COMPUTER-BASED

BUSINESS SIMULATION GAME

FOR

EAST   AFRICA

BY

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ABSTRACT

In this study the author designs a business simulation game
in the East African environment. The author argues that rapid
technological development has resulted in widening the scope
of industries the world over which has in turn increased problems
of organisation, coordination and communication in business
organisations. Modern organisations require leadership with
insight into complex problems. The aims of management education,
therefore, should be to "arm" managers with the skills and knowledge
for making effective decisions in this era. Most common
management education methods are, however, inadequate in achieving
the goals of management education.

The author presents a management education method (Simula-
tion Games) which seem to have worked successfully in the Western
World. Using information gathered in the East African environment,
the author builds a business simulation game for East Africa.
The game is tested with a group of participants to improve on
relationships in the model as well as noting the relevance of the
game as a management education method.

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CHAPTER I

'In this chapter the author looks at the question of the desirability of building a business game. The objectives of the thesis are outlined, and the author presents the methodology, scope and an overview of the thesis.

1.0. - Introduction to Thesis:

The author has been inspired to write a thesis on Business Simulation Games by the fact that many present day management training methods appear to be inadequate in achieving the goals of management education. In most universities offering degree courses in business studies, the curriculum is made up of isolated topics. At the end of a training period the students sit an exam to test whether they understood the subject matter.

There are two weaknesses in this method. First, in the business world one cannot identify areas like production, marketing, finance, and make decisions in them without regard to the impact of such decisions on the total organisation. Secondly, students are taught "management tools" that they have no chance of experimenting with until they enter the business world.

In this thesis, the author is presenting a management training method that has been used extensively and successfully in the Western World. It is the author's hope that this method can work equally successfully in East Africa.

2.0. - Need for Designing a Game

One may argue that because many business games have
already been built and tested there is no need for building
a business game. There are various points to counter this
argument. Firstly, business games are played to achieve set
educational objectives. A designer of a business game outlines
the educational objectives that his game is to achieve. It
is not impossible to find that business games that have been
designed do not serve the training needs of a user. Conse-
quently, the user should design his own business game.
Secondly, most games have been designed in the Western environ-
ment, and such games may not be relevant to participants in
other parts of the world due to differences that exist in the
economies. The participants should be presented with a game
they are familiar with before they can be expected to appre-
ciate the game. Thirdly, there are changes constantly occurring
in the real world and a business game may have been designed
on the assumptions of deterministic parameters and principles.
Building new business games incorporates these changes in the
training exercise. Fourthly, as a game is played over and
over again there is a likelihood that the participants become
familiar with the relationships in the models thus reducing
the exercise to a "guessing" one. Building new business
games ensures that the participants are presented with a
game in which they cannot guess the relationships in the
models. Lastly, design of a new business game forces the

trainer to examine the subject matter he wants to present
to the students and particularly its relevance to the business
world.

3.0. - Objectives of the Thesis:

In this thesis an attempt is made to design a business
simulation game in the East African environment. The game
designed is to be tested with a group of participants with
the aim of improving on the mathematical relationships in
the models as well as noting the relevance of business
games as a training tool in East Africa.

4.0. - Methodology and Scope:

The author proposes to proceed by way of: Literature
search, interviews, model building,   computer programming
and validation. In the literature search the author looks
at demands of modern management and the types of management
education methods that are employed. The search centres
largely on business games. The author then conducts interviews
to gather information to use in writing up a case and building
models. The author next builds models that represent mathema-
tical relationships in the game. Since the results in the
game are calculated on a computer, the author writes a computer
program using FORTRAN IV Language. The game is validated
by having a group of participants play the game for six
decision periods.

5.0. - Overview of the Thesis:

In Chapter 2 the author looks at the demand for management
education in this era of rapid technological development.

An exploration of the needs for industrial development in East Africa shows that this demand exists as well in East Africa. The author looks at the common methods of management education and points out their weaknesses.

In Chapter 3 the author looks at the historical development of Business Games with particular reference to contribution of War Games and Operations Research. In looking at differences in present day management games, the author presents the features that can be incorporated in various Games.

In Chapter 4, the author presents findings from the interviews and points out facts from the interviews that are incorporated in the game. The author then presents the mathematical models and the source program used in calculating results.

In Chapter 5, the author presents the Participants Manual, Administrators Manual and Board of Directors' Manual.

In Chapter 6, the author presents the validation exercise, and in Chapter 7, he presents a summary of the thesis and areas for further research and study.

CHAPTER 2

Introduction

This chapter first examines modern management the world over and with emphasis on East Africa. The chapter next discusses the type of management education required. It lastly examines current management education methods and closes by arguing that even with their limitations, business games are more effective management education methods than other methods.

1.0. - Modern Management:

The twentieth century has been characterised by increasingly rapid technological innovation. In the words of Galbraith,

> "The innovation and alterations in economic life in the last seventy years, and more especially since the beginning of World II have, by any calculation been great. The most visible has been the application of increasingly intricate and sophisticated technology to the production of things. Machines have replaced crude manpower."[1]

This technological advancement has resulted in requirements of large organisations and specialists to run business organisations.

