which link abstract concepts to empirical indicators. It involves both theoretical and empirical considerations.

When the relationship is strong, analysis can lead to useful inferences amongst underlying concepts. Conversely, when it is weak, it leads to misleading conclusions and fails to yield any greater understanding of the phenomenon. The measurement process is dependent on two concepts, validity and reliability. Validity "concerns itself with the crucial relationship between concept and indicator" (ibid, 1985).

Of particular importance is the concept of construct validity or the "extent to which a particular measure relates to other measures consistent with the theoretically derived hypotheses concerning the concepts being measured" (ibid, 1985). The validity of the Complexity Rating Scheme will be empirically tested using regression techniques as outlined in Chapter 4 of this paper. Reliability on the other hand "is the extent to which an experiment, test, or any measuring procedure yields the same results on repeated trials" (ibid, 1985) or how consistently it represents the abstract phenomenon (ibid, 1985). The question is does the Complexity Rating Aggregation Scheme consistently classify white collar crimes.

Carmines & Zeller, 1985 suggest a testing for Internal Consistency to establish the reliability of a measurement scheme. One such reliability coefficient is Cronbach's Alpha which is referred to as a measure of internal consistency. It could be considered as an "estimate of expected correlation of one test with an alternate form containing the same number of items" (ibid, 1985). It focuses on the inter-correlation amongst items in the system and provides a "conservative measure of a measurements reliability" (ibid, 1985).

The process involves the calculation of the reliability coefficient and statistics commonly associated with it. The reliability coefficient is based on internal consistency of items within a test. It ranges in value from 0 to 1. A negative value for alpha indicates that items on the scale are negatively correlated and the reliability model is inappropriate. Table 6.0 [page 68] outlines the findings of the Reliability Analysis. Of particular note is the value of Alpha of .6540 and Standardized item Alpha of .7893.

Summary:

These findings seem to suggest that the Complexity Rating Scheme is moderately reliable in terms of its aggregation scheme. Campbell et al. provide evidence that complexity is a multi-dimensional and multi-attribute phenomenon composed of activity, skills, cognitive capacity, and information attributes. Few of these factors are controlled or measured for by the Complexity Rating Scheme. Thus while the aggregation scheme is internally consistent, it is not externally representative of the abstract phenomenon of complexity.

Reliability Analysis - Item Total Statistics

Results - Alpha .6540 Standardized Alpha .7893

Variable	Scale Mean - Item Deleted	Alpha - Item Deleted
Analysis	5.5964	0.5777
Legal Challenges	7.1607	0.5998
Charged	6.6857	0.5883
Entities	5.7	0.5835
Interviews	4.7679	0.6016
Other	6.9071	0.5955
Priority	7.1357	0.6041
Searches	6.8464	0.573
Sensitivity	7.1923	0.6115
Travel	7.0536	0.5981
Privacy	7.1607	0.5998
Under Cover	7.1607	0.5998
Informants	7.1607	0.5998

Table 6.0

4.3 Extending the Research – Principal Component Factor Analysis

Stevens (1986) suggests that when a researcher is confronted with a large number of independent variables, all of which are believed to contribute something to the system under study, that Principal Component Factor Analysis constitutes a means of identifying the underlying constructs that contribute the greatest proportion of the variance in the system. He [Stevens] describes Principal Component Analysis as "a mathematical maximization procedure, where each successive component accounts for the maximum amount of the variance that is left" (ibid, 1986). Through this process, the most influential components in the system are transformed into a new set of un-correlated variables called factor loadings. Because factor loadings are un-correlated, the problem of collinearity in regression modelling is eliminated.

