THE APPLICATION OF SYSTEMS ANALYSIS TO A PROBLEM OF COUNTY AMALGAMATION: THE PROPOSED AMALGAMATION OF KAIRANGA, KIWITEA, MANAWATU, OROUA AND POHANGINA COUNTIES.

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PREFACE.

Throughout New Zealand County Councils are endeavouring to fulfil various designated functions without imposing an increasing rate burden on their ratepayers. Rising costs of county operation have confronted a number of county councils with prospects of reduced expenditure on development, rate increases, greater efforts to secure more subsidies and reorganisation of county operations so that available money goes further. The last alteration has often taken the form of an amalgamation between counties.

In the Manawatu area the counties of Kairanga, Kiwitea, Manawatu, Oroua and Pohangina undertook an investigation of the desirability of amalgamation. An independent investigation was recommended as a suitable thesis topic by Mr B.G.R. Saunders of the Geography Department, Massey University. After a preliminary study of the county investigation it was decided to examine in detail aspects that would not be covered by the counties.

Only a few studies have so far been carried out on examples of county amalgamation. These were comparative and descriptive studies that failed to provide factual evidence either for or against amalgamation. It was, therefore, necessary to find an approach that would assist the compilation of analytical evidence about any proposed amalgamation.

Systems analysis was adopted as the broad problem solving method. This approach requires a step by step analysis of the central problem, that of the desirability of county amalgamation. Because of the absence of any systems study of government operations in New Zealand, it was necessary to outline in detail the 'system' before any attempt was made to solve the problem. The approach of systems analysis could be applied to any level of government or to any other government problem. The associated techniques used in the thesis are some examples of analytical techniques that can be readily used within a systems framework.

Attention is also focused on the results of several controlled or simulated aspects of amalgamations. These are treated as system changes.

Changes in performance are measured in terms of alterations in efficiency and effectiveness of county operations.

The extent of the study, particularly the simulation of amalgamated county operation, has been limited by the amount of information available. As the counties are preoccupied at present with auditing and financial procedures there has been little recording of information about other aspects of their output or work. In the thesis suggestions have been made of possible topics worthy of further research and some of the information requirements and procedures necessary before more detailed studies of county amalgamation can be undertaken.

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CHAPTER ONE.

INTRODUCTION.

Local government in New Zealand has been characterised by many attempts at reform. The impetus to change has rested on two broad bases. Firstly, there has been dissatisfaction with the role of local government in the political framework. Secondly, considerable attention has been focused on the viability of local government units, particularly the territorial unit, the county. So far no major changes have been made to the constitutional basis of any government in New Zealand. However, various attempts have been made to improve the usefulness and effectiveness of local authorities. An early response to this was the establishment of a large number of ad hoc local bodies. These were aimed at reducing the amount of work undertaken by the counties and introducing uniformity into the administration of legislation.

Since the Second World War a gradual trend towards county amalgamation has been taking place. County amalgamations that have occurred to date are between counties only, and have not included the merging into a county of other local authorities carrying out different functions.

County amalgamation is often seen as one answer to the long term income reducing effect of rural depopulation. At the same time the reduction in the proportion of national income generated by the rural sector of the economy has made county councillors acutely conscious of the seemingly inevitable rises in capital and maintenance costs of county operations. A reluctance to increase rates to meet rises in costs is often accompanied by reductions in capital development and maintenance work and greater demands for more external or subsidy sources of income. In an effort to counter the apparent 'economic' plight of county local government, attempts have been made to improve the efficiency and effectiveness of local government.

The National Roads Board (N.R.B.) supported for a time county amalgamation in areas where larger county units were expected to increase the rate of roading development. The active encouragement of the amalgamation of Ohura and Taumarunui County in 1956 is one example.

Various Local Government Commissions were established by central government to reorganise local government units so that local government could economically meet demands made of it. Some of the arguments advanced in support of amalgamation as a solution to local government problems are outlined below. The maintenance of one administrative centre rather than a number of smaller centres would give rise to economies particularly from reduced overhead costs. Engineering costs could be reduced through economies of scale and plant used more efficiently. Staff and county councillors could also be used more efficiently. Town planning in united districts could be administered more uniformly. A reduction in the number of local authorities in any area would result in less competition for the raising of loan monies. There could be a reduction in the number of central government services required such as auditing of local authority accounts and the preparation of valuation rolls by the Valuation Department.

In some instances amalgamation proposals have developed in response to local stimuli. The Masterton-Castle Point County amalgamation in 1958 and the Cook-Uawa County amalgamation in 1964 were the result of the joint discussions between the County Councils.

With the advent of the 1967 Local Government Commission and its wider powers, many counties decided to precede the Commission's investigation and see how they measured up to the requirements of the Local Government Commission. The five counties, Kairanga, Kiwitea, Manawatu, Oroua and Pohangina (see Figure I) were quick to respond to the possibility of the Commission reorganising local government in their area. A five county investigation committee was set up in 1968 to investigate many aspects of an amalgamation between the counties concerned.

In New Zealand pre-amalgamation investigations have to date been characterised by :

(a. examples of fact which have not been analysed or are very difficult to analyse as evidence either for or against amalgamation,

(b. a large number of subjective reasons supporting or negating an amalgamation proposal that are offered as "accepted fact" despite absence of empirical evidence,

FIGURE 1.

LOCATION MAP OF THE FIVE COUNTIES.

(c. an almost total absence of any problem solving methodology, and
(d. minimal assessment of effected amalgamations.

Recent amalgamations in New Zealand have been carried out either on the recommendation of the then current Local Government Commission or by poll in the counties concerned. In keeping with statutory requirements, the Local Government Commission draws up a final scheme report and proposal. Its primary concern in such documents is not to offer evidence of any kind, but rather to record the necessary details about the proposed new county or counties. Therefore, evidence for and against a proposal often remains in the minutes of county council meetings and is not easily accessible or publicised in detail. This has resulted in a series of independent pre-amalgamation investigations.

Where an objective approach has been used as in the Wellington Local Government Area Scheme, 1969 and the Amalgamation of Masterton and Castlepoint Counties, 1964, the analysis has rarely been conclusive. Most investigations in New Zealand have dwelt upon problems that could be encountered after amalgamat.. and are characterised by comparative tabulation of general information on each county involved in the discussion.

Local Government reforms of England and Wales show a similar pattern though these have been concerned with counties of larger size and wider functions. The participating English counties involved in the first two area alterations in 1964 carried out documentary studies of the existing county areas. No attention has been given to simulating reorganisation before amalgamation. However, attention has been focused in other directions. The Institute of Local Government Studies, University of Birmingham, has undertaken a research project entitled The Process of Local Authority Amalgamation. The field of interest is the administrative problems of amalgamation and the response of members and officers in the new authorities. It is not specifically concerned with more efficient or effective local government or the spatial relationships of local authorities.

The approach in this thesis differs considerably from previous amalgamation studies. The thesis investigates the contention that amalgamation would lead to more efficient and effective local government. To come to some conclus-

ions about efficiency and effectiveness in a local government context it is necessary to use a framework in which possible changes from amalgamation could be studied. Systems analysis was adopted as the way of exploring the study problem. A number of county operations are studied in terms of the criteria of improvement, 'efficiency and effectiveness'. Amalgamation is treated as one possible solution to improve efficiency and effectiveness. To assess the worth of amalgamation probable amalgamation conditions are compared against existing county conditions. This requires analysis of information about county operation. The study is limited by the amount of information collected by the counties on their operation.

CHAPTER TWO.

AN OUTLINE OF SYSTEMS ANALYSIS IN GOVERNMENT.

"A model is a simplified structuring of reality which presents supposedly significant features or relationships in a generalised form." (Chorley and Haggett, 1967, 22). The structuring of local government operations into a system provides one means of translating local government activity into a framework amenable to analysis by a problem solving methology. The abstraction into a model can be achieved by discarding large amounts of available information. This information, although discarded in order to construct the model, remains available for use either as data to test the model of the real world or to elaborate the initial model. Succeeding description and analysis is aimed at utilising as much information as is necessary to find a solution to the problem under consideration. The amalgamation problem orientation is futuristic and this requires a step by step procedure to represent adequately present and expected patterns. It is then possible to make tentative suggestions about the future. The validity of any suggestion is always open to debate, particularly if models used incorporate only a small amount of information, or if the activity under study has complicated or conflicting objectives.

Local government throughout New Zealand is exercised by a number of local authorities constituted under various Acts of Parliament. These Acts provide for the creation of districts over which the local authorities exercise jurisdiction. Different types of districts are distinguishable, each type being identified with a specific function or group of functions. The total area of New Zealand (except for certain small islands which are not included in the boundaries of adjacent counties) is divided into geographic counties. In all except one, Fiord, the Counties Act is fully operative. Often within the geographic county are cities, boroughs and independent town districts. Superimposed on this basic subdivision are overlapping districts which may be divided into two broad classes:

(a. districts formed from parts and groups of counties, e.g. road districts.

(b. those composed of a group of adjacent districts of other types united for a common purpose, e.g. electric power districts.

Those constituted for a single purpose are termed ad hoc local authorities.

The discussion in this thesis will be confined mainly to the local government unit, the county. In the North Island there are $C = (C_1, C_2, \ldots, C_x)$ counties. Each county $C_1 \ldots, C_x$ carries out a number of activities and functions. The expenditure of money on the $_j$th activity or function, E_j, can be defined as:

$E_j = f(X, K)$ where X is a set of independent variables which might include X_1 = population, X_2 = political system, X_3 = total road miles, ..., X_n; and K is the sum of understanding or knowledge about the activities and functions. These variables are important in any study of county amalgamation. An investigation of any casual relationship between E and X would provide information about the operation of county local government in the North Island of New Zealand.

County boundary alteration can take many forms. Some of the more important types of alterations are covered by the terms amalgamation, consolidation, merger and union. The term most frequently used in both press and academic publications is county amalgamation. Amalgamation may be defined as: "The combination and/or regrouping of local government units". Amalgamation requires the removal of the boundaries of former county units, the merging of the activities carried out by each former unit and the establishment of a new local body. The number of counties is reduced but the activities and functions are not necessarily altered in this manner. Instead, the activities formerly carried out are usually maintained, a few are discontinued and a number are included for the first time. Thus one key point to amalgamation is the replacement say of two counties by one county carrying out the functions formerly administered separately by the two former counties.

<u>The Systems Approach to the County Amalgamation Problem</u>.

Local authorities use and absorb goods and services produced in the economy. The productive gain from such activity is usually easy to recognise but difficult to measure. The counties are vested with many functions, the most important of which are probably the regulatory function and road construction and maintenance. To get as much from resources allocated to these activities is a matter of importance. One possible way to achieve this is the use of systems

analysis in government (Horvath, 1966; McKean, 1958; Hitch and McKean, 1960; Novick, 1965). Systems analysis provides a problem solving methodology suitable for application to the county amalgamation problem.

Hall and Fagan, 1956, 18, have defined a system as "... a set of objects together with relationships between the objects and their attributes". Using the terminology of Von Bertalanffy, 1950, 1951, 1962, it is possible to recognise in general two separate systematic frameworks for the observation of social phenomena. These are closed and open systems. Both are based on the concept of an energy input - output system in which the energic return from the output reactivates the system. Government as a function satisfies the properties of open systems in that the input and the conversion of output into further energic output consists of transactions between government and its environment. These usually take place in the form of services, performance of regulatory functions and growth stimulating activity. The characteristics of an open system are listed below and are compiled from Von Bertalanffy and Chorley, 1963;

- the steady state is achieved by self regulation
- energy supply is needed for the maintenance and preservation of the system
- an input is transformed by work into an output
- negative entropy or free energy can be imported
- the system is capable of behaving equifinally.

The study of self-regulatory open systems explores the ways in which some output of a dynamic system can be maintained in a steady state, in the face of disrupting external forces. The most general answer to this question is that the system must somehow be supplied with information about the disrupting forces so that it may be used to offset their effect. A common way of supplying this is by means of a feedback of information on the deviations of the output from equilibrium. The availability of the information causes the equilibrium to be restored in some appropriate manner. It should be remembered that any system is best understood in terms of its intended use; the goals and purposes for which it was contrived. A statement of system goals, objectives, values and measures of effectiveness, together with a few major constraints, allow the analyst to approach the controlling structure of

the system at the outset. This form of higher-order simplification recommended by Van Court Hare, 1967, 161, makes it easier to study the system potential for improvement, growth, change and optimisation.

The complexity of systems analysis as a research technique has been well summarised by Wildavsky, 1966, 299.

> "the less that is known about objectives, the more they conflict, the larger the number of elements to be considered, the more uncertain the environment, the more likely it is that the work will be called a systems analysis ... . Systems analysis builds models that abstract from reality but represent the crucial relationship. The systems analyst first decides what questions are relevant to his enquiry, selects certain quantifiable factors, cuts down the list of factors to be dealt with by aggregation and by eliminating (hopefully) less important ones, and then gives them quantifiable relationships with one another within the system he has chosen for analysis. But crucial variables may not be quantifiable. If they can be reduced to numbers, there may be no mathematical function that can express the derived relationship. More important, there may be no single criterion for judging results among conflicting objectives. Most important, the original objectives, if any, may not make sense".

The operation of the system and the attempted fulfilment of the objectives can be aided by measures of performance. In a simple form, measures of performance or criteria can be reduced to two elements. These are efficiency and effectiveness. The usefulness, implementation and assessment of the criteria depends largely on the emphasis given to each criterion. In investigating change in counties criteria impose a consistency in evaluation of the change.

The following definitions of efficiency and effectiveness from the basis of the criteria,

Efficiency: efficiency has at least two different meanings.

(a. Technical efficiency, which can have one of three meanings:

(i) Something is efficient if it is adequate to meet all the demands made on it. One test of the efficiency of a county is whether it can supply the rate of sealing required in the county.

(ii) Efficiency can be assessed with reference to some quantitative standard of performance. The efficiency of a county road surface could be the rate of surface disintegration.

(iii) Efficiency can mean doing the job in the cheapest possible way. This meaning of technical efficiency requires some elaboration. The efficiency of any activity is the amount of output units produced from one unit of input or the amount of input units required to produce one unit of output. If efficiency is measured in terms of dollars and cents then an increase in efficiency may be defined as either an increase in output per unit cost, or as a reduction in cost per unit output.

(b. The second definition of efficiency is derived from two further concepts. These are scarcity of resources and opportunity cost. Speight (1962, 4) states "an economic system is economically efficient insofar as it is technically efficient, and insofar as it succeeds in rationing out its scarce resources, and the scarce products of these resources, in the most desirable way". ("Most desirable" is a question-begging phrase. Economists often use utility and consumer satisfaction, equated with production combinations as the test. For example, see McKean, 1958, 129-131.)

Underlying each meaning of technical efficiency is the unifying concept of energy loss through input transformation or work. Strictly speaking, then, any activity is carried out at a level of efficiency less than 100 per cent efficient. Two important long term outcomes of surpluses generated by increased efficiency are growth and control over the environment. (Katz and Kahn, 1966, 137-142). Further, Ackoff, 1958, 218, draws attention to the need to include the relevant time period and environment when designating efficiency.

Effectiveness: since people and activity are very closely linked, it becomes important to isolate the effect of any activity upon people. The effectiveness of an activity must be defined relatively. A simple definition such as

"doing the job better" has connotations of quality. In fact, effectiveness stands as a qualitative measure of an activity in terms of the purpose for which the activity is carried out. It represents an extension of the concept of efficiency, and as such may be considered in two forms

(a. a qualitative measure of efficiency
(b. as a measure of any whole operation. In this form, then, efficiency measures are applied to parts of any operation or system.

Any given level of effectiveness has an associated cost. An increase in effectiveness may be achieved without any increase in cost. With successive increases in effectiveness there will eventually be a rise in cost. Generally a critical cost level limits increases in effectiveness.

The system of local government in New Zealand is undergoing considerable structural modification brought about by a need to bring closer together the pattern of government and man's activity in the country. To enable this system to function effectively in the face of structural or other change, government needs to understand the interrelationships of different parts of the system, hopefully to the point where it is possible to predict the effects on any part of the system of changes made in other parts.

Like most social systems, the local government system has evolved through a series of trial and error modifications rather than by deliberate design. The research needed to identify and measure all of the parameters that affect its operation could be a very time consuming task. An exact mathematical model is therefore out of the question for any short term solution to the problem. A crude simulation could be attempted by trying to identify the major interactions and then, for example, formulating a decision matrix. However, before any quantitative simulation can be carried out it is necessary to decide what are to be used as measures of efficiency and effectiveness.