> ".... machines and sophisticated technology .... require in turn, heavy investment of capital. They are designed and guided by technically sophisticated men... From these come the need and opportunity for the large business organisation. It alone can deploy the requisite capital. It alone can mobilize the requisite skills."[2]

Business organisations have become so complex that only specialists can run them.

"The inevitable counterpart of specialisation is
organisation... brings the work of specialists to a
coherent result. If there are many specialists, this
coordination will be a major task. So complex, indeed,
will be the job of organising specialists that there
will be specialists on organisations."[3]

Planning has been identified as the most vital task of a

manager in this technological era.

"... planning ... also requires a comparatively high
level of specialised talent. To foresee the future
in all its dimensions and to design appropriate action
does not necessarily require high scientific qualification.
It requires ability to organise and employ information,
or capacity to react initiatively to relevant experience."[4]

The patterns of industrial revolution in the developing

countries have not been different from those in the developed

countries. Kenya, which operates a mixed economy whereby part

of the productive resources are privately owned and operated

while the other part belongs to the public sector, recognised

the need for industrialisation.

"Industrial output must increase to provide the farming
population with inputs and manufactured consumption
goods; to provide exports ... which we believe ought to
increase at annual rate of about 10% to constitute a
gradually rising proportion of Kenya's total exports."[5]

Kenya has, at the same time embarked on a programme of Kenyani-

sation of ownership of industry.

"The aims of an industrialisation strategy are set out
in the Second Development Plan and policies have been
developed to achieve the following multiple objectives.
(1) "An active and... growing participation of Kenya
    citizens in management and ownership of industry."[6]

The basic problem that a developing country as Kenya faces

is lack of skilled-managerial manpower.

"The shortage of management and supervision is likely
to be a limitation also on the development of Kenya's
ownership in large scale enterprise."[7]

Tanzania, which operates a socialist-style government, spells

out her economic policy in the Arusha Declaration under what is

termed "The Tanu Creed".

> "(1) That all the citizens together possess all the
> material resources of the country in trust for
> their descendants.
>
> (2) That in order to ensure economic justice the state
> must have effective control over the principal
> means of production."[8]

The principal aims and objectives of the Tanu Government are

therefore:

> "(1) To see that the government mobilizes all the
> resources of this country towards elimination of
> poverty, ignorance and disease.
>
> (2) To see that the government actively assists in the
> formation and maintenance of corporative organisations.
>
> (3) To see that wherever possible the government itself
> directly participates in the economic development of
> this country."[9]

The means of production communally owned and exploited range

from natural resources to large industries. This means that

even in a socialist country the size and scope of industry is

expanding due to the need for economic development through

industrialisation. The growth of large scale enterprises the

world over has created problems of organisation, coordination,

and communication that requires leadership with insight into

complex problems.

2.0. - Aims of Management Education:

The rapid technological development outlined above

demands that management education train managers with the

skills and knowledge necessary for effective decision-making.

The aims of management education, Fairhead says should be to:

"(1) Increase analytical skills

(2) Increase awareness of the forces shaping management decisions.

(3) Increase awareness of the functioning of organisations and in social sensitivity skills."[10]

2.1. - Increase Analytical Skills

In modern organisations a manager has a mass of data to be analysed before reaching decisions. This analysis requires employment of analytical tools, for example; operations research, net present value, and so on. Such tools of analysis have become fairly sophisticated. As Fairhead says:-

"This process (sophistication in tools of analysis) has already developed considerably in the last thirty years, as witnessed by the great growth in functional specialisms during this time; and the signs are that the pace will increase."[11]

2.2. - Increase in awareness of forces shaping Management Decisions

The modern manager must be aware of the nature and magnitude of forces that shape his decisions. Such forces may be political, macro-economic or social and they are such that cannot be ignored. As Fairhead says:-

"They (these forces) cannot be regarded as unfortunate intrusions getting in the way of the "real job" of managing the internal problems of the organisation."[12]

The aim of management education should be to teach the manager how to make decisions in this environment.

2.3. - Increase in Awareness of the Functioning of Organizations and in the Social Sensitivity Skills

The increase in the awareness of the functioning of organisations must be from a point of view of the inter-relatedness of the various departments in the organisation. Inevitably decision-making will be on a group basis:

"Both the making and taking of decisions will have to be thought of as group activities. Management committees, project team, liasion groups will become more and more the basic method of working."[13]

With such groups will arise the problem of inter-personal relationships, which the manager should be skilled in solving after management education.