Duntelman (1989) describes Principal Components Analysis as a means of reducing a system to a set of coherent variables that are linear combinations of the originals. The process reduces the original set of variables to a smaller set that represents most of the information contained in the original set. This suggests the process enhances our understanding of the data's structure and characteristics. He reports that Principal Component Analysis has no underlying statistical model. Rather, it is a mathematical process. When vectors are rotated, it cancels the effect of multi-collinearity by producing a set of un-correlated vectors (Duntelman, 1989). Duntelman (1989) suggests that the first principal component is the line with the closest fit to the cluster of data points. The second is the principal component closest to the residuals of the first line.

In effect, Principal Component Analysis breaks the total variance of a system down into separate components. When complete, the first two components identified generally account for a substantial proportion of the variance (Dunteman, 1989).

The actual process itself is quite straight-forward. First, a Correlation Matrix of the independent variables is calculated. Then eigenvalues are calculated for each of the variables. Then the eigenvalue are rank-ordered on a Factor Matrix. All factors with an eigenvalue greater than 1 remain, while all others are eliminated in the process known as factor extraction.

Before the factor extraction process can begin, Makridakis & Wheelwright (1978) recommend the removal of variables that exhibit high inter-item correlations. They [Makridakis & Wheelwright] suggest the collinearity problem can be mitigated by removing the independent variables that exhibit an inter-item correlation of .7 or greater. Observe the high degree of correlation between Informants, Privacy, Under Cover and Legal Challenges on Table 7.0 [page 71].

As a consequence, Informants, Privacy and Under Cover were dropped from the list of candidate variables for factor analysis. Table 7.1 [page 72] is a revised Correlation Matrix with the three highly correlated independent variables removed. The remaining variables constituted the independent variables that were used in the subsequence analysis.

Correlation Matrix

Variable	Analysis	Charged	Entities	Interviews	Informants	Other	Priority	Privacy	Searches	Sensitivity	Travel	Under Cover	Legal Challenges
Analysis	1												
Charged	0.0418	1											
Entities	0.3863	0.0064	1										
Interviews	0.3539	0.214	0.2069	1									
Informants	0.445	0.1175	0.0175	0.0098	1								
Other	0.2708	0.0644	0.2883	0.0777	0.1693	1							
Priority	0.1858	-0.0214	0.2768	0.0985	0.1213	0.1659	1						
Privacy	0.0445	0.1175	0.0175	0.0098	1	0.1693	0.1213	1					
Searches	0.0249	0.3962	0.0873	0.2461	0.2058	0.0361	0.1305	0.2058	1				
Sensitivity	0.0284	0.0572	0.0828	0.0159	0.2165	0.0869	0.2688	0.2165	0.3474	1			
Travel	-0.067	0.3162	0.0927	0.1949	0.1261	0.0564	-0.0112	0.1261	0.3163	0.0159	1		
Under Cover	0.0445	0.1175	0.0175	0.0098	1	0.1693	0.1213	1	0.2058	0.2165	0.1261	1	
Legal Challenges	0.0445	0.1175	0.0175	0.0098	1	0.1693	0.1213	1	0.2058	0.2165	0.1261	1	1

Table 7.0

Revised Correlation Matrix

Variable	Analysis	Legal Challenges	Charged	Entities	Interviews	Other	Priority	Searches	Sensitivity	Travel
Analysis	1									
Legal Challenges	0.09174	1								
Charged	0.07142	0.19549	1							
Entities	0.39175	0.04803	0.06573	1						
Interviews	0.35713	0.07164	0.2289	0.21089	1					
Other	0.27308	0.14309	0.08265	0.29903	0.0746	1				
Priority	0.15166	0.18764	0.00998	0.25745	0.11872	0.14144	1			
Searches	0.0417	0.29725	0.44468	0.11885	0.26611	0.0424	0.1816	1		
Sensitivity	-0.00976	0.33148	0.10654	0.06489	0.06357	0.04351	0.36902	0.40132	1	
Travel	-0.05741	0.19526	0.29844	0.07835	0.21349	0.03645	0.04146	0.31442	0.11254	1

Table 7.1

To assess the viability of this type of factor analysis, the Kaiser–Meyer–Olkin statistic of Sampling Adequacy was calculated. It is an index for comparing the magnitudes of the observed correlation coefficients to the partial correlation coefficients. If the sum of the squared partial correlation coefficients between all pairs of variables is small when compared to the sum of the squared correlation coefficients, the statistic is close to 1.