Of particular interest to the geographer are the influence and importance of spatial aspects of the county system. These are derived from man's creation and use of environments, and relationships within these. The organisation of phenomena, under most circumstances, assumes a spatial perspective and dimension. Spatial

attributes that are of major importance to geographers have been reduced to three Nystuen, 1963,384. They are direction or orientation, distance, and connection or relative position. These aspects underlie many aspects of the county system and its operation. Nystuen goes further and aggregates common geographical problems into a group of tensions, namely "a dimensional tension between point, line and area activities; a time-space tension in current activities; or a tension between present activities and past facilities and institutions". (Nystuen, 384). The above tensions assist in the understanding of government spatial organisation and the operation of the land based county system.

Some Studies of Government Spatial Organisation.

A wide variety of approaches have been used in attempting to understand the functional workings of government. A number of the techniques could be usefully introduced into an amalgamation study. Some appear to yield very useful results but cannot be practically attempted in this study. The choice of a systems approach means any technique may be considered in attempting problem solution. Therefore, the following discussion includes comments on the appropriateness of any technique to this study.

Research on government spatial organisation has concentrated itself into several broad groups. Two groups are immediately relevant. One group deals with the role and extent of cost-benefit analysis and systems analysis in government decision making and organisation. Another group emphasises the use of quantitative techniques to measure local government performance and study spatial attributes of government. These two groups are now considered.

In recent years, cost-benefit analysis has been frequently advocated as a means of introducing analysis and objective decision making into government activity. Lichfield, 1960, 277, argues with respect to city planning that high levels of measurement are not essential. "... precise description with an indication of incidence would of itself help decision making for it would give a framework within which all relevant arguments for and against a proposal could be organised. This would offer an improvement on much of the analysis for decision

decision making in city planning today." The actual application of the technique is confronted with many problems and limitations. Of importance to the study of county amalgamation is the process of settling on goals for local government. In New Zealand, local authorities are "creatures of Statute" (Sidebotham, 1968, 9) and as such derive most of their functions from this source. There is no restriction, however, on the extension of local government activity both within or outside the statutory functions. It must also be remembered local government activity has an impact on the regional economy and could perhaps be encouraged to assist this sector positively. For some years, American municipal and county government has been endeavouring to sort out suitable community goals, ascertain the implications of any constraints, and reduce the level of uncertainty in decision making.

A number of researchers have sought to quantify relationships (or lack of them) found in local government activity. Interest has been focused on several topics of investigation. The choice of topics reflects the reduction of government into components or parameters. Three components, expenditure, output and spatial attributes have received attention. However, the dependence and independence of factors varies and two sets of relationships have been analysed. They are, that expenditure is a function of spatial attributes and that output is a function of expenditure. The type of analysis varies. In some studies correlation analysis is used as the test for existence of any association. This is extended by the postulation of a framework of relevant and associated variables which may be used to evaluate the degree of relationship. Predictive equations are then fitted or the importance of each contributing variable ascertained using factor analysis or principal components analysis. The difficulty here is to make sure the variables which stand as prime causes (independent variables) can be plausibly evaluated as far into the future as may be necessary.

Studies published in the early 1960's did much to resolve the issue of economies of scale associated with size of administrative areas. Earlier papers had revealed a wide variety of expenditure determinants. These studies analysed

expenditure only, not quality or units of service. They made no attempt to determine to what extent the variable service level contributed to variation in expenditure. Significantly, one paper (Hirsch, 1959) attempted the development of a theoretical framework for analysing the question "what are the likely expenditure effects of metropolitan growth and consolidation?" Hirsch, 1959, 231-241 outlined three general growth patterns and discussed the context and validity of each. The growth patterns are horizontal integration of government where government controls a number of units all furnishing a single service, circular or complementary integration where a number of units render a number of complementary services, and vertical integration of government where there exist operations at different levels of the production-service process.

Schmandt and Stephens, 1960, 369-375, proposed a "service output index" which employed measurement related to output and was based on a breakdown of each municipal service into subfunctions or activities. Variation was derived from different, but adjacent, areas contributing to the study sample. Shapiro, 1961, 394-397, published a complementary paper on county local government. Using the state of Wisconsin as the study area, he developed a multiple regression model based on county activities (using the Schmandt-Stephens index) and seven independent variables. The variables used were total population, area in square miles, population density per square mile, full property value, percentage full property value within cities and villages, total expenditure and per capita expenditure. The peculiar nature of American counties requires mentioning. "The county was created (in U.S.A.) primarily to act as an agent of the state in undertaking functions regarded as largely or primarily of State concern". (Shapiro, 395). His results yield considerably weaker correlations than those found in the study by Schmandt and Stephens of Milwaukee municipalities. The lack of significant correlation is intuitively explained by the complication (present in New Zealand) that many activities are undertaken for the State without regard for such variables as were used in the study.

The preceeding two studies contributed to the empirical analysis of local government activity. In both cases treatment was diagnostically orientated and provided a means of testing relationships. Their raison d'etre lay in the use and formulation of an approach which has a universal applicability.

A recent study by Braschler and Klindt, 1969, complements the work of Shapiro on county local government. They argued that the economic objective of local government amalgamation was to reduce the amount of public costs and improve the quality of services. Their argument hinged on there being a relationship between population and per capita costs. The magnitude of cost reductions were held to be dependent on economies of scale with respect to population. The three relationships hypothesised were, costs per capita as a function of population (or cost as a function of population squared), the population density and distribution throughout the area of proposed amalgamation, and the increased cost of distribution of services to a simulated amalgamation resulting from increased private and public transit costs to make the service available. Further, they noted the direct relationship between rates and area did not yield any economies when counties were amalgamated. Any economic advantage was argued to come from reduction in costs associated with population economy.

The use of the gravity model to evaluate administrative subdivisions (Massam and Burghardt, 1968) offers another approach to quantifying the effectiveness of local government. The construction of an Index of Efficiency based on the deviation between actual and optimal administrative centre siting in terms of population provides a means of assessing the present pattern of subdivision.

The preceding discussion introduced and placed county amalgamation in a general framework. The procedures of systems analysis and the choice of this broad research technique were discussed. A review of earlier works in the field of government spatial analysis was specifically aimed at demonstrating the use-

fulness of a number of specific techniques in systems analysis. The systems approach provides the necessary framework to approach a problem of change such as a proposed county amalgamation. Information derived from the application of systems analysis can then be used to equate the defined system with specified criteria. The distinction between the conceptual framework and the procedural framework should also be borne in mind. The approach dictates a description of the system under study but this in itself does not constitute systems analysis. It is only when the system has been investigated or manipulated in terms of the stated problem objective that the term "systems analysis" can be appropriately applied.

By viewing local government and in particular counties as systems, the information about the system can be readily thought of as "packages" of system information. It is then possible, metaphorically speaking, to plug these back into the system via feedback. Any one study might not complete the analysis of the problem but the information secured at any point in time is available within the general framework.

In analysing the system change brought about by a controlled and simulated amalgamation, attention will be given briefly to the many issues surrounding an amalgamation study. Several issues are particularly important. The objectives of county local government are at present loosely phrased and appear to lack overall unity. It becomes difficult to study amalgamation in the light of this. Without a clear statement on the major purposes and present performance of county government it is hard to assess whether amalgamation would achieve better results. Equally important is the relationship between the County Council and the area administered by the county. It is difficult to decide to what extent counties (the principal unit of local government) should undergo change to meet changes in the area administered by them. Furthermore, an amalgamation investigation presupposes a decision about the desirability of amalgamation. Again it is very difficult to decide what should be studied and what information is needed to make a decision on an amalgamation combination. The problems attendant with an actual amalgamation are not

considered in this thesis.

The aim of this thesis is to investigate whether county amalgamation would lead to more efficient and effective county local government. To fulfil the aim, two conditions must be met. These are a clear structuring of the local area county systems and a controlled change of aspects of the county systems so as to simulate amalgamation. Attention will be given to the deficiencies in the system that prompted an amalgamation investigation. A comparison of the possible behaviour and characteristics of the changed systems with the original systems in terms of the criteria provides feedback information about the system that can be interpreted in terms of amalgamation proposals. The thesis material at this level is specific, dealing with the five Manawatu Counties of Kairanga, Kiwitea, Manawatu, Oroua and Pohangina, but the general systems approach allows application elsewhere in New Zealand.

CHAPTER THREE.

DEFINITION AND STRUCTURE OF THE COUNTY SYSTEM.

In this chapter the county system is defined and structured. Only the five rural counties of Kairanga, Kiwitea, Oroua, Manawatu and Pohangina are considered specifically. The Boroughs of Feilding and Foxton, and the City of Palmerston North have been omitted as these are not specifically associated either with the system and its operation or the county amalgamation problem. Throughout the chapter an attempt is made to outline the system, describe its character and operation, assess whether it works as well as expected and offer possible reasons for any malfunctioning of the system.

The System Objective:

Local government has its origin in the fact that certain problems are of peculiarly local interest and importance. Each type of local authority has a clearly established place in the scheme of government. Functions and powers are restricted and often integrated with those of State Departments. The functions performed by any county involve relationships with activities that are carried out in the land area under county jurisdiction. Many of the county functions are concerned with the regulation, maintenance or development of aspects of the area's infrastructure. This could, for example, include the issuing of building permits, road construction and maintenance, fire protection work, pest destruction, or noxious weed eradication. Thus roads, buildings and farms and their associated functions may come within the scope of county local government. A second element of importance is population. The county system is ultimately derived from and responsible to the people. Table I indicates a decrease in population in Kiwitea and Pohangina counties, while Kairanga, Manawatu and Oroua counties have a slight increase.

TABLE I.

POPULATION OF THE FIVE COUNTIES.

	1961	1966	Intercensal Increase Percentage	Estimate 31 March 1968[1]
Kiwitea	2339	2215	-1.10	2150
Pohangina	1199	1082	-2.07	1040
Oroua	4559	4601	0.19	4630
Manawatu	7288	6852	-1.25	6390
Kairanga	6160	6446	0.93	5500[2]

1 Government Statistician

2 The result of a major boundary change in 1967 when Palmerston North City took over a portion of Kairanga County.

Source: Population Estimates, 1966-86, 46-47.

The continuing decrease of population in Pohangina County and probable decreases in all others except Kairanga County could lead to a future rethinking about the county system objectives. Figure 2 illustrates a number of basic components of the five county area, namely, the county boundaries, county towns, county offices and road surfaces.

The objective of the county system to carry out delegated functions in the territorial area of the county is, therefore, necessarily broad and incorporates implicitly the two elements, area infrastructure and population.

Emanating from the objective are the various system parameters that exist and operate to allow the system to achieve its objective. Two complementary approaches make the task of interpreting the objective easier. The first approach is a requirements approach which is based on known or expected future activity. Here emphasis is given to searching out the best way of getting the future activities done and deals mainly with the organisation of activities. The second approach does not assume activities have been decided on. It is a priorities approach which lays emphasis on the order in which the county activities should be carried out.

System Parameters:

The county system in operation for the five counties under study is a general one. The system parameters (illustrated diagrammatically in Figure 3)

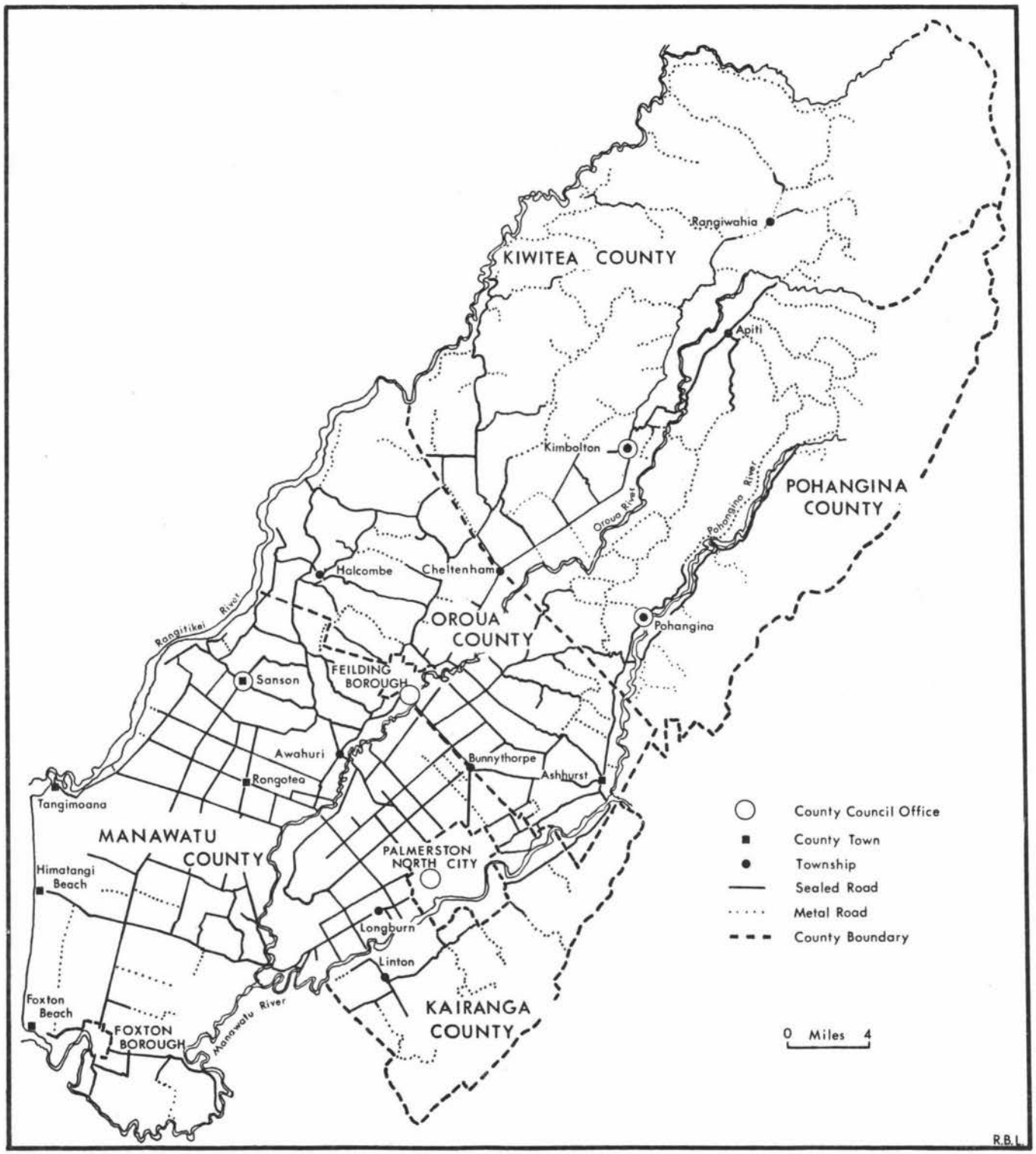

FIGURE 2.

THE ADMINISTRATIVE AREA AND INFRASTRUCTURE OF THE FIVE COUNTIES.