"The third major aim of management education, therefore, must be to increase the awareness of the working of organisations combined with increasing the personal skills of social sensitivity which would lead to an effective functioning of the managers in group situation, both as a leader and a participant."[14]

3.0. - Methods of Management Education:

Over the past 50 years many methods of management education have been developed especially in U.S.A. These methods include:

3.1. - Personal Experience:

The traditional method of allowing the manager to climb the "management ladder" through experience seems an inadequate training method for management education. In this era a manager cannot master all the techniques required to cope with technological change from experience only. A variation of this method is job rotation whereby a manager is moved from job to job according to a specially designed schedule. What such a manager

gains depends to a large extent on the time devotion a supervisor can have to delegate authority, evaluate performance and assign meaningful tasks to him. The supervisor is usually not able to effectively convey to the subordinate a feeling of the complexities and inter-relationships of decision areas.

3.2. - Formal Teaching:

. The more common method of communicating large quantities of information is formal teaching. This method is not an effective training method. Fairhead says,

> "... education is not only the acquisition of new knowledge. It must also be concerned with the process of changing attitudes and developing skills... Active participation is required of the student manager if he is to have full personal development that is inseparable from education for management."[15]

3.3. - Participation Methods:

Participation methods take into account the fact that management education is a two-way interchange of lectures and discussions between the students and the teacher. The more common participation methods are: Case Study, Incident Process and role playing.

3.31. - Case Study Method:

Case study method was first developed by Harvard Business School. In a case study,

> "The discussion of abstract generalised principles is centred in, and drawn out from, a full description and study of a particular case - with its abundant wealth of specific detail used as illustrative material."[16]

A case study forces the student to apply his knowledge
and experience in a particular problem. The weaknesses of
this method are: its inability to provide for feedback, and
its ignorance in timing and dynamic change in business decision-
making.

3.32. - Role Playing:

First developed at the University of Michigan, in role
playing;

> "... each student is briefed to take the role of one
> of the protagonists in the case. Inevitably the
> student becomes committed to the part he is playing and
> assimilates it to his own personality and experience." 17

The participant gains insight into human relations training
under the role playing method. The unique quality of this
method is that it emphasizes the necessity for the manager's
decisions to be acceptable to those who carry them out.
Critics of this method say that it may lead to embarrasment
on the participants and besides the participants may forget
the subject or problem areas when they are involved in the
exercise.

3.33. - Incident Process:

Developed at M.I.T. in this method,

> "... the student is given, not the entire material
> of the case, but only the details of the crucial
> incident which would come to his notice as a manager..
> Using this as a focus, he then has to ask for the
> information that he thinks is relevant..."18

This method pins the manager down to asking for information
which is relevant.

3.4. - Group Dynamics:

Group Dynamics training was pioneered by the National Training Laboratory at Bethel. Under the method, also known as Sensitivity Training, the students got an opportunity of implementing skills of management. As Fairhead says,

> "These are the skills involved in carrying out a decision, developing the social sensitivity required for effective group working, and learning to "live with" the results of one's efforts - the failures as well as the successes." [19]

Through working as a group the student explores the difficulties in group-work. The social sensitivity training in this method is best stated in Fairhead's words,

> "By making the situation as little task-oriented as possible, the trainer forces the group to concentrate on interpersonal relationships and the individual student thus develops insights into his personal inadequacies in assessing the people and situations with which he has to deal." [20]

The limitations of this method is its nature of being a group-oriented and not a task-oriented situation. The experience gained from the training may therefore be far removed from the manager's task in his normal job.

3.5. - Simulation Methods:

Simulation methods owe their origins to War Games and operations Research. Under this method the participants make decisions on the basis of information presented to them. These decisions are used to calculate results using pre-determined mathematical models. The results are handed back to the participants and they are allowed to make decisions again. The continuous on-going situations with built-in feedback allows for

development of skill and an environment for understanding to take place. This method is discussed in detail in the next chapter.

3.6. - Simulations Methods as Effective Management Education Method

Simulation methods have a quality that make them a more effective Management Education method than the methods outlined above. The goals of management education of: increase in analytical skills provision of practice, training managers to make decisions for total organisation and increased awareness of functioning of organisations and in social sensitivity skills, are to a large extent fulfilled by Simulation Methods.

One strong advantage of simulation methods is the built-in feedback system. Feedback allows the participants to analyse the actual response of a business environment and if the game is an inter-active competitive one, feedback enables the participant to analyse the reactions of competitors to his strategies. Under simulation method feedback enables the participants to practice management skills and especially where the organisation is structured on a functional basis. The concepts of time dimension, a serious drawback in Case Study Method, allows the participants in a Simulation exercise to operate in a situation that is constantly changing in response to previous actions. The participants realise, as in the real business world, that planning must consider the present and the future simultaneously.

The degree of participant involvement in a simulation

exercise provides an environment whereby learning is enhanced.

3.7. - Limitations of Simulation Methods

Like all other management education methods simulation methods have their limitations. To date there is no empirical evidence which shows the relative educational effectiveness of simulation methods in comparison with other teaching procedures. The likely weaknesses of simulation methods are:

1) After participating in the game the participant may return to his organisation with the wrong impression about business management. One of such wrong impression may be, for example, that advertising always generates more sales than any other form of promotion.

2) The environment in the game situation may be so far removed from the participants experience that he sees no relevance of the exercise.

3) The time pressure may be so great that analysis of data and results is impossible.