Small values indicate that a factor analysis may not be a good idea, since correlations between pairs of variables cannot be explained by the other variables. SPSS (1999) suggest that values for the Kaiser–Meyer–Olkin "statistic in the 0.90's as marvellous, in the 0.80's as meritorious, in the 0.70's as middling, in the 0.60's as mediocre, in the 0.50's as miserable, and below 0.50 as unacceptable" (SPSS, 1992). The result was a Kaiser–Meyer–Olkin of .67647 indicating the candidate list of factors are moderately suited to this form of factor analysis.

Factor extraction process revealed three factors which account for the majority of variance amongst the remaining Complexity Rating Scheme's variables. Table 7.2 [page 74] represents the eigenvalue associated with the remaining variables. A Scree plot of the variance associated with each factor is presented in Figure 3.0 [page 75]. It can be used to determine how many factors should be retained for analysis. Typically, the plot shows a distinct break between the steep slope of the large factors and the gradual trailing of the rest (the scree). Stevens (1986) recommends all eigenvalues greater 1.0 be retained for use in calculating the Factor Matrix.

Factor Analysis – Scree Plot

Factor Number

Figure 3.0

Factor Extraction - Principal Component

Variable	Factor #	Eigenvalue	Percent of Variance	Cumulative Percent
<i>Analysis</i>	1	2.53739	25.4	25.4
<i>Legal Challenges</i>	2	1.52036	16.2	41.6
<i>Charged</i>	3	1.28337	12.8	54.4
Entities	4	0.93044	9.3	63.7
Interviews	5	0.79832	8	71.7
Other	6	0.7271	7.3	79
Priority	7	0.62202	6.2	85.2
Searches	8	0.58145	5.8	91
Sensitivity	9	0.47179	4.7	95.7
Travel	10	0.42777	4.3	100

Table 7.2

Factor Matrix

Variables	Factor 1	Factor 2	Factor 3
Searches	0.69412	-39713	-0.08102
Charged	0.53175	-30620	-0.45118
Legal Challenges	0.52845	-23851	0.27572
Interviews	0.52085	20625	-0.43804
Travel	0.45775	-36467	-0.35835
Analysis	0.40366	0.67499	-0.14965
Entities	0.46271	0.58349	0.00683
Other Factors	0.35384	0.47315	0.07088
Priority	0.47951	0.15626	0.57528
Sensitivity	0.5297	-0.30353	0.56438

Table 7.3

Rotated Factor Matrix - Varimax Method

Variables	Factor 1	Factor 2	Factor 3
Searches	0.75906	0.04779	0.04027
Charged	0.67938	-0.04849	0.08378
Interviews	0.67003	0.01645	0.44369
Travel	0.51639	0.48104	-0.08746
Analysis	0.05209	0.79709	-0.05356
Entities	0.0319	0.73346	0.12501
Other Factors	-0.02889	0.5778	0.13933
Priority	0.11743	-0.0472	0.82172
Sensitivity	-0.12552	0.32124	0.68289
Legal Challenges	0.26945	0.03535	0.58165

Table 7.4

Transformation Matrix

Variable Descriptions	Factor 1	Factor 2	Factor 3	New Variable Name
Factor 1 - Activity	<i>0.63791</i>	0.50386	0.58241	FAC1_1
Factor 2 - Cognitive	-0.44384	<i>0.85857</i>	-0.25663	FAC2_2
Factor 3 - Subjective	-0.62934	-0.09479	<i>0.77132</i>	FAC3_3

Table 7.5

In the Factor Matrix each row corresponds to an observed variable and each column corresponds to a common factor. Each row contains the coefficients used to express the standardized observed variable in terms of the factors. These coefficients are called factor loadings. Rows with large coefficients (in absolute terms) for a given variable are closely related to the parent factor. As such it is often referred to as a factor pattern matrix. Table 7.3 [page 76] depicts the Factor Matrix for the factors selected.