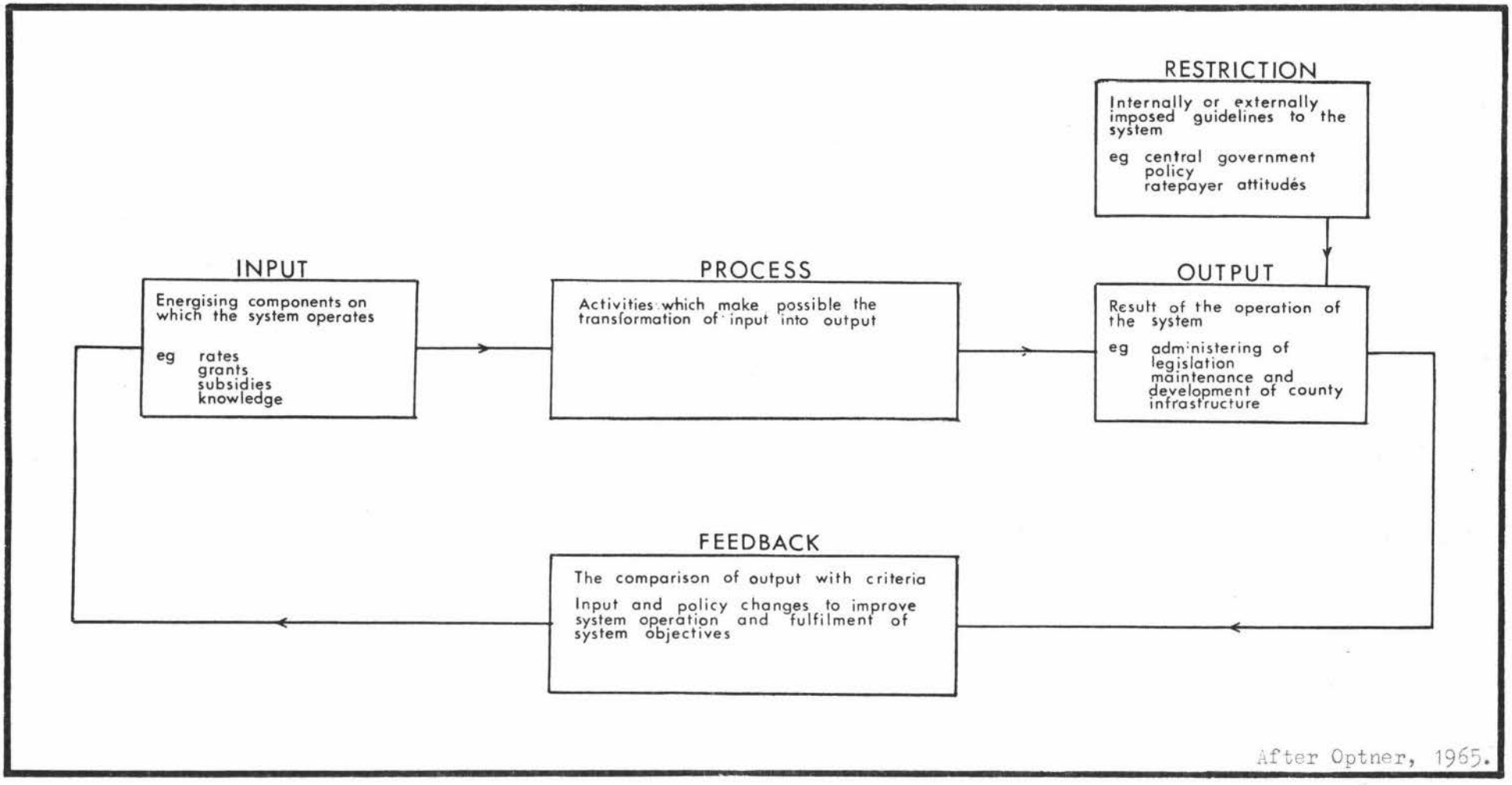

FIGURE 3.

SCHEMATIC DIAGRAM OF THE COUNTY SYSTEM.

are an input, process, output, feedback and a restriction. Briefly, the input consists of rate income and grants and subsidies from sources such as the N.R.B. and the Department of Agriculture. The process represents the activities carried out to meet the system objective. Output of the system is frequently varied and not always measurable. It includes output to keep the system operative and output that contributes directly to the fulfilment of the objective. Feedback in this context is the continual assessment of the performance of the county system. Importantly, the counties are slightly restricted or constrained by legislation and supervision from government departments. For example, an upper limit to rate income is set at three cents per dollar of unimproved valuation, and accounting procedures are rigidly controlled. The County Councils also voluntarily impose restrictions on their activity by tending to peg rates. The amount of rates levied in a year is decided by each council in terms of a decision matrix that could include such factors as the previous years rates, the local political feeling, the state of the economy, the actions of adjacent county councils and the desired works programme for the forthcoming year. Closely associated with the direct income sought from rates is the amount of financial assistance offered by the N.R.B. for the current works programme. The assistance is considerable as can be seen in Table II and indicates the large dependence on N.R.B. income by Pohangina County in particular.

TABLE II.

PERCENTAGE COUNTY CONTRIBUTION TO TOTAL EXPENDITURE ON ROADS BY COUNTY.

	Kairanga	Kiwitea	Manawatu	Oroua	Pohangina.
1961-62	55.9	47.6	56.5	58.7	21.2
1962-63	57.7	48.8	57.4	57.5	26.3
1963-64	56.8	54.9	56.2	52.0	23.6
1964-65	54.8	55.6	57.4	55.5	19.5
1965-66	54.0	55.0	57.4	60.2	20.3
1966-67	49.5	44.5	54.3	51.4	22.8
1967-68	52.5	52.0	60.1	51.5	26.5

Source: National Roads Board, Annual Reports, 1962-68, Appendix V "Details of County, Road Board, and Dependent Town Council Expenditure".

System Attributes:

The attributes or properties of the system parameters impinge on any isolated or aggregated county system and exercise a measure of regulation over system behaviour and performance. Listed below are two key attributes for each parameter:

Input: . income from rates is fixed annually and the N.R.B. allocation biannually.
. knowledge is dependent on calibre of employees.

Process: . priorities may be changed to meet unexpected circumstances such as flood road damage.
. is determined by fixed expenditure (wages and salaries) and variable expenditure (plant operation).

Output: . may be permanent, fulfil the system objective and promote system stability.
. may be regulatory and fulfil the system objective.

Feedback: . in part is commonly known as experience.
. may be ignored if thought expedient.

Restrictions: may be imposed by statute.
. can also be imposed by the system.

The attributes of the system reflect the interrelations between the county system, environment and the supporting systems associated with the counties.

System Relationships:

The pattern of county expenditure is probably the composite result of numerous physical, political, historical and economic "influences". To understand the system relationships completely is beyond the scope of this study, but it is possible to sort out what seem to be the dominant factors in a logical relationship and then examine their relative significance. A logical relationship is synthesised in the following hypotheses.

System Hypotheses:

The first hypothesis is that variations in expenditure from county to county are directly related to variations in the environment. Such a hypothesis is very broad and aggregates a number of variables into an expenditure group and an environmental group. There is no published evidence in New Zealand

to suggest a different tentative hypothesis or to indicate the closeness of the relationship over the area of the North Island. In addition, should a relationship be found to exist between expenditure and the environment system, it might not be possible to ascribe a deliberate operational relationship. Money might be allocated to a project because of necessity and not because it happened in the past to be related to a particular variable. The second hypothesis is that expenditure is also directly related to the income received by the county. The income is generated from two major sources. First, rate incomes from within the county system and second, government grants and subsidies from the supportive system. Both influence each other, as the amount of expenditure proposed for a year could (and is often claimed to) influence the amount of rates levied and the allocation finally made by the N.R.B.. However, once the allocation decision has been made the expenditure in the county system is decided with direct reference to the amount of allocation. The third hypothesis is that income generated by a county is in direct response to the character of the environment. Again no investigation has been previously undertaken to test this relationship either causally or empirically. Finally it is hypothesised that the number of staff employed by counties exhibits a direct relationship with the environment, expenditure and income.

The available information on the operation of the 63 North Island mainland counties for 1966-67 was reduced to twelve expenditure variables, four income variables, two labour force variables and fourteen environmental variables. (refer Appendix A). Variables selected for detailed study were chosen for several reasons. Firstly, earlier studies overseas suggested a number might be regarded as general variables. Secondly, a number of variables would be important in the New Zealand situation. Thirdly, the variables represent the major subdivisions of county expenditure and income and are frequently large components of county expenditure or income. The data represented the latest available at the time of investigation (1969). However, no intervening statutory changes have been made to alter the county processes or system.

The following specific relationships between the variables were postulated as being particularly important. The choice of variables was dependent on inferential evidence from overseas and likely relationships in the New Zealand setting.

1. That each of the four major categories of expenditure are directly related to the environmental variables, area, population, percentage of population in county towns and miles of metal and paved roads.

2. That each of the four major expenditure categories are directly related to rate income and N.R.B. support.

3. That rate income is directly related to unimproved valuation, population and total road miles; and that the N.R.B. support is directly related to the miles of metal roads.

4. (a That the number of administrative staff is directly related to the environmental variables, area and population; the income variables, N.R.B. support and rates; and the expenditure variables, county roads and maintenance of works and services.

(b That the number of other employees is directly related to area, population, miles of metal and paved roads, and percentage of metal roads; the income variables, N.R.B. support and rates; and the expenditure variables, county roads, and maintenance costs of roads, streets and bridges.

It is appropriate to employ statistical analysis after tentative descriptive hypotheses about the relationships between the study variables have been formulated. The following test hypotheses were proposed to make explicit the existence of relationships initially propounded in the working hypotheses. The null hypothesis, H_0, was that there were no significant correlations between the 32 North Island county variables under study. The alternative hypothesis, H_1, was that there were significant correlations between the variables. N, the number of counties, was 63 and the significance level set at .01. H_0 was rejected in favour of H_1 when the probability associated with the observed correlation coefficient value under H_0 is greater than the significance level of .01.

By setting the significance level at .01, the region of rejection is small thereby reducing the risk of rejecting H_0 if it were true.

Problems of Data Preparation and the Correlation Analysis:

An examination of the distributions revealed very few normal or near normal distributions. Most were either positively skewed or positively J shaped. In an effort to manipulate the data distributions into a form whereby parametric statistical techniques could be used logarithmic transformations were attempted. These failed in most cases to yield near normal distributions. The inconsistency of the distributions and their lack of normality restricted the choice of statistical techniques to non-parametric ones. This precluded any additional analysis of the data by otherwise appropriate techniques such as partial and multiple correlation analysis, factor analysis and principal components analysis. The test finally selected was the Spearman Rank Correlation Coefficient, rho, as outlined in Siegel, 1967, 207-13 and summarised in Appendix I. The Spearman's rho was chosen instead of the Kendall Rank Correlation Coefficient because it requires fewer computational steps and would, therefore, reduce the amount of computer time used. It does, however, have the disadvantage that it is not generalisable like Kendall's tau to a three variable partial correlation coefficient.

A Fortran II computer program was developed to rank and store the variables, calculate the correlation coefficient and test for significance a computed Student's t value with 61 degrees of freedom. The rank correlation coefficients as a measure of association apply to the entire area under study. Their role is to describe the degree of spatial correspondence among the areal variations of the variables as measures of the validity of the hypotheses constructed for the North Island Counties. The results can be constructed into a generalised series of system relationships that could be reasonably applied to any given county system.

Relationships Between the Variables:

In Table III the correlation coefficients are laid out in a matrix format. Only values that are significant at the one per cent level of significance are included. The correlation coefficients for the test hypotheses may be read

direct from the table and where specific variables are mentioned in the text they are followed by the variable code number in brackets. Very high correlations are evident between the expenditure variables and population (5). Area (1) and miles of metal (11) and paved roads (10) have weaker correlations. The variable 'population in county towns'(7) is almost eliminated at the one per cent level of significance. The second hypothesis is adequately sustained. The third hypothesis is likewise supported but the last is only partly sustained. Again area, and miles of metal and paved roads do not have particularly high values. Percentage of metalroads (15) is not significant. The remaining variables indicate high positive correlations in terms of the test hypotheses.

Had it been valid to use parametric tests, then it would have been possible to test for intercorrelations, particularly amongst the expenditure variables where there could be cumulative variability in the four major categories of administrative, maintenance of works and services, capital expenditure and total expenditure. In an effort to isolate further the more important relationships in Table III an arbitrary selection was made of a "high" correlation value. The coefficient value chosen was plus or minus .70 which has a significance level well beyond any tabulated for 61 degrees of freedom. This reduces the number of values that have to be interpreted from the matrix. Every attempt has been made to eliminate spurious correlations and in Figure 4 the relationships at the nominated high level of correlation are laid out in terms of possible causality. The function notation specifies the assumed dependence of the variables. It must be remembered that the arbitary value chosen does not prevent reference to or inference from the remainder of the correlation coefficients.

TABLE III.

RANK ORDER CORRELATION COEFFICIENTS FOR SIXTY THREE NORTH ISLAND COUNTIES, 1966 *

Sources: Local Authority Statistics 1966-67
Tables 18, 21-25B, 27
Increase and Location of Population, 1961-66
Tables 14-15

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
1 Area in square miles	--																															
2 Capital property valuation	.30	--																														
3 Unimproved property valuation		.94	--																													
4 Percent developed land	.38			--																												
5 Total population	.47	.86	.74		--																											
6 Population density per square mile	.42	.60	.59			--																										
7 Population living in county towns				.58			--																									
8 Percent population in county towns				.60				--																								
9 General rate income	.50	.82	.74		.81				--																							
10 Miles of paved roads		.81	.82		.59	.57			.61	--																						
11 Miles of metal roads	.74				.44				.47		--																					
12 Miles of unmetalled roads	.55			.34		.36						--																				
13 Total road miles	.76	.63	.46		.70				.72				--																			
14 Percent paved roads	.48		.34			.58	.30			.59	.64	.40	.34	--																		
15 Percent metal roads	.43		.36			.42	.40	.46		.61	.60			.68	--																	
16 Central plant purchases	.39	.65	.58		.57				.64	.50	.47		.59			--																
17 County roads, bridges, streets	.52	.72	.57		.71				.74	.46	.62		.71			.72	--															
18 Total Capital Expenditure General Funds	.54	.73	.60		.70				.75	.45	.60		.76			.74	.94	--														
19 Payments noxious weed eradication	.48	.48	.41		.46				.59		.44		.52			.36	.43	.43	--													
20 Central plant hire and operation	.40	.54	.42		.53				.46		.49		.52			.75	.52	.41	.41	--												
21 Roads, bridges, streets	.70	.58	.43		.68				.70		.77		.86			.55	.60	.53	.53	.53	--											
22 Halls, baths, domains, reserves.	.25	.58	.57		.57				.60				.38			.39	.44	.59	.59	.31	.42	--										
23 Total Maintenance Works and Services	.66	.68	.54		.75				.78	.38	.73		.85			.69	.67	.72	.58	.70	.93	.52	--									
24 Wages, etc., maintenance	.65	.53			.60				.66		.56	.34	.68			.53	.59	.72	.50	.50	.75	.42	.77	--								
25 Administrative wages and salaries		.77	.65		.76	.49			.69	.52	.36		.60			.49	.63	.65	.44	.50	.59	.58	.69	.56	--							
26 Total Administrative Expenditure	.58	.79	.69		.84		.37		.87	.45	.52		.76			.65	.77	.79	.53	.55	.68	.60	.77	.61	.73	--						
27 Total County Expenditure	.55	.79	.65		.81				.82	.50	.59		.78			.73	.77	.82	.49	.68	.80	.62	.89	.75	.79	.86	--					
28 Grants and subsidies N.R.B..	.68	.58	.42		.66				.69		.82		.86			.67	.77	.80	.50	.62	.85	.39	.88	.69	.54	.72	.81	--				
29 Grants and subsidies M.O.W.	.37			.37	.35				.55					.41			.39	.35			.36		.36			.33		.40	--			
30 Other grants and subsidies	.42	.47	.32		.51									.32		.34	.54	.56	.36	.34	.58		.56	.49	.62	.57	.56	.53		--		
31 Number administrative employees	.46	.84	.74		.90	.42	.35		.83	.50	.47		.71			.67	.77	.80	.51	.57	.67	.64	.80	.64	.79	.90	.87	.72	.32	.55	--	
32 Number of other employees	.65	.69	.55		.74				.76	.40	.64		.77			.70	.74	.79	.50	.68	.77	.49	.86	.79	.68	.78	.87	.81	.33	.56	.80	--

* The results are significant at the 1% level of significance.
The coefficients underlined are negative correlation coefficients.

FIGURE 4.

POSTULATED SYSTEM RELATIONSHIPS FOR NORTH ISLAND COUNTIES*

Notation: f_E reads, is a function of (the following environmental variables)

f_I reads, is a function of (the following income variables)

f_X reads, is a function of (the following expenditure variables)

* Dependent variables are recorded in descending order of the value of the correlation coefficient. The code number of variables in Table III is in parenthesis.

EXPENDITURE VARIABLES

Total Administrative Expenditure (26) = f_E (population (5), capital value (2), total road miles (13))
f_I (rates (9), N.R.B. (28))

Salaries and wages (25) = f_E (capital value (2), population (5)).

Total Maintenance of Works and Services (23) = f_E (total road miles (13), population(5), miles of metal roads (11)).
f_I (rates (9))

Roads, streets, bridges and footpaths(21) = f_E (total road miles (13), miles of metal roads (11), area (1))
f_I (N.R.B.(28)).

Total Capital Expenditure out of General Funds (18) = f_E (total road miles (13), capital value (2), population (5)).
f_I (N.R.B. (28)), rates (9)).

County roads, streets, bridges(17) = f_E (capital value (2), population (5) total road miles (13))
f_I (N.R.B. 28), rates (9)).