4) The decision areas may be defined so narrowly that only insufficient scope is left for problem definition.

5) Players who "succeed" may get the impression that they are able to manage business organisations better than its present managers. Those who do not "succeed" may lose confidence in themselves.

6) Over-emphasis on quantifying the relationships in a business game situation means that personal attributes of sensitivity, creativity, and morale development find little place in the current use of business games.

7) There is the problem of telling the participants who "won". The judgement in business games should be on the basis of how best the objectives of the company were achieved with the resources in hand and the constraints facing the firm.

Some of the limitations in Business Games can be overcome by the Administrator or Game Designer. The good administrator will ensure that; the participants are given a relevant game, the participants are well introduced to the game environment, given enough time for decision making and they are judged using an appropriate yardstick. The good game-designer will include in the game situation some room for exercising the participants' sensitivity, creativity and morale development. For the best results in management education more than one of the methods of management education ought to be used.

3.8. - Summary:

This chapter looked at the required change in the style of management due to technological development. The chapter outlined the proposed aims of management education in this era. It next discussed the current methods of management education and their limitations. The chapter, lastly, argued that even with their limitations Business Games posses qualities that make them a more effective management education method than other methods.

3.9. - <u>Footnotes and References</u>

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4. Ibid., P.15

5. ILO, "<u>Employment, Incomes and Equality</u> - <u>A Strategy for</u>

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8. Julius K. Nyerere, "<u>Ujamaa - Essays on Socialism</u>" Oxford

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10. J.N. Fairhead, D.S. Pugh, W.J. Williams - "<u>Exercises in</u>

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11. Ibid., p.7

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19. Ibid., p.11

20. Ibid., p.13.

CHAPTER 3

Introduction:

In this chapter the author presents the definition of business games. Next, the historical development of business games are traced and particularly the contributions of War Games, Operations Research and educational role playing are outlined. The chapter closes by looking at features that differentiate between various Games that have been built.

1.0. - Definition of Business Games:

Greenlaw and his colleagues define a business game as;

"... a sequential decision-making exercise structured around a model of a business operation, in which participants assume the role of managing the simulated operation."[1]

Although all games provide the participants with discretion in decision-making, in some games the participants follow decision rules laid down by the Administrator. Games which teach techniques used in making business decisions are useful in teaching, for example, inventory control systems since the participants experience stockout costs and stock-holding costs. Not all business games are of a competitive-interactive nature.

"... a growing number of games provide for competition only in the sense that each team or participant attempts to operate as effeciently as possible in a similar or identical environment."[2]

The word "game" is unfortunate in that most people think that business games are played for entertainment, but business games are "... a serious educational approach. It is for this reason that many users of the tool have avoided the use of

word "game" and have chosen to refer to their exercises as
"simulations" instead."[3]

To fully appreciate business games it is perhaps best that
the procedures followed in organising for, and playing, a
business game be laid down. Greenlaw and his colleagues lay
down five steps followed in most typical business games.[4]

1.1. - Participants Education:

Each of the participating teams is given time to organise
itself for decision making. They gather the data needed for
decision-making, make decisions and enter such decisions on
decision forms provided.

1.3. - Administrator's Role:

At the end of each period each team hands over its decision
forms to the games administrator. The administrator sees to
the scoring, hands back and discusses results and may introduce
new elements to the game.

1.4. - Mathematical Manipulations:

The Administrator using a computer or manually and with
pre-determined mathematical relationships calculates the
results for each team and hands these back to the teams with
some information about the competitor's decisions.

1.5. - Feedback:

On receipt of results the team evaluate their performances
vis-a-vis the decisions made by them and by the competitors.
The team   makes decisions again. This cle of decision-

making, calculation and feedback of results is repeated a
number of times. At the end of the game the participants can
get together to discuss and analyse the game.

2.0. - Historical Background of Games:

Business Games draw their originality largely from War
Games, operations research and educational role playing.

2.1. - War Games:

The idea of War Games first orignated from chess.
Helwig, Master of Pages at the court of the Duke of Brunswick
is said to have started war chess in the 18th century. The
chess Board had 1,666 squares and the pieces were battalions
of fusileers, squadrons of dragoons and batteries of siege
guns. In modern war games actual maps of terrains are used
instead of the checkered board. Actual War Games date back
to the work of Von Reinswitz Sr. in about 1811 where opposing
teams of military personnel were given an imaginary mission and
called on alternately to make decisions in an effort to
accomplish the mission.

A documented application of War Games comes from Japan.
Japan is known to have set up a Total War Research Institute
in October 1940 and in 1941 a War Game was written up. The
players in the game represented; the Italo-German Axis, Russia,
United States, England, Thailand, Netherlands, East Indies,
China, Korea, Manchuria and French Indo-China. In the game
Japan was played as an uneasy coalition of Army, Navy and

Cabinet with the military and the government constantly disagreeing over the topics of whether to go to war or not and what to do about civilian demand versus heavy industry demand. The measures to be taken within Japan were gamed in detail and included economic, educational, financial and psychological factors. In America games were first developed at Naval War College at Newport and the name of the game was U.S. Navy Electronic Warfare Simulation (NEWS).