Stevens (1986) recommends rotating the Factor Matrix to help interpret the results. He suggests that rotation "essentially reallocates the loadings" and produces a more coherent set of factors (Stevens, 1986). This Factor Matrix was the rotated [varimax method] to reveal the Rotated Factor Matrix Table 7.4 [page 77] and the Factor Transformation Matrix Table 7.5 [page 78]. Based on this, SPSS created three new variables representative of each factor: 1) Fac1_1, Fac2_1 and Fac3_1. Intuitively, these factors fall into three categories: 1) Fac1_1 – Activities; 2) Fac2_1 – the Cognitive Demands of the Task and; 3) Fac3_1 – the Subjective perceptions of the investigator. They will be used in place of the Complexity Rating Score as the independent variables in the balance of the multiple regression analysis.

4.4 Exploratory Analysis – Multiple Regression:

Using the Multiple Regression equation $INV_HRS^{Exploratory} = Y^{intercept} + (slope) (Principal Component Complicating Factors) + Error$, the strength of the relationship between INV HRS and the three contributing factors was explored. The analysis revealed a Durbin–Watson Statistic of 1.94433. This indicates the absence of auto–correlation amongst the regression residuals. Of particular note are: the Model fit statistics which include Multiple R, r^2 and the Unexplained Error. The results are summarized on Table 8.0 [page 80].

Regression Results

Statistic	Multiple Regression
Multiple R	0.61271
R-Squared	0.37542
<i>Unexplained Error</i>	0.62458
Adjusted R-Squared	0.53055
Durban-Watson	1.94433
Goodness of Fit	F=56.10015 Significance=.0000
Significance of Regression Coefficients t-test	Constant t=4.418 Significance=.0000
Factor 1 - Activity	t=6.441 Significance=.0000
Factor 2 - Cognitive	t=-.751 Significance=.4535
Factor 3 - Subjective	t=11.236 Significance=.0000
Mean Studentized Residual	0.001
Do Residuals Reveal Violation of Model	Yes

Table 8.0

They revealed:

- 1) a **Multiple R** of .61271 indicating that a moderate correlation exist between the dependent and independent variable;
- 2) a r^2 of .37542 indicating that about 38% of the variation observed in INV_HRS is associated to the changes in the Complexity Rating Score and;
- 3) an **Unexplained Error** of .62458 suggesting that about 62% of the variation in INV_HRS is not accounted for by the model.

To determine the utility or fit of the regression equation to the observations the regression coefficients were calculated and significance testing was performed on the Regression Coefficients and the Coefficient of Determination R-Squared [r^2]. This revealed:

a) three Regression Coefficients [b]:

- 1) for Fac3_1 of 618.5703. A *t-test* for resulted in a *t* score equal to 11.236 with a Significance of .0000, at a Confidence level of .95, indicating the value of the regression coefficient in the equation is not simply a matter of chance;
- 2) for Fac2_1 of - 42.3221 a *t-test* for resulted in a *t* score equal to -.751 with a Significance of .4543, at a Confidence level of .95. This indicates that the value of the regression coefficient in the equation is due to chance not any underlying relationship and;
- 3) for Fac1_1 of 354.6115 a *t-test* for resulted in a *t* score equal to 6.441 with a Significance of .0000, at a Confidence level of .95. This indicates the value of the regression coefficient in the equation is not simply a matter of chance.

b) a Constant [a] of 242.7711 for the equations was calculated. A *t*-test of the Constant resulted in a *t* score equal to 4.418 with a Significance of .0000, at a Confidence level of .95. This indicates the value of the constant in the equation is significantly different than zero and not simply a matter of chance.

c) a *F*-test statistic of 56.10015 for the fit of the regression line was calculated. This suggests that the value of r^2 is significantly different than zero and that relationship [or fit] between the Dependent and Independent variable is not simply a matter of chance.