Total Expenditure: (27) = f_E (population (5) capital value (2), total road miles (13)
f_I (rates (9), N.R.B.(26)).

INCOME VARIABLES

Rates (9) = f_E (capital value (2), population (5) total road miles (13)).

National Roads Board (26) = f_E (total road miles (13), miles of metal roads (11)).

LABOUR FORCE VARIABLES

Number of Administrative Employees (31)

$= f_E$ (population (5), capital value (2) unimproved value (3), total road miles (13))

f_I (rates (9), N.R.B. (26)).

f_X (Capital expenditure general funds (18), maintenance of works and services (23), county roads, streets bridges (17)).

Number of other employees (32)

$= f_E$ (total road miles (13), population(5))

f_I (N.R.B.(26), rates (9)

f_X (Roads, streets, bridges (21), capital expenditure from general funds (18), county roads, streets bridges (17), maintenance of works and services (23)).

The recurrence of population (5), capital valuation (2) and total road miles (13), as variables directly related to categories of expenditure suggests that as these increase, so does the expenditure on most county functions. Thus they could be key determinants of expenditure. This could be symptomatic of some economies of scale, but no conclusion may be drawn on this from the results shown. Interestingly, almost no significant relationships are evident between expenditure, income and labour force variables on the one hand and the environment variables, population (5) and percentages of population in county towns (8) miles of unmetalled roads (12), percentage of developed land (4) and percentage miles of paved (14), and metal roads (15) on the other hand. In the first instance then it would appear the extent of urbanisation does not influence the county relationships or processes. The absence of an influence from unmetalled roads could be attributed to the predominance of metal or paved surfaces on county roads. The expenditure on upgrading these roads would be small compared to that allocated to sealing metal roads or upgrading paved roads. With regard to the percentage of developed land, it would appear that area or any derived variable of area is not a major determinant of county operations. As the absolute number of road miles tends to govern the work content of the system, it is not surprising to find little association attached to percentage road mile figures.

System Performance:

Decision making in any county system frequently requires recognition of the importance of efficiency and effectiveness of county operations. These criteria constitute direct measures of performance. They can be used to promote greater system definition and encourage continued searching for system economies. The economies might not be recognised or may only become apparent after reorganisation of county operations.

The problem is also to determine the alternative courses of system development. Conflicting objectives become apparent. The following illustrate some of the specific alternatives open to the local counties:

(a to assist the development of the Manawatu region,

(b maximise the short run return to ratepayers by yielding to local interests even though the return may not be in the best interests of either the county or the region, and

(c prevent loss of farm land to urban areas.

The above are subobjectives of the county system, established once the county system is operational. The amount of expenditure on the objective and subobjectives will dictate the system character in the future. A willingness to incur debt could lead to more rapid development while a continuing policy of rate pegging might cause rapid breakdown of system parameters. The first sign of system deficiencies could be a reduction in quality of service offered to ratepayers and residents.

Other System Characteristics:

Each county is a bounded system. All activities carried out by any county are directed towards an output within the county area. Occasionally, however, system processes enforce activities to be conducted outside the areal unit of the county. As listed in Appendix B, it can be seen that functionally the area is administered by many local authorities. This introduces a further components into the county system. The relationship between these local bodies varies considerably. In some cases the functions of another local authority may be administered from a County Council Office. (The Manawatu District Hydatids Committee and the Ruahine Pest Destruction Board are administered from the Oroua County Office). At the other extreme are large independent local authorities such as the Feilding Borough Council, Manawatu Catchment Board and the Manawatu Oroua Electric Power Board.

The County boundaries are stable but may be altered by a poll of ratepayers on a specific issue. One important boundary aspect is boundary conformity with the "community of interest" and patterns of economic activity in the county area. In previous attempts at local government reform, such attention was given

to the local nature of "community of interest". The five counties under study could well cover, when aggregated, a large portion of the economic and cultural hinterland of Feilding and Palmerston North. Also associated with system boundaries is the type of boundary demarcation that should be used. To date, most counties have at least one boundary based on a river. Quite often this administratively divides an otherwise unified region of activity. As shown in Figure 2, the Manawatu, Oroua and Rangitikei rivers form county boundaries.

System Malfunctioning and Response:

It is necessary to isolate instances of system malfunctioning as this gives insight into possible reasons for changing the existing county systems of the five counties. There are limitations on finance that restrict the amount of work that can be undertaken by the counties. Complementing the problem of insufficient input are difficulties that arise from a large number of local authorities governing one area. These two aspects underlie the present county amalgamation investigation being undertaken by the five counties under study.

A press article in Manawatu Evening Standard, 1969, June 25, indicates possible repercussion effects of Council decisions.

> " But almost without exception, council officers reported hard times. They complained about rising costs and wage increases. They tried to emphasise for the sake of the elected representatives that the National Roads Board could cut both the basic subsidy rates and the counties sector allocations in its five-yearly review, and tried to point out that by cutting back on roading works to keep the rates down would succeed only in postponing expenditure which would have to be faced sooner or later - and at increased cost."

Concomittant with the above is the indication that at least one county, Pohangina has had short run organisation and staffing difficulties.

The suggestion by No. 9A Roads District of the N.R.B. that it might degrade State Highway 54 in Kiwitea county to a country road represents an external 'perturbation that could drastically alter the operational pattern of the county. The removal of the State Highway designation brings with it a two fold effect. At present the State Highway Works programme is financed by the

N.R.B. and carried out by the Ministry of Works. The change would enforce a redistribution of county funds and a reorganisation of the works programme in terms of priorities. The net effect, in the short run, would be a reduction in the rate of county road construction because of the need to maintain a greater length of road miles out of county funds. At the same time, technological change elsewhere could be readjusting the relative position of the county with respect to the environment.

Despite attempts to peg rates over the last few years in all the five counties and raise income elsewhere either by loan or subsidy, the counties are gradually increasing the burden on their ratepayers. This is brought about by a legislative restriction requiring rate income to be raised from property owners. Not uncommonly, the rating issue assumes excessive proportions. Recently, for example, it has been argued that a change in the rating system from unimproved value to capital value rating in the counties of Kairanga and Manawatu would help to increase rate income particularly from industrial properties. However, a change in rating system need not necessarily increase rate income, unless it is stipulated the new rating system should yield more income than the previous system. This aspect is at present being investigated by Kairanga County Council.

Another source of system breakdown stems from boundary changes in 1967 between Kairanga County and Palmerston North City. The 3440 acres transferred to Palmerston North had largely state highway or sealed roads with low maintenance costs. Although an appeal to the Local Government Appeal Authority was dismissed, the County can anticipate stability of its Palmerston North boundary for at least ten years. Other minor boundary adjustments in recent years are tabulated below:

TABLE IV

POPULATION EFFECT OF BOUNDARY ADJUSTMENTS SINCE 1965.

Kairanga County	- 850 persons	Palmerston North City, 1 September, 1967
Oroua County	- 2 persons	to Feilding Borough, 1 April, 1967
Oroua County	- 30 persons	to Ashhurst County Town, 1 April, 1968
Manawatu County	- 0 persons	from Horowhenua County, 1 April, 1967
Manawatu County	- 200 persons	to Feilding Borough, 1 April, 1968.

Source: Extracted from Report on the Population, Migration and Building Statistics of New Zealand, 1967-68.

Administrative problems could arise from inadequacies in the system. The activities carried out by each county are frequently performed without reference to other counties. Difficulties may arise if, for example, counties disagreed on what constituted a correct policy for civil defence, beach development or the Manawatu Regional Abattoir support. At this juncture, the different subobjectives of each county might not be compatible. There are situations, however, where a county undertakes an activity of another county because of problems of access or to secure greater financial support. In addition, there is some employee sharing to reduce overhead costs. A number of instances are recorded below:

(a Kairanga County maintains the Oroua portion of Provincial State Highway No. 57A,

(b The grant and subsidy applications to National Roads Board, for the boundary bridges between Kiwitea and Pohangina Counties, are made by Pohangina County as it receives a higher rate of subsidy.

(c Kairanga and Manawatu Counties share the cost and services of one Health Inspector.

Relationships with other local authorities are not always harmonious. Kairanga County recently decided to investigate the possibility of Manawatu Drainage Board functions becoming amalgamated with those of the county. According to the press report, Manawatu Evening Standard, 1969, November 5, the Works Committee

" was concerned that the control of some road drains in the county by a separate local authority was resulting in the inability to coordinate roading and drainage works. It also expressed considerable dissatisfaction

in the fact that the Manawatu Drainage Board's district covered only part of the county, and the reluctance of the board to extend its district to cater for drainage needs outside its present boundaries was causing some difficulty in the county pursuing its programme of road works."

Further evidence exists to suggest the possibilities of system breakdown have been recognised for some time. A request by Kiwitea, Oroua and Pohangina Counties in 1962 to the N.R.B. prompted an investigation of the three counties concerned by a Survey Team. The counties were hopeful that if they amalgamated the N.R.B. would offer greater assistance. The board was not disposed to this view but was willing to increase assistance to Pohangina County. This has since been made available and is still continuing.

It seems clear that the strong possibility of local government boundary changes in the Manawatu area before 1972 by the local Government Commission, encouraged Kiwitea County once again to advocate an amalgamation discussion and investigation. Kairanga County, at first opposed to the idea, changed its attitude and joined the investigation. The reasons for the change of attitude are enumerated in the following press statement.

" The Kairanga County Council is approaching an unenviable decision. Its future moves are restricted to three (alternatives) - rate increase, drastic cuts in roading expenditure, or amalgamation. The first two are direct alternatives. Amalgamation could be the only way out, and is being considered seriously for the first time." (Manawatu Evening Standard, 1968, June 5).

In addition, a number of local issues were involved:

(a the three counties, Kiwitea, Oroua and Pohangina felt the lower counties should help meet the cost of their development,

(b there was uncertainty about future N.R.B. subsidies to counties,

(c there was a recognised need for some local government reorganisation and extension of county functions, and

(d a larger county was seen as a more influential body in dealing with other local bodies in the Manawatu area.

At a combined Council meeting held on August 19, 1968 to discuss amalgamation prospects, a subcommittee was appointed to investigate and report on aspects of amalgamation. The subcommittee appointed at the meeting was

given seven points of reference:

(a to obtain an equalised capital and unimproved valuation of the area,

(b to consider the incidence of rating based on capital and unimproved value to return an income consistent with the individual position at the present time, and project trends for the next 5, 10, 15 and 20 year period,

(c to negotiate with the N.R.B. to ascertain the needs of the district and the extent of financial contribution with or without amalgamation,

(d to report on all general financial matters, and estimated costs related to proposed roading developments in individual counties until 1974,

(e to outline and cost amalgamation and non amalgamation administrative and engineering organisations,

(f to examine existing staff usage, and

(g to survey all plant and machinery and cash reserves for plant renewal and indicate probable replacement needs up to 1974.

It was decided at the time that only two amalgamation combinations were politically desirable. These were amalgamation of the five into one unit, or any suitable division of the five counties into two areas based on existing boundaries.

It would seem that the investigation being carried out by the Counties' investigating subcommittee, even if only preparatory to a more detailed study, is restricted on one hand by political expediency and on the other by insufficient definition of the problem in hand. In order to overcome these deficiencies it is necessary to study various amalgamation combinations and clearly define criteria against which a proposed amalgamation may be assessed.

CHAPTER FOUR.

ASPECTS OF AMALGAMATION AS COUNTY SYSTEM CHANGE.

The Local Government Commission Act 1967 contains a broad summary of central government response to county system malfunctioning at both national and local levels. The Commission has been delegated functions that are designed to aid the operation of county processes to meet system objectives. The five functions listed below are complementary and introduce at a local level the importance of the criteria efficiency and effectiveness.

" the functions of the Commission shall be to carry out all such investigations ... to ensure that,

(a the system of local government in any area or locality best provides for the needs and continued development of that area or locality

(b local authorities have such district boundaries and such functions and powers as are necessary or expedient to enable them to provide most effectively and economically essential or desirable local government services and facilities

(c the purposes and provisions of this Act and any other Act in relation to local government or any aspect thereof are effectively implemented

(d local authorities have such resources as will enable them to engage adequate services and to obtain and operate adequate technical facilities, plant and equipment

(e districts will be of such size and nature as will promote efficient local government and avoid the necessity of uneconomic expenditure." (Local Government Commission Act 1967).

An examination of any aspect of amalgamation can be made using some or all the above objectives concerning system change and performance. System change could be precipitated by any type of internal or external perturbation. To study the desirability of amalgamation in terms of the problem objectives, portions of the anticipated changed system must be adequately represented. Only then can any reasonable assessment be made of the impact of the proposed changes. Thus, in order to simulate change, more may have to be done than merely "adding" two counties together. (Addition here refers to the summing of unchanged systems). In some cases this may be sufficient to bring about a change in efficiency or effectiveness. An example of this type of pre-amalgamation

assessment would be the considerations of between-county differences in functions undertaken. Frequently, however, amalgamation presupposes more complex system changes. In this respect any change may be seen from two viewpoints. First, part of the system is altered by county combination and the change studied by comparing the output of the changed portion of the system processes with that of the present output. Second, the degree of conformance of the county system/s with the external systems can be considered. Change here is brought about by addition but some definition of the relevant external system is also required.

Throughout this chapter several system changes and comparisons are made to demonstrate the extent of issues involved in any proposed amalgamation and some of the practical and theoretical difficulties accompanying any prior assessment of amalgamation. The simulated system changes are made in part response to inadequacies of some system operations. Many operation research techniques, such as Resource Allocation and Multi-Project Scheduling, Critical Path Analysis, or Replacement Modelling that would have given clear representations of aspects of system operation and system change could not be applied. This was because data was not in a suitable form, did not exist, or the counties only partially planned operations, thereby presenting difficulties in obtaining data. The system changes are frequently achieved only by introducing limiting assumptions to make the model operational. Where assumptions have been made, their implications are discussed and conclusions are drawn in terms of the assumptions.

Population Distribution Aspects of Amalgamation:

A variety of different techniques have been used to measure the spatial distribution of population in an area. Most utilise the variables, distance and population. Three measures are particularly suitable for determining various distributions of population in the environment system. They are population potential, mean centre and median centres of population.

Defined precisely, Population Potential, V, is:

$$V_i = \sum \frac{P_n}{D_n}$$

where: V_i is the population potential at point i,
P_n are the populations at n points, and
D_n are the distances from i to n points.

To construct a map of population potential, the point potentials were plotted on a map and isolines connecting points of equal population potential drawn in.

The median centre and mean centre of population are derived from the moments of population about any point. The moments about any point, i, in a pattern can be derived by the formula,

$$M_{x,i} = \sum (p.d^x)$$

where x is the particular moment concerned,
p is the population at a point, and
d is the distance to the point i.

The definition of the Median centre, M, or the first moment of population is:

$$M_i = \sum (P_n D_n)$$

where M_i is the first moment of population at point i
P_n are the populations at n points, and
D_n are the distances from i to n points.

The Mean centre, I, or the second moment of population is:

$$I_i = \sum (P_n D_n^2)$$

where I_i is the second moment of population at point i
P_n are the populations at n points, and
D_n^2 are the squares of the distances from i to n points.

To construct a map of either first or second moment values, the point moment values were plotted on a map and isolines connecting points of equal value were drawn in.

Stewart and Warntz (1958) regard population potential about a point as a measure of the nearness of people to that point, or as a measure of influence of people at a distance. For example, this may have a bearing on the amount

of community participation that could be expected in local government. The median centre of population is the point where the whole population could be assembled with the minimum aggregate travel distance. Finally, the mean centre reflects the degree of compactness or central tendency of population in an area. If the county boundaries are then considered in relation to the areal pattern of dispersion, the degree of conformity of the county system may be assessed.

A Fortran II computer program was written to calculate the areal pattern of population potential, median and mean population values for the five-county areas. Population figures were those obtained in the 1966 Census. Values for Feilding or Foxton Boroughs or Palmerston North City were not included in the analysis. Airline miles were used as the distance measure. This may have modified the impact on access of the Manawatu, Oroua and Pohangina rivers. It may also have increased the gradient of change between isolines of population potential but decreased it for median and mean centre values. Further, analysis was confined to the five-county area because of the data input procedure used. Grid overlays were used in compiling input data and since each overlay would yield a unique value for V, M and I, it was decided to perform three random rotations to investigate the effect of a change in grid orientation. The pattern of the isolines for each statistic had little between rotation variation. The steps taken in compiling the input data are outlined in Appendix C.