Wherever they have been built War Games seem to have some common features. The concept of competition seems to be inherent in all War Games. Dr. Specht said;

> "... all of them, however, share one factor in common-
> competition which exposes weak points in an argument
> and vague points in a plan."[5]

The models used in war games are abstractions of the real world situation since there would be no other way of replicating the real world. The question arises of how closely to approximate reality. A complex game is more likely to approximate to reality than a simple one, but the degree of complexity should be chosen according to the training objectives of the game. Dr. Specht said,

> "... we have not settled the question of the realism of
> a war game ... we must be careful, however, that our
> detail and complexity are compatible both with our
> knowledge of the real world and with the purposes of
> the game."[6]

War Games are a powerful learning device as one experiences making decisions and seeing the consequences of such decisions and then, making a new set of decisions. Dr. Specht said this about the teaching quality of war games,

"... that is a war game teaches both intellectually and
emotionally - it is an experience that one lives through."[7]

The values of war games as a learning tool is further enhanced
by the fact that one can look at the results of various decisions
and assumptions. Dr. Specht,

"... We can afford to play the game many times, under many
conditions, varying the assumptions used and exploring
many tactics."[8]

There are concepts borrowed from War Games in building
business games. Objectives of the game must be set and the
game structure built to serve these objectives. The degree of
abstraction from the real world will be determined by the
training objectives. Both war games and business games are
powerful training tools because decisions are made and through
some manupulation (usually mathematical) results are produced
and the participants allowed to make decisions again. Through
this feedback process, the quality of decisions made by
participants is expected to improve.

2.2. - Operations Research:

Operations Research is defined by John W. Pocock as,

"... a scientific methodology - analytical, experimental,
quantitative-which by assessing the overall implications
of various alternative courses of action in a management
system, provides an improved basis for management decision."[9]

The application of scientific tools to management problems were
first made in 1940 to determine the location of British Inter-
ception radar. Since then operations research has been used
extensively in military and business organisations to facilitate
decision making. One of the tools that Business Games borrow
from operations research is simulation.

Simulation is a model of a system which involves abstraction
of certain aspects of the system that one is studying and
attempting to replicate these aspects by other means e.g.
words or mathematical models. Greenlaw says,

> "... the major advantage of this approach (simulation) is
> that new policies and procedures can be tested without
> disrupting the operation of an organisation, which would
> often be extremely costly and difficult, if not impossible
> to do..."[10]

In simulation models the variables are selected and given
values; relations among the variables are specified and the
model is allowed to operate.

In business games, simulation models are built to represent
mathematical relationships in the game. The degree of abstraction
in the simulation model would depend on the purpose of the
simulator.

Another contribution of operations research to Business
Games is that some management games are designed around opera-
tions research tool. The participants in such a game learn
how to use operations research tools in reaching decisions.
Many business games have been designed to teach techniques
like; inventory control, linear programming, transportation,
Critical Path Methods. One such game dealing with solving
an assignment problem was written by Greene and Sisson[11]
using the problem designed by Churchman, Ackoff and Arnoff.[12]

2.3. - Educational Role Playing:

There are many training tools that are used for educa-
tional role playing, for example; In-Basket, Case Study Method,
Incident process and Operation-surbubia. Business games draw

from role playing tools in that the participants assume a role
in a.currently developing problem situation. Under these roles
the participants are expected to analyse a problem and make
decisions in the problem areas.

3.0. - Origins of Business Games:

The first Management Game was developed by American Manage-
ment Association in 1957. The game called "Top Management
Decision Simulation" was first used in a training course at
the American Management Association Academy at Savance Lake,
New York in 1957. Calculations were done on an IBM 650. At
about the same time Messrs Adlinger and J.R. Greene had been
discussing the training implications of business games and
began developing a game later known by various names; the
Ardlinger Game, the McKinsey Game, and the Harvard Business
Review Game. Many institutions then joined in building
business games notably the University of Califonia at Los
Angeles, the University of Washington, Carnegie Institute of
Technology and General Electric to mention only a few.

4.0. - Features of Business Games:

Business games that have been developed since 1957 can
be examined under the five different features suggested by
Greenlaw.[13]

4.1. - Orientation:

Business Games can be built to encompass the total
enterprise where the game is:

"a game linking different functions in the simulated

> company so that the participants are able to see how
> these functions are integrated when making decisions
> affecting total company policy."[14]

Or a game may be built to teach the participants particular

functional areas like inventory control, production planning,

routing, decision theory. The coverage of a game may be

designed for a specific industry e.g. supermarket, capital

goods industry, aircraft companies or the game may cover general

area of business operation.

In designing SIGMEA (Simulation Game for East Africa)

the author has attempted to achieve the objectives outlined

in the participants' manual.[15] It will be noted from that

manual that the participants have taken functionally separate

courses in business studies. The aim of SIGMEA is to involve

the participants in these functional areas and at the same

time make them realise that decisions made in these areas will

affect total enterprise policy. SIGMEA is a total enterprise

game, and is about a particular industry (hardware industry).