Based on these calculations the Exploratory Regression Equation can be written as:

$$\text{INV_HRS} = 242.77 + (354.61) (\text{FAC3_1}) + (-41.32) (\text{FAC2_1}) + (618.57) (\text{FAC3_1}) + 62\% \text{ Error.}$$

Lastly, there is the examination of the Studentized Residuals associated to the fitted regression line. A residual is the difference between the actual value of the dependent variable and the value predicted by the model. They are the differences between observed values of a series and values predicted by a model. When plotted, the Studentized Residuals should not exhibit any recognizable pattern, rather they should be randomly distributed. Observe the plot of the residuals on Figure 4.0 [page 83]. In particular, note the clustering of the Studentized Residuals. This indicates a possible underlying pattern in the residuals and a model violation.

Multiple Regression – Studentized Residuals

Figure 4.0

Summary:

Davis & Cosenza suggest that models with an Unexplained Error in excess of 30% are not useful as business tools. The error associated with the exploratory analysis exceeds that criteria. In summary, these findings indicate that while there is a linear relationship of some description between INV_HRS and the three factors, however, neither is it the basis for a predictive model. About 38% of the variance in INV_HRS is attributable to the change in the three factors. Secondly, there are major violations of the Regression Model as evidenced by the unusual distributions of the regression residuals. Of particular note is the t-test for the Regression Coefficient Fac2_1. It suggests that the fit of this factor to the observations of INV_HRS is simply a matter of chance.

4.5 Transformation of the Dependent Variable:

The authors of the SPSS Manual (1992) observe that when there is evidence of model violations remedial action in the form of a transformation of the dependent variable can bring clarity to the analysis. They note that positively skewed distributions respond favourably to logarithmic transformations. This sentiment is echoed by Erickson & Nosanchuk (1977) who suggest the transformation of the variable, INV_HRS to a logarithmic value, would result in a new variable, LOGINV_H, which would exhibit normality and serve as a proxy for INV_HRS for the purposes of analysis. To this end, the dependent variable was transformed by SPSS to produce a new variable LOGINV_H which will serve as the proxy for INV_HRS for the balance of the analysis. A Normal Probability Plot was made of the transformed variable. Figure 5.0 [page 85] reveals that LOGINV_H approximates a normal distribution.

Normal Probability Plot of LOGINV_H

Observed Value

Figure 5.0

Descriptive Statistics

Statistic	LOGINV_H
Mean	1.441
S. E. Mean	0.049
Std. Deviation	0.831
Variance	0.691
<i>Kurtosis</i>	<i>0.074</i>
S. E. Kurtosis	0.288
<i>Skewness</i>	<i>0.372</i>
S. E. Skewness	0.145
Minimum	0
Maximum	4.204
# Observations	284
Distribution	Normal

Table 9.0

Regression Results

Statistic	Multiple Regression LOGINV_H
Multiple R	0.73179
R-Squared	0.53552
<i>Unexplained Error</i>	<i>0.46448</i>
Adjusted R-Squared	0.53055
Durban-Watson	1.41438
Goodness of Fit	F=107.60978 Significance=.0000
Significance of Regression Coefficients t-test	Constant t=42.619 Significance=.0000
Factor 1 - Activity	t=15.149 Significance=.0000
Factor 2 - Cognitive	t=5.723 Significance=.0000
Factor 3 - Subjective	t=7.779 Significance=.0000
Mean Studentized Residual	-0.0007
Do Residuals Reveal Violation of Model	No