In interpreting the results, more attention should be given to the pattern of change rather than the absolute values recorded. It is apparent from Figure 5 that the highest population potential values are found between Feilding and Palmerston North. Such a grouping suggests that, ceteris paribus, the five-county area would be best serviced from administrative centres located in or near these urban areas.

The Efficiency of Administrative Centre Location:

The five counties are at present administered from five different county offices. They are Kairanga (Palmerston North), Kiwitea (Kimbolton) Manawatu (Sanson), Oroua (Feilding) and Pohangina (Pohangina). Various county functions

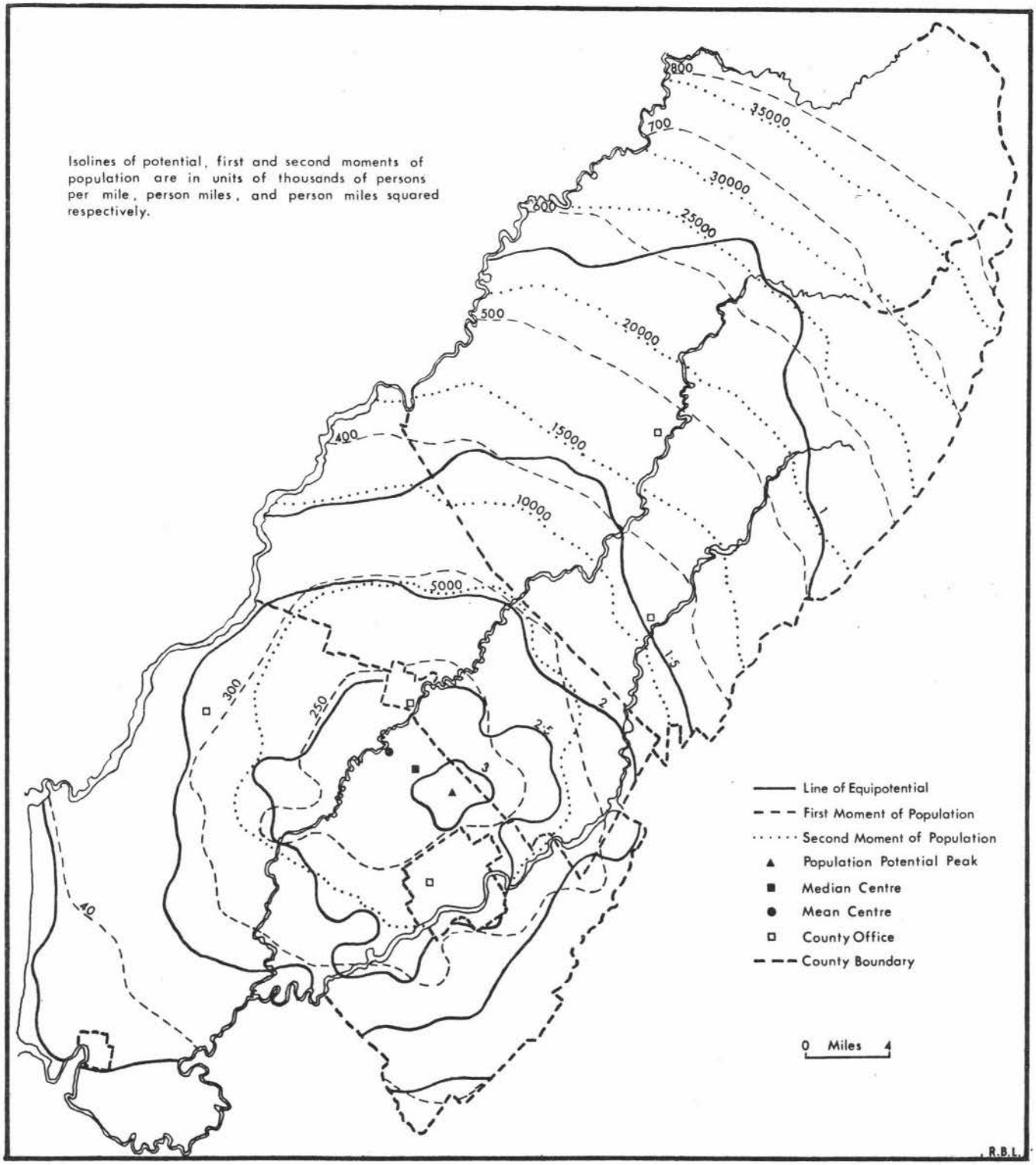

FIGURE 5.

POPULATION MOMENTS AND POTENTIAL OF THE FIVE COUNTY AREA 1966.

often lead ratepayers and residents to visit their county offices. With an amalgamation, several courses of action would be open. All administration could be centred in one office, or a number of existing offices might be re-designated area offices. Considerations such as the horizontal economies associated with building maintenance costs and centralisation tendencies in office procedures would become important in deciding the final policy on administrative centres.

The Index of Efficiency, E, provides a measure of the relative efficiency of each county office or proposed county office for any nominated amalgamation combination, in terms of the most efficient office location. The most efficient location of each combination was determined by the point of minimum aggregate travel or the median centre of population for the combination. The following assumptions were made when obtaining a value for E.

(a that the population in each census township, county town, locality and vicinity is located at the centre of the respective census category. Each areal centre of population constitutes a population cell. In the case of localities and vicinities around the boroughs of Feilding and Foxton, the centre was taken as the centre of the respective boroughs,

(b that airline distances are representative of the distance of each cell to its county office,

(c that the only politically acceptable (see Page 34) amalgamation combinations are: Kairanga and Manawatu; Kairanga, Manawatu and Oroua or Kiwitea, Oroua and Pohangina; and a five county amalgamation,

(d that the county offices would be located at any of the three centres, Feilding, Palmerston North and Sanson.

These assumptions clearly define the operational limits of the model.

The results are laid out in Table V to permit a comparison between the centres for each amalgamation combination. A comparison between centres for each amalgamation combination enables a number of tentative conclusions to be drawn.

Palmerston North is ranked highest for any amalgamation combination. This suggests that amalgamation of any counties, centred on Palmerston North,

would increase the efficiency of operation of the county system for that level of amalgamation. Of particular importance is the very low efficiency reading of Sanson for all amalgamation combinations. It would seem Sanson is not a very efficient location for a county office, particularly in a two county amalgamation between Kairanga and Manawatu counties. Feilding is consistently ranked second to Palmerston North. In a three northern county amalgamation, the choice of Feilding as an administrative centre would considerably reduce efficiency unless other locational factors such as access to specialised services outweighed the location at the edge of an amalgamated county. There could also be a further reduction in overall system effectiveness because of a need (brought about by administrative office location in Feilding) to maintain several engineering area offices. These would enforce continued duplication of facilities and staff.

TABLE V.

INDEX OF EFFICIENCY VALUES FOR ADMINISTRATIVE CENTRES.

Notations: Kai = Kairanga, Kiw = Kiwitea, Man = Manawatu, Oro = Oroua and Poh = Pohangina Counties.
E_1 refers to Index of Efficiency value for rotation 1.
E_2 refers to Index of Efficiency value for rotation 2.
The value of E lies between 0 and 1.

County	Administrative Centre	E_1	E_2
Kai	Palmerston North	*	*
Kiw	Kimbolton	(.89)	*
Man	Sanson	(.59)	(.65)
Oro	Feilding	(.82)	(.75)
Poh	Pohangina	(.86)	(.67)
Kai - Man	Sanson	(.48)	(.53)
Kai - Man	Palmerston North	(.62)	(.70)
Kai - Man - Oro	Feilding	(.90)	(.84)
Kai - Man - Oro	Palmerston North	(.91)	(.87)
Kai - Man - Oro	Sanson	(.71)	(.63)
Oro - Kiw - Poh	Feilding	(.76)	(.66)
Five Counties	Feilding	(.86)	(.81)
Five Counties	Palmerston North	(.99)	(.93)

* Values obtained were greater than 1.00 (see Appendix D)

There are several limitations to the above results. A small amount of variation may have arisen from the use of rotations and the choice of administrative centres and amalgamation combinations are only some representations of alternative system changes. Other locations and combinations could exist.

The Five County Road Network:

The area administered by the five counties is characterised by a road pattern that is complex and suggests an advanced stage of development. This represents one environmental variable that yielded high correlation coefficient values. The existence of roads and their pattern is basic to county operations and forms the starting point in the consideration of many county activities. The conceptualisation of the road network using Graph theory, and the subsequent analysis of connectivity yields information that is fundamental to the organisation of activity in the five-county area. The limitation of the analysis to the State Highway network in the local area (see Figure 6) was brought about by available computer storage. Accordingly, the results cannot be considered as general of the total road network of the five counties but it does indicate the importance attached to each centre by the external system. The procedures for obtaining measures of connectivity are outlined in Appendix E.

The total connectivity of each centre is summarised in Table VI. The values of total connectivity listed are the total number of ways any town (vertex) may be reached from every other town measured in terms of the graph's diameter.

TABLE VI.

TOTAL VERTEX CONNECTIVITY STATE HIGHWAY NETWORK FIVE COUNTY AREA.

Palmerston North	324	Foxton	140
Awahuri	252	Sanson	140
Feilding	251	Cheltenham	74
Longburn	250	Kimbolton	65
Linton	198	Rangiwahia	7
Ashhurst	187		

Inspection reveals the centres Palmerston North and Feilding are characterised by very high State Highway connectivity. This again supports earlier analysis and points to the areal focus on both Feilding and Palmerston North. Of note is the absence of any State Highway through Pohangina County and the low connectivity of the other county administration centres, Kimbolton and Sanson. The results of a complete network analysis of county roads would depend very much upon the influence of the dense road network in Kairanga and Manawatu counties, the number of bridge connections across rivers and the elongated roading pattern of Kiwitea and Pohangina counties.

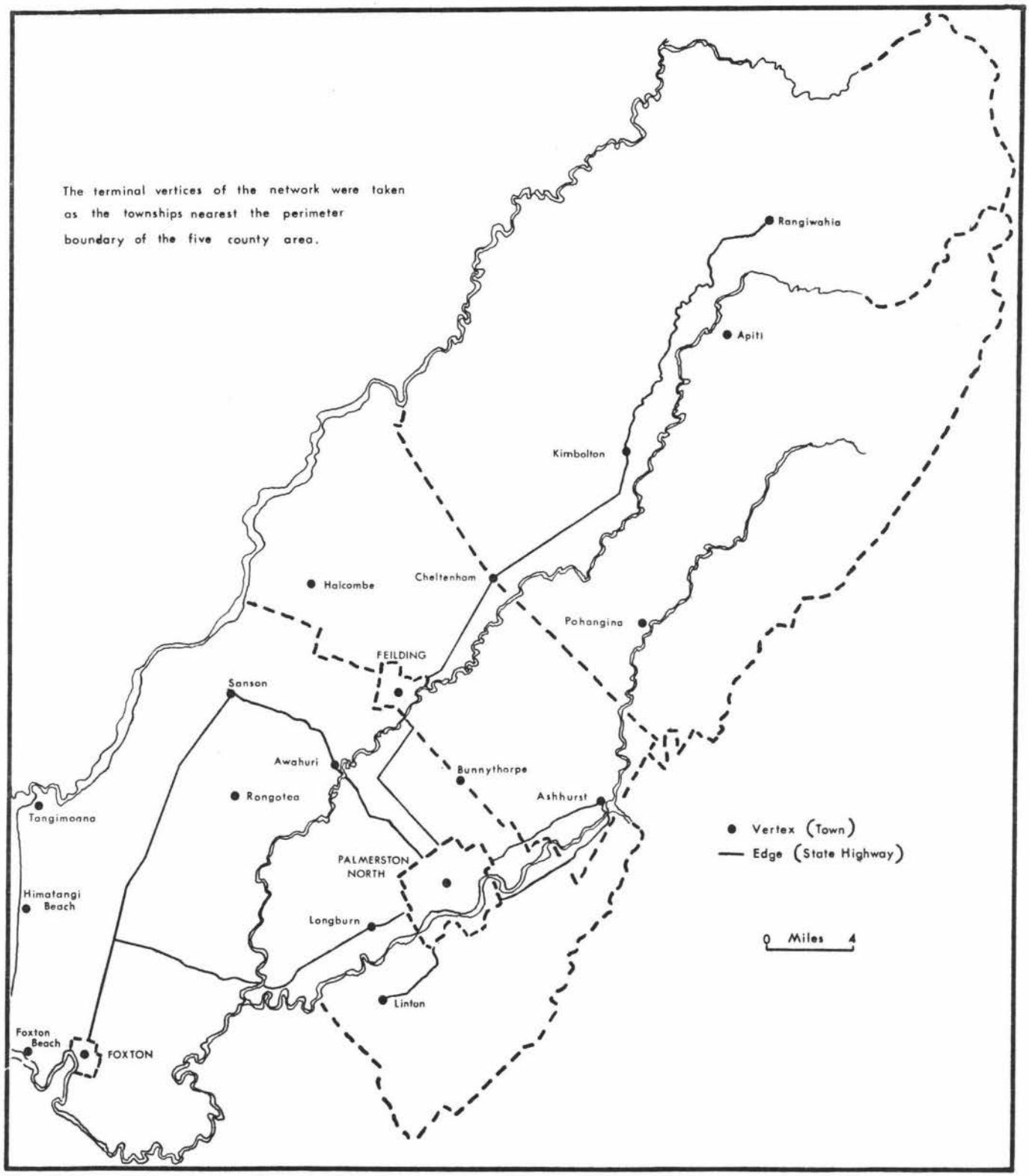

FIGURE 6.

THE STATE HIGHWAY NETWORK OF THE FIVE COUNTY AREA.

Simulated Change of County Metal Allocation:

As the works schedule of each county involves large capital and maintenance expenditure, it represents a sector of county processes that should be investigated for economies from amalgamation reorganisation.

The selection from this schedule of metal allocation for investigation was made because information could be compiled on metal allocation and requirements for the 1968-69 year of operation. It was possible to study this aspect of the system process in terms of a clear criteria of efficiency, that of dollar savings. The extensions of organisation likely with amalgamation include all aspects of work operation. They are all linked with the enlarging of operation area and an increase in number of resources used by one (combined) county system. The alteration of the operational area of the county with amalgamation could give access to economies that were previously unobtainable because of areally bounded operations.

The allocation of metal depends on the availability of the desired metal category at a source and the ability to deliver the metal to a particular works project or destination. These constitute the basic conditions of the problem. It is comparatively easy to allocate metal from one source to a destination providing metal is available. Difficulties in allocation are encountered when attempts are made to satisfy objectives such as minimum cost or minimum vehicle travel time. The number of alternative allocations that are optimal, (i.e., that satisfy both the basic conditions and the objective) are usually small.

The application of the linear programming technique, the Transportation Problem (Cox, 1965; Sasieni, Yaspan and Friedman, 1967) to allocation problems is one technique that determines an optimal solution. Appendix F contains a general statement of the Transportation problem. The information needed for the problem is as follows:

- metal sources (river beds or metal pits)
- the amount of production at each source (cubic yards)
- metal destinations (roadworks projects)
- the amount of metal required at a destination (cubic yards)

- the distance from each source to each destination (miles)
- transport costs from each source to each destination (cents per cubic yard mile
- production costs at each source (cents per cubic yard).

All input information was supplied by the County Council Engineers.
The criteria of efficiency is the reduction in allocation costs (if any) with optimal allocations.

The large amount of input information in the study necessitated computer processing and the I.B.M. 1620 Library Program, The Transportation Program With Indirect Addressing was used. The program had provision for the unbounded condition where a "dummy destination" was included because demand did not equal supply. A dummy destination does not influence the result or abstract the model from reality. It allows problem solution by 'demanding' the excess production from the sources. In the day to day running of the works programme the actual amounts produced at sources would equal the requirements. It provided an optimal solution for a minimum cost objective function and the allocations (from appropriate sources) and the objective function were listed. Input information was divided into two metal categories, namely basecourse and topcourse metal. The program was run for each category using both transport costs and combined transport and production costs as cost penalties.

A number of assumptions were made to facilitate problem solution. These are discussed below:

(a Homogeneity of metal within the categories basecourse and topcourse. The counties currently differentiate the above metal categories. Basecourse metal is spread at the base of a road while topcourse metal is spread on top of this prior to compaction and sealing. Each county favours certain local metal sources because they are closest or because the metal is suitable (in terms of the county road standards). Any amalgamation would lead to one general policy regarding metal sources.