The author feels that this identification of the industry

helps in that the participants know that they are dealing

with a situation that may well be existing or is possible

to create and therefore they do not lose confidence in the

game.

4.2. - Interaction:

Interaction implies the competitive element that exists

in the game. A game may be built which is inter-active whereby:

"... each team is largely in command of its own performance;
or at least its performance is affected only by its own
.decision."[17]

SIGMEA is an inter-active game. Inter-action is built into the
game by use of mathematical models that generate demand after
manipulating the decisions of the competing teams. A total
enterprise game should be inter-active as that is the only
way to approximate a total enterprise game to reality.

4.3. - Inclusion of Chance Elements:

Games may be built using deterministic or probablistic
models. In games that employ deterministic models the
results are determined purely by the decisions made by the
firms while in games that employ probablistic models chance
plays some. role in the results that the firms get. SIGMEA
includes some chance elements with the purpose of concealing
the mathematical relationships in the game.

4.4. - Method of Calculating Results:

Results in business games are calculated either manually
or by a computer. The advantages of using a computer for the
calculations are speed, and accuracy. Computers are costly
to use and inflexible. The place for playing the game must be
located near the computer installation except when the system
is on-line, and besides it may be difficult to get time on
the computer. Because of the speed involved in computerised
games it is possible to build games that have complicated
mathematical relationships. While a manual system is more
prone to errors and slow, it is cheap to run and allows for
flexibility in the administration of the game.

The initial version of SIGMEA was manually scored. Since the game was a total enterprise one designed to serve a number of students the calculations of the results took a long time and the game was played for a half-semester. SIGMEA is now computerised using FORTRAN IV and currently runs on an ICL 1902A.

4.5. - Participation Structure:

Games have been designed where individuals compete against each other although the more common games are where teams compete against each other. In total enterprise games team competition is characteristic. In some games the participants are left to organize themselves as regards the duties to be performed are concerned while in other games the administrator defines the roles that ought to be filled. In SIGMEA one of the training objectives is to get the participants to structure their organisation in the way that they think will best aid their decision-making.

4.6. - Summary:

In this chapter a definition of business games was presented. This definition was extended to encompass the variations in business games. Business games have been found to draw their originality from War Games, Operations Research and educational role-playing. The most common features - Orientation, Interaction, Inclusion of chance elements, Method of Calculating Results, Participation Structure - of business games were presented.

4.7. - Footnotes and References:

1. Paul S. Greenlaw, L.W. Herron, R.H. Richard, "Business
   Simulation In Industry and University Education", London,
   Prentice-Hall (1962) p.5.

2. Ibid., p.5

3. Ibid., p.6

4. Ibid., p.6

5. Dr. Robert D. Specht, "War Games" In "Operational Research
   In Practice - Report of Nato Conference", PERGAMON PRESS,
   London-New York-Paris-Los Angeles (1958), p.44

6. Ibid., p.146

7. Ibid., p.149

8. Ibid., p.149-150

9. John W. Pocock," Operations Research. A Challenge in Management -
   in Operations Research, A Basic Approach," (ed.Elizabeth Marting)
   New York: American Management Association Inc.1956 Report No.13 p.9.

10. Paul Greenlaw, L.W. Herron, R.H. Richard; Op.Cit., p.9

11. Jay R. Greene and Roger L. Sisson, "Dynamic Management Decision Games"
    New York: John Wiley and Sons Inc.(1959)pp.18-24

12. Paul Greenlaw, L.W. Herron, R.H. Richard; Op.Cit.,p.10

13. Paul Greenlaw, L.W. Herron, R.H. Richard; Op.Cit., pp.16-30

14. International Labor Office," An Introduction to Business Games
    With Examples," Management Development Branch, Human Relations
    Dept., p.2

15. See Participants Manual Chapter 5

16. ILO; Op.Cit., p.2

17. ILO; Op.Cit., p.2

CHAPTER 4

Introduction

This chapter presents the features incorporated into
SIGMEA, their realism and necessity. The questions
(Appendix A) presented to practising managers for the purpose
of data collection are discussed and these data are used for
writing a case which appears in the Participants Manual,
Chapter 5.

The author builds mathematical models used in
calculating results in SIGMEA. The models developed are;
Production model, Demand model and Market Share model. The
chapter closes by discussing the computer printouts and limi-
tations of the source program.

DESIGN OF "SIGMEA"

1.0. - Educational Objectives:

The educational objectives of SIGMEA, outlined in the
Participants Manual Chapter 5, can be summarised as training
participants to make decisions in the functional areas of
an organisation while at the same time operating towards
attaining the goals of the total organisation.

2.0. - Features of SIGMEA.[1]

SIGMEA has three major features; historical dependency,
adverse business conditions and organisational set-up.