Table 9.1

This is confirmed by examining the descriptive characteristics of LOGINV_H found on Table 9.0 [page 86]. Using Multiple Regression equation: $\text{LOGINV_H}^{\text{Exploratory}} = Y^{\text{Intercept}} + (\text{slope}) (\text{Principal Component Complicating Factors}) + \text{Error}$, the fit of the model was examined. The results are outlined on Table 9.1 [page 87]. They revealed a Durbin-Watson Statistic of 1.414338. This indicates mild degree of serial correlation (or auto-correlated) amongst the regression residuals. Of particular note are the Model fit statistics which include Multiple R, r^2 and the Unexplained Error. They revealed:

- 1) a **Multiple R** of .73179 indicating strong correlation exists between the LOGINV_H and the three factors;
- 2) a r^2 of .53552 suggesting that about 54% of the variation observed in LOGINV_H is associated to the changes in three factors and;
- 3) an **Unexplained Error** of .464448 suggesting that about 46% of the variation in LOGINV_H is not accounted for by the model.

To determine the utility or fit of the regression equation to the observations their regression coefficients were calculated and significance testing was performed on the Regression Coefficients and the Coefficient of Determination. This revealed:

- a) three Regression Coefficients [*b*]:

- 1) for Fac3_1 of .263418. A *t-test* resulted in a *t* score equal to 7.779 with a Significance of .0000, at a Confidence level of .95. This indicates that the value of the regression coefficient in the equation is not simply a matter of chance;

2) for Fac2_1 of .193961. A *t*-test resulted in a *t* score equal to 5.728 with a Significance of .0000, at a Confidence level of .95. This indicates that the value of the regression coefficient in the equation is not simply a matter of chance and;

3) for Fac1_1 of .512990. A *t*-test resulted in a *t* score equal to 15.149 with a Significance of .0000, at a Confidence level of .95. This indicates that the value of the regression coefficient in the equation is not simply a matter of chance.

b) a Constant [*a*] of 1.440631 for the equations was calculated. A *t*-test of the Constant resulted in a *t* score equal to 42.619 with a Significance of .0000, at a Confidence level of .95. This indicates the value of the constant in the equation is significantly different than zero and not simply a matter of chance and;

c) a *F*-test statistic of 107.60978 for the fit of the regression line was calculated. This suggests that the value of r^2 is significantly different than zero and that relationship [or fit] between the dependent and independent variable is not simply a matter of chance.

Based on these calculations the Confirmatory Regression Equation can now be written as:

$$\text{LOGINV_H} = 1.44 + (.263) (\text{FAC3_1}) + (.194) (\text{FAC2_2}) + (.513) (\text{FAC1_1}) + 46\% \text{ Error.}$$

Lastly, the Studentized Residuals associated to the fitted regression line were examined.

A plot of the Studentized Residuals of LOGINV_H associated with the model, Figure 6.0 [page 90], reveals a widely scattered, large residual effect. Overall, no abnormalities of concern were observed in the visual inspection of the residual plot.

Multiple Regression – Studentized Residuals

LOGINV_H

Figure 6.0

Summary:

In summary, using LOGINV_H as a proxy for INV_HRS does provide some insight into the relationship between LOGINV_H and the three factors. However, this relationship has little practical application for the business managers. Managers seek to predict INV_HRS not LOGINV_H. One observation of note is the effect the logarithmic transformation had on improving the fit of FAC1_2 to the distribution. This apparent improvement in significance in the test results for this factor suggests that the variance in the unexplained error may not be constant. Transforming the dependent variable may simply be masking the heteroscedasticity in the data. The residual pattern found on Figure 6.0 seems to confirm this observation.

5.0 Findings:

This research exposes the difficulties associated to building and validating models. The process requires scientific rigor and continual monitoring of its reliability. While the Complexity Rating Scheme is adept in measuring the activities undertaken during the course of a white collar crime, it fails to capture the true essence of complexity.