(b In the program the underlying assumption is linearity, i.e. 10 units of production (or miles) cost the same as 10 times the cost of 1 unit of production (or miles). Both these represent first approximations. In reality, distances travelled are small and probably allow few economies with distance and production costs at river sources are generally constant. The county engineers of Kairanga

Kiwitea, Oroua and Pohangina Counties listed metal transport costs as ten cents per cubic yard mile. Manawatu County had transport costs of eight cents per cubic yard mile.

(c The county associated with any metal destination was assumed to pay for metal transportation. The Manawatu County per mile transport cost mentioned above placed the county at a cost advantage and allowed access to more distant sources.

(d Production at sources was arbitrarily constrained.

(e Road sections such as State Highway 54A were point located at the mid point of the section.

(f There were no barriers to sale or purchase of metal between the five counties.

In the basecourse analysis, forty sources and thirtyfive destinations (plus one dummy) were used. The topcourse analysis was confined to twentythree sources and thirtyone destinations (plus one dummy). The respective sources and production destinations and requirements, and production costs are tabulated in Appendix G. Transportation costs used were calculated by distance from source to destination multiplied by cents per cubic yard mile. In this manner a working model of various amalgamations is worked out for the 1968-69 year. The model differs slightly from the actual operation of the county processes. For instance, a whole year's allocation is planned in advance. This is not normally done by the counties. No provision was made for contingencies such as flooding, which could temporarily remove access to river sources. The transport costs assigned may differ from those that would prevail in a competitive situation. Production costs are only estimates as no accurate record is kept of production costs. In view of the costs being only approximations, it is difficult to draw absolute conclusions about county amalgamation. Attention should be focused on deviations from the present system pattern.

The savings computed for the counties are shown in Table VII. The value of the savings were obtained by summing the difference between the cost of the actual allocation (as defined by the input data) made in 1968-69 and the optimal cost determined by the program. The table is subdivided into program runs to allow comparison and give some idea of the impact of production costs (usually a proportionally lower cost penalty) on the metal allocations made. Very frequently

deviations from actual allocations, detected first in the transport cost runs were incremented in the subsequent transport and production cost runs.

TABLE VII.

TRANSPORTATION PROGRAM RESULTS FOR METAL ALLOCATIONS, 1968-69.

Iteration 1 refers to transport costs as cost penalties. Iteration 2 refers to transport and production costs as cost penalties.

	Topcourse Metal Savings (Dollars)		Basecourse Metal Savings (Dollars)	
	Iteration 1	Iteration 2	Iteration 1	Iteration 2.
Kairanga	1290	1290	1650	1350
Kiwitea	166	335	0	0
Manawatu	148	198	10254	10875
Oroua	880	1094	3034	3170
Pohangina	35	35	200	0

Of particular importance are the flows across existing county boundaries, namely, topcourse metal reallocations from Oroua to Manawatu County (destination) of 1989 cubic yards of metal and the basecourse reallocations from Kairanga to Manawatu County (destination) of 4261 cubic yards of metal.

The former reallocation suggests the large Manawatu County crushing plant is placed at a disadvantage by that County having lower per mile transport costs. In order to test the effect of a reduction in production costs of the Manawatu County crusher (source 12) on allocations, a third basecourse iteration was carried out. The reduction in per cubic yard cost by ten cents yielded a slight decrease in total costs. Significantly the only decrease recorded in Table VIII occurs in Manawatu County. This suggests that within the terms of the model, Manawatu County would have to reduce production costs considerably to become a more economical source or, alternatively, maintain constant production costs while the costs at other sources rise. At the same time, however, economies in the vehicle operations of other counties could be found and this could easily place the Manawatu crusher back on a less competitive base.

TABLE VIII.

TRANSPORTATION PROGRAM RESULT FOR VARIED PRODUCTION COST IN METAL ALLOCATIONS. 1968-69.

	Basecourse Metal Savings (Dollars)
Kairanga	1350
Kiwitea	0
Manawatu	9457
Oroua	3170
Pohangina	0

The results illustrate clearly the following implications for county amalgamation with respect to metal allocations. Firstly, an increase in efficiency of this portion of system processes is possible from internal reorganisation of metal allocation within counties. Had the year's allocations been tested for optimality at the beginning of the year, considerable savings could have been made. Secondly, alternative sources were made available by the removal of present county boundaries. Several large reallocations were made between counties for both metal categories. Year by year variations in metal destinations and requirements could result in further non-optimal allocations unless amalgamation or county trading restrictions were removed. Thirdly, the higher value of savings in the three counties, Kairanga, Manawatu and Oroua, could be the outcome of present allocation policies that tend to bias allocations to particular sources. Amalgamation in any form could remove many of these policy differences thereby allowing more efficient operation of this component of the system process.

Some Boundary Aspects of County Amalgamation:

The perimeter county boundaries of the five-county area include two major physical barriers; Manawatu County is bounded on the west by the sea while Pohangina and Kairanga counties are bounded on the east by the Ruahine and Tararua ranges. The Rangitikei River effectively forms a barrier to access into Kiwitea, Manawatu and Oroua Counties with only six bridge points linking the counties to Rangitikei County. In the south, the Manawatu River divides Manawatu and Kairanga counties and forms a perimeter boundary for Manawatu County. Considerable doubt exists as to whether there is any functional association between the northern area of Kiwitea County and Rangitikei County and the southern portions of Kairanga and Manawatu counties with Horowhenua County.

The absence of any published information on the conformance of the county boundaries with the 'community of interest' of the local area prompted an investigation of this aspect using Kairanga and Manawatu counties. Resident travel patterns were selected for study. Travel patterns in the county areas are assumed to reflect the pattern of human activity and community of interest for that area. By classifying travel according to trip purposes it is possible to

isolate many different travel patterns. In the study, the travel patterns originating in the two counties were tested for within county patterns, between county patterns and a uni-directional pattern to the adjacent counties of Horowhenua, Oroua and Rangitikei.

A questionnaire survey was undertaken to obtain data about travel patterns in the two counties. The questionnaire was designed to collect town travel frequency data categorised according to trip purposes for each household occupant over twentyone years of age. Five trip purposes were included. They were work, business but not work, shopping, entertainment and other purposes. This facilitated the collection of information on a number of major determinants of travel. The questionnaire sought travel information for a time period of four weeks so as to give more generality to any emergent patterns.

A number of problems arose in designing the sample survey. Firstly, the population in the county to be sampled was compiled from the current county electoral rolls. The choice of a household as the sampling unit was enforced by difficulties encountered in compiling a population of individuals with a single attribute such as age, occupation, or sex. It was anticipated differences could exist between rural and urban (county town) households, but the household population could not be accurately stratified into rural and urban households from addresses given in the County Electoral Rolls. The sample size was finally set at 100 households for each county after balancing the high costs of collecting the information sought by the questionnaire and the need to have a sufficiently large sample to give a workable number of questionnaire replies. The sample was selected randomly and independently.

Ideally the questionnaire approach should be that of a personal visit to each respondent. However, the widely dispersed and large population of households imposed financial and time limitations on the approach so a mail survey was used.

A pilot survey of twenty questionnaires, using stamped and addressed reply envelopes yielded a 55 per cent return. Several additions were made to the questionnaire at this stage as it was felt more information might be gained from

including questions on the following: place of work, means of transport to work, distance to Feilding and Palmerston North and one further township.

The main questionnaire was sent out to collect information for the four weeks previous to 8th November, 1969. The questionnaire and introductory letter is contained in Appendix H. Seventytwo completed replies were received with thirtyfour from Kairanga County and thirtyeight from Manawatu County. Five refusals were received. Twelve questionnaires were stamped 'address unknown' and a further random draw was made to replace these.

The possibility exists of various forms of bias in the sample survey. Households may be areally clustered with respect to travel patterns. It is also likely the county electoral rolls do not constitute a complete record of the household population in each county. The use of mail questionnaires, which are generally acknowledged to have high non-response rates, may have introduced further bias. There is no way of establishing whether those who replied have different travel patterns from those who did not reply. Non-response may have arisen from an unposted refusal, failure to take the trouble to return the questionnaire or an inability to furnish the information required. Care was taken to minimise misinterpretation, secure accurate completion of the questionnaire and encourage replies. Additional variation may also have unavoidably arisen from the time of questionnaire application. However, the time period contained only one statutory holiday, that of Labour Weekend, so it may be considered a representative four weeks.

The estimate of the population obtained from the sample is subjected to variation that is dependent in part on sample size. In the questionnaire survey it was necessary to obtain an estimate of the sampling error in each county so that chance differences in a travel pattern to any town caused by sampling would not be misconstrued as an actual difference in travel pattern of the parent population.

This was tested by calculating the confidence limits in each county for the proportion of households in the sample with one or more person trips to a given town. In Table IX the standard error (S.E.) attached to the proportions of

households with trips to specified towns are recorded. The towns outside the two county study area are grouped together into destination counties. Two sampling proportions, those of Rangitikei County (Bulls and Marton) and Sanson are sufficiently distinctive for the difference to be attributed to non sample variance. Other proportion differences are within the range of the standard error. The 95% confidence limit ($\pm$ 1.96 Standard Errors) was used.

TABLE IX.

STANDARD ERROR OF PROPORTIONS OF HOUSEHOLDS IN COUNTIES TRAVELLING TO SPECIFIED TOWNS.

	Kairanga County.			Manawatu County.		
Destination Town/s	% Households with trips to centre	S.E.%	1.96 S.E.	% Households with trips to centre	S.E. %	1.96 S.E.
Oroua County (Ashhurst, Bunnythorpe, Halcombe)	17	6.4	12.5	5	3.5	6.9
Rangitikei County(Bulls, Marton)	12	5.6	11.0	47	8.0	15.7
Feilding	29	7.8	15.3	50	8.1	15.8
Rongotea	14	5.9	11.6	39	7.8	15.3
Sanson	0	-	-	18	6.1	11.9
Foxton	15	6.0	11.8	21	7.0	13.7
Longburn	26	7.5	14.6	8	4.3	8.4
Palmerston North	97	2.9	5.7	82	6.1	12.0
Horowhenua County (Levin, Shannon)	9	4.9	9.6	13	5.5	10.7

The overlap of the confidence limits is not large. A larger sample would be necessary to establish whether the observed sampling variation can be attributed to non sample variation. It is not unreasonable to assume further sampling would establish the source of the variation as being non sampling variation. Bearing this assumption in mind it is then possible to proceed with the analysis of the questionnaire data and test a number of hypotheses about the travel patterns of the parent population. In the ensuing discussion results are postulated with respect to the possibility that statistical differences are partly the product of sampling error brought about by sample size for each county.

A summary of the questionnaire returns gives an indication of the relative importance of each town included in the questionnaire. The total number of household trips (Table X) and total household trips differentiated by purpose (Tables XI to XIII) for the four week period show the dominance of

Palmerston North as a centre for both Kairanga and Manawatu Counties. In Kairanga county no other town in the adjacent counties generates such a large number of trips. In Manawatu County three 'secondary' centres emerge. They are Bulls and Marton (Rangitikei County), Feilding (a borough adjacent to Manawatu County) and Rongotea (a county town centrally located in Manawatu County). A very low number of trips to towns in Oroua County and Levin and Shannon (Horowhenua County) are recorded. Trips appear to be confined to the area of the two study counties. Within these counties there are some between county differences. The 'secondary towns' of Kairanga County (Longburn) and Manawatu County (Rongotea and Sanson) are important only to people in their respective county. Breakdown of the total trips into trip purposes illustrates again the dominance of Palmerston North. Tables XI to XIII are compiled for towns having enough total trips to make further breakdown by trip purpose meaningful. No figures are included for the journey to work and distance from Feilding and Palmerston North as the information does not contribute to further understanding of the boundary aspects of amalgamation.

TABLE X.

TOTAL PERSON TRIPS FOUR WEEK SAMPLE PERIOD.

Destination Town/s or County	Head of Household (Male)	Head of Household (Female)	Other Household members Over 21 years of age	Total Trips
KAIRANGA COUNTY				
Oroua County (Ashhurst, Bunnythorpe, Halcombe)	33	12	0	45
Rangitikei County (Bulls, Marton)	3	1	2	6
Feilding	15	45	1	61
Foxton	8	5	7	20
Rongotea	13	3	0	16
Sanson	0	0	0	0
Longburn	29	8	2	39
Palmerston North	387	291	256	934
Horowhenua County (Levin, Shannon)	8	7	4	19
MANAWATU COUNTY				
Oroua County	0	0	10	10
Rangitikei County	78	68	2	148
Feilding	104	90	56	250
Foxton	49	20	1	70
Rongotea	89	68	20	177
Sanson	32	32	5	69
Longburn	5	2	0	7
Palmerston North	121	138	156	415
Horowhenua County	35	4	30	69

TABLE XI.

TOTAL PERSON TRIPS FOR BUSINESS, FOUR WEEK SAMPLE PERIOD.

Destination Town	Kairanga County Household Members		Manawaty County Household Members	
	Male	Female	Male	Female.
Feilding	13	11	47	12
Foxton	0	0	11	6
Rongotea	3	0	20	0
Sanson	0	0	22	6
Palmerston North	128	45	32	4

TABLE XII.

TOTAL PERSON TRIPS FOR ENTERTAINMENT, FOUR WEEK SAMPLE PERIOD.

Destination Town	Kairanga County Household Members		Manawatu County Household Members	
	Male	Female	Male	Female.
Feilding	0	0	7	14
Foxton	8	5	1	2
Rongotea	4	3	3	4
Sanson	0	0	0	2
Palmerston North	32	25	41	23

TABLE XIII.

TOTAL PERSON TRIPS FOR SHOPPING, FOUR WEEK SAMPLE PERIOD.

Destination Town	Kairanga County Household Members		Manawatu County Household Members	
	Male	Female	Male	Female
Feilding	12	10	31	65
Foxton	0	0	0	4
Rongotea	2	0	14	33
Sanson	0	0	7	23
Palmerston North	50	148	31	88

In the following analysis and discussion of the questionnaire date various null hypotheses are formulated, tested and accepted or rejected. Each hypothesis is aimed at clarifying the correspondence of county boundaries with travel patterns and community of interest.

The first null hypothesis, H_0, under test was that the two counties were not significantly different with respect to the relative frequency of total person trips per household to the towns listed in Table XIV. The alternative hypothesis, H_1, was that the frequencies were significantly different. The Chi-Square Test for independent samples (refer Appendix I) was used and the level of significance set at .05 with one degree of freedom (df = 1). N, the

number of households in the sample, was seventytwo. Table XIV below contains the results of the analysis. Palmerston North is not included in the Chi-Square analysis because the frequency distribution can be analysed by the more rigorous Median Test.

TABLE XIV.

ANALYSIS OF FREQUENCY OF TOTAL PERSON TRIPS PER HOUSEHOLD FOR KAIRANGA AND MANAWATU COUNTIES.

Notation: ns refers to, not significant at .05. H_0 was accepted
s refers to, significant at .05. H_0 was rejected in favour of H_1.

	1 week	3 weeks	4 weeks.
Oroua County (Ashhurst, Bunnythorpe, Halcombe)	ns	ns	ns
Rangitikei County (Bulls, Marton)	s	s	s
Feilding Borough	ns	s	s
Rongotea	ns	s	s
Sanson	ns	s	s
Foxton Borough	ns	ns	ns
Longburn	ns	ns	s
Horowhenua County (Levin, Shannon)	ns	ns	ns

The analysis of the total household trip distributions reveals no significant difference between counties for trips to adjacent towns in Horowhenua and Oroua counties. The significant difference of trips to Bulls and Marton is probably a response to the close proximity of these centres to a large portion of the population of Manawatu County. Similar trip frequencies and absolute number of trips to Horowhenua towns suggests a weak orientation of travel patterns and community interest to the south. The pattern to the secondary towns in each county yields a significant difference and this supports the existence of localised travel patterns to the secondary centres of Longburn, Rongotea and Sanson. Trips to Foxton Borough were not significantly different in the sample.

The confidence limits indicate the proportion of household trips to Feilding in each county are not significantly different. The results of the analysis, however, show significant differences between the county trips to Feilding. If these results are accurate estimates of the total population behaviour, some doubt can be cast upon Feilding as a suitable administrative centre given amalgamation.

In order to test the larger trip volume to Palmerston North, the Median

Test for independent groups was used (refer Appendix I). H_0, was that the trip frequencies to Palmerston North for the two counties were from populations with the same median. H_1, was that the median of one population is higher than that of the other. This constitutes a one tailed test of the direction of the difference. N was set at 72 and the level of significance used was .025 with df = 1. Table XV summarises the results. The test results demonstrate that the total household trip frequency of travel to Palmerston North is higher for Kairanga County.