2.1. - Historical Dependency:

In SIGMEA, some decisions made in one period affect
the results only in subsequent decision periods - "time-lag

concept", and some decisions made this period have effects on results that last till the next period - "time-cumulation" concept. Historical dependency is necessary because;

> "The situation facing any business today is a function not only of present conditions and impact from competitor action but also of the policies followed and decisions made by that business and others in the past."[2]

In SIGMEA the concept of time-cumulation is brought into the game by expenditures on promotion, preventive maintenance and sales representatives having an effect lasting till the next decision period. The concept of time-lag is brought in by the fact that interest on investment is not collectible until after a six-month period and by the fact that sales representatives have to be trained at the head office for one month before assignment.

2.2. - Adverse Business Conditions:

To have the game reflect to a certain degree what is happening in the real world, variable business conditions are built into SIGMEA. Production costs of the firms will rise as the costs of raw materials rise. The foreign markets of Uganda and Tanzania will face strict foreign exchange dealings that make it difficult to transfer funds to the head office, and the parliament can pass a price control act to make it illegal to charge more than a certain price for a finished product.

2.3. - Organisational Set-up:

Organisational structure and its impact on managerial decision-making is brought into SIGMEA by having the participants

produce and market a single product in five regions. This
forces the participants to think about internal team
organisation, division of work, and decisions in different
areas with regard to achieving company-wide objectives.
The division of work could be on a functional or geographical
basis.

3.0. - Gathering Information:

An initial hypothetical case was written up for SIGMEA.
The author used the case in conducting interviews in the field
to determine the realism of the case. The problem, necessarily,
arose of how much replication of the real world to include in
the case. One caution is that a highly complex game may not
serve the educational objectives it is designed for.

Even after conducting the interviews there are some findings
that were ignored in building the game because if taken into
account the game would not serve the educational objectives set
for it. For example, the author discovered that since 1974 the
President banned all forms of strikes. In designing SIGMEA
this fact was ignored because one of the training objectives of
the game is to acquaint participants with personnel management.

3.1. - The Interview:

The interviewees included a production manager dealing in
the production of cigarettes, a retailer dealing in bicycles
and bicycle components, a production and marketing manager
dealing in the production and marketing of soap. The questions
in Appendix A were posed to each of these managers. Most of the
questions were designed to give information about parameters,

because the author considered that the changes in the case should
be more on the quantitative rather than on the qualitative data.
Since the case is of a general industry nature the author
felt that each of the interviewees could give valuable informa-
tion on all aspects of the industry.

4.0. - Findings From Interviews and Relevance to the Case.[4]

The interviews provided information about financing, invest-
ments, dividends, marketing, distribution, and production.

4.1. - Financing:

Government loans are extended to African businessmen
through Industrial Commercial Development Corporation (ICDC)
where the government is the majority shareholder. Such loans
usually carry an interest rate of 10% and are due for repay-
ment in two or more years' time depending on the terms of the
loan. Other sources of funds are Bank Overdrafts. Such over-
drafts are usually extended for a period of one year, carry an
interest rate of 10% and are normally secured against fixed
assets. Overdrafts are now difficult to get because of the
"credit squeeze" imposed by the Central Bank in a bid to curb
inflation. In the manual the participants are extended a
government loan which carries a 10% interest charge payable each
June. Interest on Bank-overdraft is 1% payable at the end of
each month.

4.2. - Investments:

Cash can be invested in banks as fixed deposits for a period of one year at an interest rate of 3¾%. On a fixed deposit of six months the investor earns interest of 3%. The investor must give one month's notice before withdrawing such monies. The participating teams can invest excess cash at 3% interest per annum. To ease computation such monies can only be invested in January or July.

4.3. - Dividends:

Most incorporated companies declare dividends at the rate of 8-12%. Such dividends are normally declared in December and paid in February the following year. This information applies also to the case.

Marketing and Distribution:
4.41. - Sales Representatives, Sales Offices:

Under government legislation passed in July 1974 a manufacturer is not allowed to distribute. The largest distributor in Kenya is Kenya National Trading Corporation (KENATCO) where the government holds the majority shares. The manufacturer is responsible for collecting excise taxes which can be as high as 80% of the cost of the finished product. Due to rigid Price Control System the manufacturer cannot easily pass these costs to the consumers. The distributor is responsible for the collection of sales taxes on behalf of the government. It can be seen that there are few, if any, agents employed in Kenya. Sales Representatives are usually, employers of the company and apart from the travel and night claims, they receive a monthly salary. Their work involves

finding out patterns of consumer demands and advising on product
quality and/or production volume decisions.

Before the government legislation came into force manu-
facturers were making extensive use of sales offices. These
offices were located in the markets and ordered goods from the
manufacturers to sell at the price stipulated by the manufacturers.
In the manual the participants are involved in the production
and distribution of goods. The mathematical models employ sales
representatives as a variable that has impact on demand. Sales
offices and agents are included in the case but have no impact
on demand.