Confirmatory findings suggest that about 85% of the variation in the time expended on white collar crimes is not associated with changes in the Complexity Rating Score. Only 15% of the variance in INV_HRS is attributable to the change in the Complexity Rating Score. Secondly, there are major violations of the Regression Model as evidenced by the unusual distributions of the regression residuals. Surprisingly the association between investigative time and the Complexity Rating Score is significant, however, the scheme, in its native form, is not a reliable human resource model nor is it the basis for productivity norms.

The Reliability findings seem to suggest that the Complexity Rating Scheme is moderately reliable in terms of its ability to classify white collar crimes. However, Campbell et. al. provide evidence that complexity is a multi-dimensional and multi-attribute phenomenon composed of activity, skills, cognitive capacity, and information attributes. Few of these factors are controlled or measured for in the Complexity Rating Scheme. Thus while the aggregation scheme is internally consistent, it is not externally representative of the abstract phenomenon of complexity.

The scheme's reliability is only valid within the limited context of complexity as defined by the developers of the scheme. The research indicates that some variables may have been excluded from the Complexity Rating Scheme.

Exploratory findings isolated the principal components and exposed the underlying relationships between the INV_HRS and the three principal components and marginally improves the unexplained error associated to the model. Unfortunately, residual violations persist and the *t-test* for the Regression Coefficient Fac2_1 suggests that the findings are simply a matter of chance.

That problem disappears with the logarithmic transformation of the dependent variable. So while running a Regression Line through the transformed variable LOGINV_H clarifies the interaction of the three factors it masks another potential threat to successful regression modelling. The net result is that 54% of the variance in LOGINV_H is attributable to the change in the three factors. No material violation of the regression model were observed. The evidence suggests that the users of the Complexity Rating Scheme should exercise caution when interpreting Complexity Rating Score results recognizing its limited capacity to predict investigative time or, by extension, serve as the basis for productivity norms. From the standpoint of improving the Complexity Rating Scheme's performance, it is important to point out that each iteration of the regression analysis resulted in a reduction of the unexplained error associated to the model and fewer model violations pointing the way for future research.

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS
STANDARD REFERENCE MATERIAL 1010a
(ANSI and ISO TEST CHART No. 2)

5.1 Recommendations for Future Research:

This research contributes to our understanding of the investigative process as an information-processing activity and reinforces the observations of Hammond (1986) and Steinmann (1976) and complements Campbell's (1988) work on complexity. It exposes the rigors of model building and the varied opinions surrounding the efficacy of those processes. It suggests that managers, must recognize the internal bureaucratic forces that exist and resist the implementation of models that have yet to benefit from scientific scrutiny. Finally, it suggests the body of knowledge surrounding the development of qualitative and quantitative models is in its infancy. Therefore by necessity, the recommendations that arise from this research are general in nature primarily designed to offer future developers a framework by which to improve the viability of the Complexity Rating Scheme as a managerial tool.

It is premature to suggest that a single case model can properly evaluate complexity and at the same time serve as a basis for human resource prediction. To enhance the viability of the Complexity Rating Scheme two avenues of future research seem appropriate. First researchers should explore the attributes of investigative activities that account for the greatest portion of the variance in the system. The evidence suggest that: 1) Search Warrants; 2) Entities Charged; 3) Legal Challenges; 4) Interviews and; 5) Analysis are candidate variables for examination. The goal of this research should be the identification of the causal effect and the development of a model with enhanced predictive qualities.

The second, to explore the cognitive demands of the investigative task should be examined in more detail under the framework proposed by Campbell (1988) who provides a plausible means of segregating complexity into measurable elements. His observations, suggest that knowledge, experience and cognitive capacity play an equally important role in task complexity. The evidence suggests that these attributes must be included in any scheme that purports to measure complexity. A mechanism, defined by white collar crime experts, should be devised that identifies, qualifies and measures the:

- 1) the number of multiple paths an investigator can take during the investigative process;
- 2) the number of satisfactory outcomes that the investigator can arrive under those conditions;
- 3) the conflicting interdependencies and uncertain probabilities inherent in the investigative process.