TABLE XV

ANALYSIS OF FREQUENCY OF TOTAL PERSON TRIPS PER HOUSEHOLD FOR KAIRANGA AND MANAWATU COUNTIES.

Notation: ns refers to, not significant at .025. H_0 was accepted
s refers to, significant at .025. H_0 was rejected in favour of H_1.

	1 week	3 weeks	4 weeks.
Palmerston North	s	s	s

The above test uses more information in the frequency distribution and increases the chance of H_0 being retained.

By testing the difference between frequency distributions to the centres Palmerston North and Sanson, Feilding and Sanson and Feilding and Palmerston North, it is possible to gain more information about travel patterns within the county areas. Using again the Median Test, with significance level set at .025 for df = 1 and N = 72, the following were hypothesised. H_0, was that the trip frequencies to any two centres in the same county are from populations with the same median. H_1, was that the median of one population is higher than that of the other. Tables XVI and XVII contain the results of the analysis.

TABLE XVI.

ANALYSIS OF THE FREQUENCY OF TOTAL PERSON TRIPS PER HOUSEHOLD FOR TOWNS FEILDING AND SANSON, AND PALMERSTON NORTH AND SANSON.

Notation: s refers to, significant at .025. H_0 was rejected in favour of H_1.

	Manawatu County.		
	1 week	3 weeks	4 weeks.
Feilding and Sanson	s	s	s
Palmerston North and Sanson	s	s	s

TABLE XVII.

ANALYSIS OF THE FREQUENCY OF TOTAL PERSON TRIPS PER HOUSEHOLD FOR TOWNS FEILDING AND PALMERSTON NORTH.

Notation: na insufficient data for Median Test analysis.
ns refers to, not significant at .025. H_0 was accepted.
s refers to, significant at .025. H_0 was rejected in favour of H_1.

	1 week	3 weeks	4 weeks.
Kairanga County	s	na	s
Manawatu County	s	s	s

Each testing substantiates the difference between the existing county centre and a proposed amalgamation county centre. The median trip frequency to Feilding and Palmerston North is higher than Sanson for Manawatu County. A similar pattern emerges for Feilding and Palmerston North for both counties. The nature of the difference is partly explained by the trip purpose breakdown.

One further test was carried out to ascertain other influences in the results presented above. Each frequency distribution was subdivided into male and female frequency distributions. These were then tested using the Chi-Square test, with N = 72 and a significance level of .05 for df = 1. H_0, was that there was no significant difference between subdivided male and female frequency distributions to each town. H_1, was that there was a significant difference. Because of insufficient data, the analysis was performed for only Feilding, Palmerston North, Rongotea and Sanson. In each case H_0 was accepted.

The following tentative conclusions about county boundaries and amalgamation may be drawn from the analysis. Secondary towns in either Kairanga or Manawatu county are most important to their respective county, whilst Feilding and Palmerston North are important towns for both counties. This may be symptomatic of a broad regional focus on these large towns that ignores present county boundaries. County amalgamation between the two counties, with offices at either Feilding or Palmerston North would conform with the present travel patterns. Also, the importance of towns outside the area of the two counties is not great. Thus, in terms of travel patterns generated from within the counties, the present boundaries represent reasonable boundary approximations to the pattern of travel outside the two county area. No conclusions can be drawn about the travel patterns of people resident in areas adjacent to the counties.

CHAPTER FIVE.

SYSTEM FEEDBACK AND CONCLUSION.

In order to make recommendations about county amalgamation in the Manawatu area, it is necessary to assess the results of the system changes examined in Chapter Four. Variables that were postulated as relevant in the general system relationship were studied in greater detail to allow close approximation to the particular systems of the study counties. Population and roading aspects were considered in the light of proposed county amalgamation. The isolation of instances of system malfunctioning or county council problems were interpreted as initiators of system response and change. By treating amalgamation as only one example of possible change, other alternatives were not dismissed.

The changes made were aimed at testing whether amalgamation would fulfil the objectives of the Local Government Commission. The changes were also designed to demonstrate that detailed study of county operations can yield relevant information about amalgamation. Each change studied must be interpreted in terms firstly, of the model used and secondly, other related system operations. The results obtained are products of the conceptualisation of particular aspects of system change and operation but the procedures used can easily be extended into other system operations relevant to amalgamation. The information about the changed system is discussed and compared with the present system. In this way the system parameter of feedback is made operational.

It is realistic when making policy recommendations to take into account political considerations. There is a need to consider the degree to which any change will be accepted by the county ratepayers and residents or any other interested party. It is very likely any amalgamation decision for the five counties or any combination of these will be made not on definite evidence either for or against, but on the basis of the combined experience of the elected representatives. Therefore, in the ensuing discussion, attention is given to some of the political implications associated with the feedback conclusions.

Taking first the population distribution aspects of amalgamation. From the results given it is possible to conclude a number of points. The five county area has a point of greatest influence and minimum travel in the vicinity of Feilding and Palmerston North. The population is concentrated in the Kairanga, Manawatu and Oroua counties. A dispersed and declining population in Kiwitea and Pohangina counties limits the effectiveness of these counties. The counties are confronted with a large area of land and human activity which is primarily orientated towards Feilding and Palmerston North. The focus has been demonstrated but it remains a political decision as to whether local area government or regional local government is chosen. Should the decline in population of Kiwitea and Pohangina counties continue, the per capita costs of county operation could easily increase. An amalgamation of these two counties with perhaps Oroua or Kairanga, Manawatu and Oroua Counties could lead to a redistribution of per capita costs of county operation that would benefit Kiwitea and Pohangina. More particularly, the counties may not be able to raise sufficient rates to prevent system malfunctioning or even breakdown. One objective stresses the provision of a system of local government that would best continue development. The evidence presented on the population distribution aspects of amalgamation suggests a need to consider the regional context.

Complementing the above results is the Index of Efficiency of the administrative centres. The index provides information about the relative efficiency of each existing administrative centre for any amalgamation combination. Two points emerge. Palmerston North and Feilding are consistently ranked as more efficient locations for county offices. More importantly, greater areal and population efficiency is achieved through amalgamation combinations rather than for existing counties. A five county amalgamation with Palmerston North as the administrative centre would be the most efficient location in terms of population and distance from the administrative centres. The three county amalgamation of Kairanga, Manawatu and Oroua counties based on Palmerston North is ranked second, while the same combination based on Feilding is third. The choice of the centre

could depend on other factors such as the proximity of specialised facilities and services needed for local government and the availability of land for building expansion. Another factor is the amount of impact any change would have on county vehicle usage and the charges for plant operation. Likewise, a change in county office location could influence the availability of staff and affect the wage and salary payments. Further, the establishment of 'area' offices for county engineers could reduce any gains in efficiency by increasing the running costs.

Study of the connectivity of the State Highway network provides further evidence to suggest the area has a focus on Palmerston North. This analysis investigated one of the more important variables in the county system, that of roading.

The specific system change that dealt with metal allocation provided considerable information about the impact of amalgamation on this aspect of county operation. An increase in efficiency would take place given any amalgamation combination. However, greater savings are found in the three lower counties where the total volume of metal used is higher and the mileages to alternative sources are not as great. Part of the amalgamation savings can be attributed to the absence of any policy or preference decision in the model (the criterion is minimum cost). The model highlights probable large monetary savings for the county amalgamation of Kairanga, Manawatu and Oroua counties. Amalgamation would probably remove bias against particular sources as allocation decisions for the three county area would be made by one engineer. A five county amalgamation would not increase costs or reduce efficiency. The extra increment of efficiency is small when Kiwitea and Pohangina counties are included.

The evidence presented is for only one year of allocation but the large amounts of dollars involved encourages examination of future yearly allocations should an amalgamation take place. The cumulative cost reductions over time are also complemented by other possible savings associated with more efficient metal allocation. The reduction in vehicle miles would liberate vehicles and labour for other county work, thereby increasing the rate of county development. At the same time bulk processing or purchase of metal could be a source of further

economies. The planned operation of metal trucking in any amalgamated county might lead to further streamlining of operation. The model could be extended to include the purchasing of sealing chips for road surface sealing.

The analysis of boundary considerations using travel patterns as the bounded activity in Kairanga and Manawatu counties gave an indication of the effectiveness of the county boundaries. The orientation of the counties is toward both Feilding and Palmerston North. Little travel outside the study counties (except to adjacent Feilding Borough) suggests the counties contain people with a community of interest that is within the two county area. The southern boundary with Horowhenua county does not conflict with travel patterns. The boundary with Rangitikei county is not so definite, with Bulls and Marton generating inter-county trips from Manawatu county. Oroua county does not attract people from the two county study area. The boundary between Oroua and the two study counties, however, may not reflect the boundary of any community of interest. Quite probably Feilding and Palmerston North are major trip generators well into Kiwitea and Pohangina counties. Further investigation would clarify the broad area of influence of various centres on each county. Providing no loss of efficiency in the total system operations is brought about by boundary alteration, community of interest could serve as a sound basis for fixing county boundaries.

The aspects of amalgamation studied do not form a complete investigation. Many other issues and county operations require detailed investigation if useful evidence is to be presented to Councillors or ratepayers and residents. In terms of systems analysis the critical components must have been investigated before any conclusions about total system effectiveness are reached. Detailed study of administrative procedures, office equipment and salary payments before and after simulated amalgamation would enable hypotheses such as "amalgamation would reduce the number of staff employed" to be adequately tested. Replacement theory could be used to deal with work situations in which efficiency tends to decrease in time, but where it can be restored to any earlier level by some kind

of remedial action. Simulated amalgamation could establish likely savings in say vehicle replacement. Definite statements on the qualititative effectiveness of essential services such as air and water pollution, noxious weed eradication, planning bylaws and public health would enable a closer look at possible gains in effectiveness of these operations with amalgamation. The question of representation cannot be overlooked and a yardstick might well be formulated to assess various representation schemes. The usefulness of network analysis could be extended to include county vehicle allocations on the basis of work and road classification. The objective could be the minimising of miles travelled which would increase the 'work' time of the vehicle. An example of this would be grader allocation. County graders might not be operating to capacity at present. Providing factors such as the portions of road requiring regular grading, the cost of operating the grader and the maximum and minimum number of miles or hours of operation per day per vehicle are known, then operation under simulated amalgamation conditions could be carried out using connectivity, shortest path or mileag. matrices as input data.

There are, however, serious limitations to the county system as it now operates that make any amalgamation investigation a difficult task. On one hand no county has a definite policy outlining what it intends to achieve over a given time. Priorities are rarely assigned and the relative importance of service or work requirements are intuitively decided. The issue cannot be escaped by referring to legislative duties and responsibilities. These are only constraints or the framework in which the counties operate. On the other hand, procedures are not orientated towards efficiency, effectiveness or problem solving. Instead they are linked very closely to the annual audit. Difficulties met in the analysis of county organisation might be overcome if the counties chose to:

(a standardise works policy, procedures and standards,
(b undertake cataloguing and storage of information other than that necessary for the annual auditing of accounts, and
(c adopt and introduce data organisation and activity investigation procedures such as systematic planning or systems analysis.

If the above procedures were adopted it will be easier to examine carefully any proposed county amalgamation. Decisions would have more likelihood of being based on evidence about county operations rather than various opinions about the state of county operation. Further, county amalgamation studies require consideration of a number of points. These are listed below.

(a A definition of the counties operations and performances.

(b Definition of performance standards and amalgamation objectives.

(c Change of the present operations to represent at least some aspects of the amalgamated county operation.

(d Assessment of the amalgamation proposals in the light of performance standards and amalgamation objectives.

The statistical analysis of various aspects of the county system operation and the simulation of change could be reapplied to gain further knowledge about county government. In particular, the use of linear programming could place many county activities in clearer perspective. For instance, metal destinations and requirements for any year could be estimated in advance and a few minutes of computer time would yield an optimal or feasible solution. The program could easily be developed to decide questions such as the 'next best source' if flooding occurred or production at a source was inadequate. The key point in applications of this sort would be the availability of evidence on the relative efficiency of operations. This would remove any doubt about efficiency of operations and confirm the belief of optimists about current economical operations.

CONCLUSION:

By using a systems framework to study the question of the desirability of county amalgamation it was possible to arrive at a number of conclusions. County local government was first defined and structured as a system. The importance of population, valuation, total road miles and the National Roads Board to county operation was demonstrated. Some of the relationships associated with these variables were examined in detail for the five counties Kairanga, Kiwitea, Manawatu, Oroua and Pohangina to see if amalgamation would lead to gains in

efficiency and effectiveness of local government.

The evidence from the population distribution aspects of the five counties indicated greater influence of population, shorter travel distances and more compactness of area for a county centred on either Feilding or Palmerston North. The use of an Index of Efficiency of the county administrative centre locations confirmed this. A graph theory analysis of the State Highway network also pointed to the focus on Palmerston North. The above aspects of county amalgamation considered aspects of efficiency in county government in non-monetary terms.

The simulation of metal allocations under amalgamation conditions leads to the conclusion that amalgamation would be likely to bring about economies to Kairanga, Manawatu and Oroua Counties, providing policy differences between the counties were eliminated. Very few economics were found for Kiwitea and Pohangina counties. Further, with respect to this component of county operations, amalgamation would not lead to reduced efficiency. The same work output would be achieved for slightly reduced costs. Since costs include many components such as vehicle time, availability and operation costs and labour overheads, more money could be expended on other county operations. The net effect would be either an increase in county work output or reduction in energy input (money allocated for expenditure). As amalgamation is contemplated by the counties as one way of countering system malfunctioning, an increase in output or the rate of development could be the more probable amalgamation gain.

The examination of the county boundaries of Kairanga and Manawatu counties tested a number of hypotheses concerning similarity between travel patterns in the two counties. This aspect dealt with the community of interest of the county areas and is basic to any proposed amalgamation. The southern boundary of the two counties represents an adequate county boundary, but that between the two appears to cut across actual travel patterns. The focus of the two counties on Palmerston North is supported. County government in the five county area could well be based on the regional centre of Palmerston North.

Finally, only a tentative conclusion may be drawn about the impact of amalgamation on the effectiveness of county local government in the study area.

The cumulative effect of the results obtained is one of increased county effectiveness under amalgamation operation. However, until all the relevant aspects and anticipated gains of amalgamation have been analysed in detail it is not possible to advocate or oppose categorically any amalgamation combination.

APPENDIX A.

VARIABLES USED IN RANK CORRELATION ANALYSIS.

Variables following a colon represent a breakdown of one variable into a number of component variables.

EXPENDITURE VARIABLES

Administration:	Salaries and wages
Maintenance of Works and Services:	Roads, streets, bridges and footpaths; Halls, domains and reserves; Eradication of noxious weeds; Central plant hire and operation; Salaries and wages.
Capital Expenditure out of General Funds:	Central Plant purchases. County roads, streets, bridges and footpaths.

Total County Expenditure.

INCOME VARIABLES

General Rates.

N.R.B. Grants and Subsidies.

Ministry of Works Grants and Subsidies.

Other Grants and Subsidies.

ENVIRONMENT VARIABLES

Area.

Capital Property Valuation.

Percentage of Developed Land, $\left(\frac{\text{area in farm land}}{\text{total area}} \times 100 \right)$.

Total Population.

Population Density per Square Mile.

Population Resident in County Towns.

Percentage of Population Living in County Towns.

Miles of Paved Roads.

Miles of Metal Roads.

Miles of Unmetalled Roads.

Total Road Miles.

Percentage of Total Road Miles as Paved Roads.

Percentage of Total Road Miles as Metal Roads.

COUNTY LABOUR FORCE VARIABLES

Number of Administrative Employees.

Number of Other Employees.

APPENDIX B.

LOCAL AUTHORITIES OPERATING IN THE FIVE COUNTY AREA.

Only the portions of the five county area administered by the following local bodies are mentioned.