White collar crime experts would be required to contribute to a decision model which quantifies and qualifies these attributes. Saaty's (1980) Analytical Hierarchy Process could be used to measure the degree of consensus that can be achieved within the elements of a decision hierarchy. In terms of those judgements, the degree of inconsistency would alert the developers to how far they can expect the model's outcome to deviate from predicted outcomes. Saaty's (1980) Validity Coefficient provides a means of determining the extent of model violation and alerts modellers to the potential inconsistencies that may follow.

The subjective perceptions associated with the priority and sensitivity of the investigation must be more accurately measured and reflected in the scheme. To this end a scale that measures subjective assessment of priority and sensitivity should be actively pursued and their effect on the investigative process determined. Separately these models would serve two distinct purposes, one prediction the other complexity assessment. In time it may be possible to combine these two models into a single case evaluation model. Like its predecessor, this model will need to be validated before it can be relied upon.

5.2 Benefits of Research:

The managers of the Economic Crime Program believe it is incumbent upon the promoter of business models, to satisfy those who rely upon them of the model's reliability. They recognize this can only be done through empirical testing. Armed with this knowledge, managers can adapt their decision-making practices to compensate for shortfalls in the model's performance and avoid its inappropriate application.

This research fostered a greater understanding of the processes involved in building and validating models within the police community. It provided police managers with an assessment of the Complexity Rating Scheme's utility as a managerial tool to;

- 1) predict the amount of time the investigative process will take and;
- 2) classify white collar crimes.

More than that, it establishes whether or not the Complexity Rating Scheme is a valid means of establishing Productivity Norms. Finally, the analysis provides a direction to future researchers.

5.3 Limitations:

This research should be considered a Case Study based on secondary data. As such, its findings are only applicable within the context of this experiment. As in all Case Studies, it is difficult to control or quantify variables that may effect both internal and external validity. Internal Validity, or the degree to which the results of the study can be relied upon as being correct, must always be assessed on the basis of the methodology employed in the research and the context in which the research was conducted.

Of particular concern is the Maturation Process. Many of the respondents were familiar with the Complexity Rating Scheme's deficiencies, particularly the counter-intuitive results it produced when applied to white collar crimes. The respondents' negative attitude toward the Complexity Rating Scheme is a threat and a limiting factor to the research.

External Validity, or the degree to which this study can be generally applied across all white collar crimes, is threatened by the data collection process used in this research. While a necessity, samples of convenience tend to undermine external validity.

Simply recognizing the lack of control that existed over the experiment alerts other researchers to the limitations of this type of research design. The readers of this paper are cautioned to bear these limitations in mind when reviewing this paper or extending this research in any way.

Complexity Rating Work-sheet

1. Date Opened _____	2. Occurrence 0	3. OSA CODE	4. FED/PROV _____	5. Date Concluded _____	
CASE FACTORS	NUMERICAL WEIGHTING 1	NUMERICAL WEIGHTING 2	NUMERICAL WEIGHTING 4	FACTOR RATING	
				Initial	Final
6. Entities under Investigation	1	2-4	More than 4		
7. Interviews	1	2-4	More than 4		
8. Searches	1	2-4	More than 4		
9. Analysis	1-8 hours	9-40 hours	More than 40 hours		
10. Entities Charged	1	2-4	More than 4		
11. Misc. Issues		Complexity Rating Scale 5 or less enter 1 6-8 enter 2 9-11 enter 3 12-14 enter 4 15-17 enter 5 18-20 enter 6 more than 20 enter 7			
- Privacy Act	Y				
- Legal Challenges	Y				
- Informants	Y				
- C/C Op(s)	Y				
- Sensitivity	Y				
- Priority	Y				
- Travel Status	Y				
- Other	Y				
12. Comments: _____ _____ _____ _____			13. Total Factor Ratings		
			14. Com- plexity Rating		

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