Feilding Borough Council.	
Feilding Urban Fire District:	portions of Manawatu and Oroua counties.
Foxton Borough Council.	
Makerua Drainage Board:	portion of Kairanga County.
Manawatu Catchment Board:	Kairanga, part of Oroua and Pohangina counties.
Manawatu District Hydatids Committee:	the five counties.
Manawatu Drainage Board:	portions of Manawatu and Oroua counties.
Manawatu Oroua Electric Power Board:	the five counties.
Manawatu Pest Destruction Board:	Kairanga and Manawatu counties.
Oroua Drainage Board:	part of Manawatu county.
Palmerston North City.	
Palmerston North Hospital Board:	the five counties.
Palmerston North Urban Fire District:	Kairanga county.
Rangitikei Catchment Board:	a portion of Kiwitea, Oroua and Manawatu counties.
Ruahine Pest Destruction Board:	Kiwitea, Oroua and Pohangina counties.
Sluggish River Drainage Board:	part of Manawatu county.
Urban Fire Districts:	of Cheltenham, Kimbolton, Rangiwahia, Rongotea and Sanson.
Wellington Harbour Board:	the five counties.

APPENDIX C.

COMPILATION OF INPUT DATA, POPULATION POTENTIAL-MEDIAN CENTRE-MEAN CENTRE PROGRAM.

The following steps were involved in data preparation:

1. Census areas derived from Increase and Location of Population, 1966 were located on a base map (Scale 1:253,440) and respective populations recorded.

2. A coordinate grid of size two miles by two miles was overlaid on the base map. Population values were assigned to each grid cell, with those on grid borders being allocated alternately. The grid cells were used as population points 1 to i.

3. The grid information was then punched in matrix form. Each element of the matrix contained one of three data categories. Cells within the five-county area were represented by 1's. The remaining cells of the matrix were represented by 0's, defining the area outside the five counties. Where a grid cell had a population value, the one was omitted and replaced by a population value.

4. Three data input matrices were used, one for each of three random rotations. The rotations were zero degrees North, 125 degrees North and 237 degrees North.

APPENDIX D.

COMPUTATIONAL PROCEDURE FOR CALCULATION OF INDEX OF EFFICIENCY.

The population values were obtained from Increase and Location of Population, 1966.

1. The Mean Centre of Population, I, for each combination was calculated.

2. The Median Centre of Population, was approximated using cumulative frequency graphs.

(a A base map (scale 1:253,440) of the area was overlain with a two miles by two miles grid. Population points values were aggregated in each grid cell and the rows and columns of the grid matrix summed. The grid row and column containing the midpoint of the cumulative frequency curve were determined. This was transferred back to the base map and designated the optimal or most efficient centre location.

(b Three random rotations of zero degrees North, 125 degrees North and 235 degrees North were made to check on variation from the grid overlay.

(c Two rotations, zero degrees and 125 degrees North were the two extreme values (furtherest apart) in the rotational pattern of median centre location.

3. Two values of I, designated I_1 and I_2 were calculated with respect to the optimal centre locations.

4. The Index of Efficiency was then calculated by the formula

$$E = \frac{I_{1,2}}{I}$$ giving a value between zero and one.

As E tends to one, so the distance between the optimal and actual centres is reduced. Thus, a location with a value of E at .80 is more efficient than a location with a value of E at .70. The location of the actual centre is closer to the optimal centre for the higher value of E.

In the results, three values of E were recorded at E greater than one. This was caused by variations in the value of the optimal centre from rotating the grids.

APPENDIX E.

COMPUTATION PROCEDURE CONNECTIVITY MATRIX STATE HIGHWAY NETWORK IN STUDY AREA.

The following paragraph is based on Busacker and Saaty, 1965 and Garrison, 1960.

In graph theory notation, a vertex refers to 'places', an edge to 'a route' and the graph refers to the 'highway system' or 'network'. An ordinary network corresponds to a one-zero-vertex matrix $X = (x_{ij})$ when: $x_{ij} = 1$ if, and only if, a route exists between i and j; otherwise $x_{ij} = 0$.

The information in Figure 6 is reduced to a one-zero vertex matrix X with the following form:

$$X = \begin{matrix} 0\ 0\ 1\ . \\ 0\ 0\ 0\ . \\ 1\ 0\ 0\ . \\ .\ .\ .\ . \end{matrix}$$

Each of the nineteen townships, county towns, boroughs and city are listed along both the columns and rows of the 19 x 19 matrix. A 1 denotes a direct connection between two settlements while a 0 denotes no direct connection. By raising the matrix to the power of the graph diameter (six in this study example) it is possible to derive a matrix X(6) which contains the following information about the network; the diagonal entries indicate the total number of six-step routes utilisable in going out and back from a settlement and the other entries give the total number of six-step routes between pairs of places. By adding across each row a <u>total measure of connectivity</u> for each vertex is found. A portion of the powered matrix is shown below.

$$X(6) = \begin{matrix} 5\ 0\ 0\ 0\ 9\ . \\ 0\ 0\ 0\ 0\ 0\ . \\ 0\ 0\ 14\ 0\ 0\ . \\ 0\ 0\ 0\ 0\ 0\ . \\ 0\ 0\ 0\ 0\ 22\ . \\ .\ .\ .\ .\ .\ . \end{matrix}$$

APPENDIX F.

GENERAL STATEMENT OF THE TRANSPORTATION PROBLEM.

Suppose there are m origins (metal pits or river access point) and n destinations (road reconstructions). At the ith origin a_i cubic yards of metal are available (i = 1, ..., m). At the jth destination b_j cubic yards of metal are required (j = 1, ..., n). If supply equals demand, total production or extraction of metal equals the total amount of metal required on roading works. There are mn possible routes from each one of the m origins to each one of the n destinations. There is a cost (per cubic yard of metal transported) associated with each route. Specifically, it costs $\$c_{ij}$ to transport one cubic yard from origin i to destination j. The requirement is the last cost transport schedule. If x_{ij} cubic yards are sent from origin i to destination j then the cost of such is $c_{ij}\, x_{ij}$.

The model can, therefore, be stated as:

To minimise the objective $Z = \sum_{i=1}^{m} \sum_{j=1}^{n} c_{ij}\, x_{ij}$

subject to the constraints:

$$\sum_{j=1}^{n} x_{ij} = a_i \qquad i = 1, 2, \ldots, m$$

$$\sum_{i=1}^{m} x_{ij} = b_j \qquad j = 1, 2, \ldots, n$$

$$x_{ij} \geq 0 \text{ for all } i, j$$

$$\text{and } \sum_{i=1}^{m} a_i = \sum_{j=1}^{n} b_j$$

When supply exceeds demand a dummy destination is created at a zero distance (and cost) from every origin.

More detailed explanations with examples can be found in Cox, 1965; Rimmer, 1968, Sasieni, and Yaspan and Friedman, 1959, 199 - 221.

APPENDIX C.

BASECOURSE AND TOPCOURSE SOURCES AND PRODUCTION DESTINATIONS AND ASSIGNED PRODUCTION COSTS.

Metal Sources and Production Constraints.

Topcourse

Source	Production (cubic yards)
1. Child Bros Ltd.	5000
2. Manawatu Ashphalt Ltd	5000
3. Higgins and Sons Ltd.	5000
4. G.C. Smith Ltd.	5000
5. Maxwells Line Shingle Ltd.	5000
6. W. Smith Ltd.	5000
7. Puhenui Crusher	10000
8. Vautiers Pit	2000
9. Rangatawa	2000
10. Kiwitea	2000
11. Robert's Pit	2000
12. Gould's Pit	2000
13. Raumai	2000
14. TeAwa - Coulters	2000
15. Oroua Bridge	2000
16. Ruahine	2500
17. Gorge Road	8000
18. Rewa	2500
19. Shannon	2500
20. Otara	2500
21. Pourangaki	2500
22. Beaconsfield	2500
23. Vinegar Hill	2500
Total production available	81500

Basecourse.

Source	Production (cubic yards)
1. Child Bros Ltd	20000
2. Manawatu Ashphalt Ltd	20000
3. Higgins and Sons Ltd	20000
4. Karere Beach	30000
5. Kopane Beach	15000
6. James Line Pit	5000
7. G.C. Smith Ltd.	20000
8. Awahuri Beach	15000
9. Te Puna Beach	15000
10. Maxwells Line Shingle Ltd.	20000
11. S. Smith Ltd.	20000
12. Puhenui Crusher	40000
13. Rangitikei River	10000
14. Jackeytown Road	10000
15. Shannon	10000
16. Brennan's	10000
17. Pohangina	10000
18. Heneghans Line	10000
19. Kiwitea	15000
20. Oroua	20000
21. Kakariki	10000
22. Shorthalls	10000
23. Feilding Borough Council	15000
24. Robert's Pit	10000
25. Gould's Pit	10000
26. Raumai	20000
27. Totara Reserve	15000
28. Komako	15000
29. TeAwa-Coulters	15000
30. Oroua Bridge	15000
31. Marton Block - Oroua Gorge	20000
32. Ngaputahi	15000
33. Ruahine	15000
34. Gorge Road	15000
35. Rewa	15000
36. Shannon's	15000
37. Otara	15000
38. Pourangaki	15000
39. Beaconsfield	15000
40. Vinegar Hill	15000
Total production available	625000

Appendix G (cont'd)

Metal Destinations and Requirements.

The destinations used in the program were specific locations on each road. For convenience, only the road name of the destination is listed.

Topcourse		Basecourse	
Destination	Requirements (cubic yards)	Destination	Requirements (cubic yards)
1. No.1 Line	1000	1. No. 1 Line	2000
2. Roberts Line	700	2. Roberts Line	8000
3. Flygers Line	600	3. Flygers Line	1500
4. Linton Station Road	700	4. Linton Station Road	4000
5. Main Drain Road	200	5. Main Drain Road	2000
6. Kahuterawa Road	200	6. Kahuterawa Road	1000
7. Longburn-Rongotea Road	2000	7. Hamiltons Line	2500
8. Longburn Footpaths	106	8. Longburn-Rongotea Road	24000
9. Milson Bridge Approaches	236	9. Milson Bridge Approaches	1000
10. Poutu Road	99	10. Poutu Road	1089
11. Taylor Road	829	11. Taylor Road	2735
12. Foxton Beach Streets	106	12. Foxton Beach Streets	198
13. Fairfield Road	197	13. Fairfield Road	184
14. Bainesse Road	1686	14. Bainesse Road	4077
15. Wilson Road	670	15. Wilson Road	3016
16. Napier Road	240	16. Motuiti Road	5662
17. Midland Road	588	17. Himatangi Block Road	5506
18. Mangaone Road	1656	18. Napier Road	1911
19. Ashhurst-Bunnythorpe Road	1600	19. Midland Road	5206
20. Wyndham Street, Ashhurst	254	20. Mangaone Road	6109
21. Waiata Road	104	21. Ashhurst-Bunnythorpe Road	13000
22. Ridge Road	700	22. Lethbridge Road	1156
23. Cheltenham-Hunterville Road	2031	23. Wyndham Street, Ashhurst	2009
24. State Highway 54 A	1380	24. Makara Road	1105
25. State Highway 54 B	4688	25. Watershed Road	902
26. Pemberton Road	1100	26. Waiata Road	564
27. State Highway 54, Kiwitea County Maintenance Area 1	658	27. Pohangina Valley East Road	3000
28. S.H.54, Maintenance Area 2	434	28. Pohangina Valley West Road	3000
29. S.H.54, Maintenance Area 3	367	29. Pohangina Valley West Rd.(Apiti)	1000
30. S.H.54, Maintenance Area 4	190	30. Cheltenham-Hunterville Road	4429
31. DUMMY DESTINATION	56181	31. Pemberton-Ohingaiti Road	2311
		32. State Highway 54 A	5598
		33. State Highway 54 B	1564
		34. Williamsons Road	862
		35. DUMMY DESTINATION	502808
Total Requirements	81500	Total Requirements	625000

Appendix G (cont'd).

Cost of Production at Sources (cents per cubic yard of metal)

Topcourse		Basecourse	
Source	Cost	Source	Cost
1	80	1	60
2	80	2	60
3	80	3	60
4	80	4	20
5	80	5	35
6	80	6	40
7	100	7	60
8	40	8	20
9	40	9	20
10	40	10	60
11	40	11	60
12	40	12	50
13	40	13	25
14	40	14	45
15	40	15	45
16	90	16	30
17	90	17	30
18	90	18	30
19	90	19	30
20	90	20	30
21	90	21	30
22	90	22	30
23	90	23	25
		24	40
		25	40
		26	30
		27	30
		28	30
		29	30
		30	30
		31	30
		32	30
		33	30
		34	30
		35	30
		36	30
		37	30
		38	30
		39	30
		40	30

40

APPENDIX H.

SAMPLE SURVEY INTRODUCTORY LETTER AND QUESTIONNAIRE.

Dear Sir/Madam,

I am carrying out post graduate research at Massey University on the desirability of amalgamating the five counties in the Manawatu region.

WHAT THE QUESTIONNAIRE WILL ACHIEVE. Travel patterns reflect quite accurately the importance of various towns and cities in a region. This questionnaire has been prepared to gain some insight into the travel patterns within the Manawatu region.

THE IMPORTANCE OF A REPLY. This questionnaire has been sent to a limited number of households to reduce inconvenience and cost. Your reply is therefore very important. Information requested has been kept to a minimum. After answering the questionnaire please place it in the stamped and addressed envelope and post it.

ANSWERING INSTRUCTIONS.

* Please don't include school trips
* If the trip purpose was for shopping use S
* If the trip purpose was for entertainment use E
* If the trip purpose was a regular journey to work use W
* If the trip purpose was for business (not a journey to work) use B
* If the trip purpose was for other reasons use X
* Please don't include trips made in the last week into trips made in last month.

HERE IS AN EXAMPLE OF HOW A QUESTIONNAIRE MIGHT BE COMPLETED.

The Head of Household (husband) a farmer, made four trips to Palmerston North in the last month. This was made up of one trip for shopping last week and three for business in the last month. The total for the week = one trip, for the month = three trips. The wife, who does not work, made five trips one for shopping in the last week (with her husband but the entry is still recorded), and the other four in the last month, to Feilding, and by herself. All were for shopping. The total for the week = one trip, for the month = four trips. The questionnaire would read:

	Head of Household (Male/Husband)		Head of Household (Female/Wife)	
Feilding				4S
Palmerston North	1S	3B	1S	
	week	month	week	month

Thanking you for your cooperation.

Yours faithfully,

R.B. LeHeron.

Appendix H (cont'd)

TRAVEL QUESTIONNAIRE

Please fill in below the number of trips made during the last week (2/11 to 8/11) and month (four weeks) by each member of the household to the following towns.

	Head of Household (Male/ Husband)		Head of Household (Female/ Wife)		Children over 21 years of age living in Household						Other members of Household (State Sex)					
	wk	mth	wk	mth	wk	mth	wk	mth	wk	mth	wk	mth	wk	mth	wk	mth
HALCOMBE																
ASHHURST																
MARTON																
BULLS																
FEILDING																
BUNNY-THORPE																
SANSON																
RONGOTEA																
PALMERSTON NORTH																
FOXTON																
SHANNON																
LEVIN																
LONGBURN																
OTHER LOCAL TOWNSHIPS NOT LISTED ABOVE (name)																
Where do you work? (please name town or locality)																
How do you travel to work? (State type of transport)																
Please state distance by road from your home to PALMERSTON NORTH FEILDING																

APPENDIX I.

STATISTICAL FORMULAE USED

1. Spearman Rank Correlation Coefficient : r_s

$$r_s = \frac{\sum x^2 + \sum y^2 - \sum d^2}{2\sqrt{\sum x^2 \cdot \sum y^2}}$$

where $$\sum x^2 = \frac{N^3 - N}{12} - \sum T_x$$

$$\sum y^2 = \frac{N^3 - N}{12} - \sum T_y$$

$$\sum T = \sum \left(\frac{t^3 - t}{12}\right)$$

N is the number of observations in each variable

X is one variable ranked from 1 to N

Y is one variable ranked from 1 to N

$\sum d^2$ is the sum of the squares of the difference between the two ranks

t is the number of observations tied at a given rank

2. Chi Square 2 x 2 Contingency Table

$$\chi^2 = \frac{N\left(|AD - BC| - \frac{N}{2}\right)^2}{(A+B)(C+D)(A+C)(B+D)} \quad , \text{df} = 1$$

where frequencies A, B, C, D and N are based on the 2 x 2 contingency table

	0	greater than 0	
County I	A	B	A+ B
County II	C	D	C + D
	A + C	B + D	N

3. The Median Test

Based on the median score, a value for χ^2 was calculated. The 2 x 2 contingency table is arranged as set out below

	County I	County II	
Number of counts above combined median	A	B	A+ B
Number of counts below combined median	C	D	C + D
	A + C	B + D	$N = n_1 + n_2$

A detailed outline of the above tests is found in Siegel, 1956, 104–115 and 202–212.

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