4.42 - Foreign Markets:

Although the demands for goods in the foreign markets of
Tanzania and Uganda are high a distributor faces the problems of
transfer of funds from these regions to the head office due to
the stringent Foreign Exchange Control enacted in these countries.
If one, however, found a buyer in these foreign markets who
was able to obtain the necessary credit letters from his central
bank then there would be no foreign exchange problems. The
information about the foreign markets is retained in the case.
In the mathematical models the foreign markets have high demands.

4.43. - Lobbying the Government:

The managers expressed the opinion that for many businesses
it is practically impossible to lobby the government to impose
import restrictions on other goods. Such a move is only possible
if the business organisation is large and has managed to appoint
political figures on their Boards of Directorship. Multi-national
Corporations are generally known to practice this tactic quite

successfully. The managers pointed out that the problems

such corporations have is the belief the consumers hold that

imported goods are always superior in quality to locally

produced ones. The example the managers quoted was that of a

type manufacturing concern. They said, the partner states

of East Africa had agreed to set up a tyre manufacturing

company in Arusha in conjunction with General Tyres (U.S.A.)

Ltd., for supplying the whole of East Africa. This factory

went into production in 1969. Some time later Firestone Ltd.,

approached Kenya Government with plans to set up a tyre

manufacturing company in Nairobi and to be given the monopoly

to manufacture and distribute tyres in Kenya, which was granted.

Due to demand by the consumers the government had to allow

importation of other tyres. This meant a stiff competition

for Firestone existed, and they have recently asked for financial

support from the government otherwise they would lay off a

number of workers.[3] In the manual, the idea of lobbying the

government to impose import restrictions is retained. This

limits the number of competitors in the business situation to 2.

4.5. - Production:

4.51. - Shifts and Overtime:

Factories operating on shifts usually have three eight-

hourly shifts beginning at six in the morning. The payment system

is usually the basic salary plus a shift premium of 15% of the

basic salary. The managers had varying opinions about shift

effeciency. Some argued that night shifts are most effecient

because there are not so many distractions at night. This may
be true but the basic assumption is that the workers on the
shifts rest during the day rather than work on their "shambas".
This is more likely to have a bigger effect on the workers who
operate the second shift because they would not have had enough
time to rest. Overtime operates where the company has scheduled
production on the basis of hours. Most companies not operating
shifts have a 10-hour production day. Workers on overtime earn
1½ times the pay, on scheduled production. The managers informed
the author that most manufacturing concerns in Nairobi operate
on a shift basis. They pointed out that it is possible to operate
on a shift basis as well as overtime. This leaves the workers
very exhausted and is therefore not encouraged. Overtime is
possible where the worker has already finished working in his
shift and probably due to absenteeism there are not enough
people to operate the next shift. In the manual, the participants
are able to operate three shifts. The first shift is the most
effecient and the last one the least effecient. To ease compu-
tation the workers earn the same wage on each of the shifts.

4.52. - Preventive Maintenance:

Most managers seemed to be well acquainted with the concept
of preventive maintenance. If machines are not maintained
they soon break down and require heavy repairs or replacement.
The managers pointed out that there are two types of preventive
maintenance. The more common one is whereby the engineer stipulates
the number of hours the machine should be in production before

maintenance is carried out. In this case, during the maintenance period the factory is shut down and the workers sent on leave until maintenance is completed. It is not necessary to send all workers on leave if the machines are to a great extent independent of each other. The scheduling of maintenance is then with the objective of having the minimum of workers out of work. The other type of maintenance called, "break-down maintenance" is where a machine is operated until it breaks down then the factory is closed and maintenance crew brought in. This may be more expensive than periodic maintenance because the factory may have to close for a long time, the company suffering from lost sales. There is, undoubtedly, a strong correlation between maintenance expenditures and production levels. In the manual, preventive maintenance is carried out without the necessity of closing down the plant. In the mathematical models, preventive maintenance has short-run effects on production volumes. The participants, however, do not get the full benefit of preventive maintenance decisions the month the decision is made.

4.53. - Raw Materials:

In the past the lead times for acquiring raw materials from abroad were three months. Then, time for processing applications for raw materials was one month. The procedure for importation of raw materials these days is: you place an order and obtain pro-forma invoices from the supplier; you then fill in a Foreign Exchange Allocation Licence (F.E.A.L.) and attach the proforma invoice to it and send these to the Central Bank. If your application is accepted you order the goods, otherwise you find out why the application has been rejected and you try again. This procedure may be roughly flow-charted as shown below:-

PLACE ORDER

RECEIVE PRO-FORMA INVOICE

PRO-FORMA INVOICE

WHAT WAS WRONG ?

F.E.A.L.

FILL IN F.E.A.L. ATTACH PRO-FORMA AND SEND TO CENTRAL BANK

GENERAL SUP. CHECKS, VALUE OF GOODS & F.E.A.L.

YES

TRY AGAIN ?

FIND WHY

NO — ACCEPTED ? — YES

PLACE ORDER FOR GOODS ON EXCHANGE GRANTED

NO

STOP

REJECTED AND CUSTOMER INFORMED

NO — IN ORDER ?

YES

ARRIVE

STOP
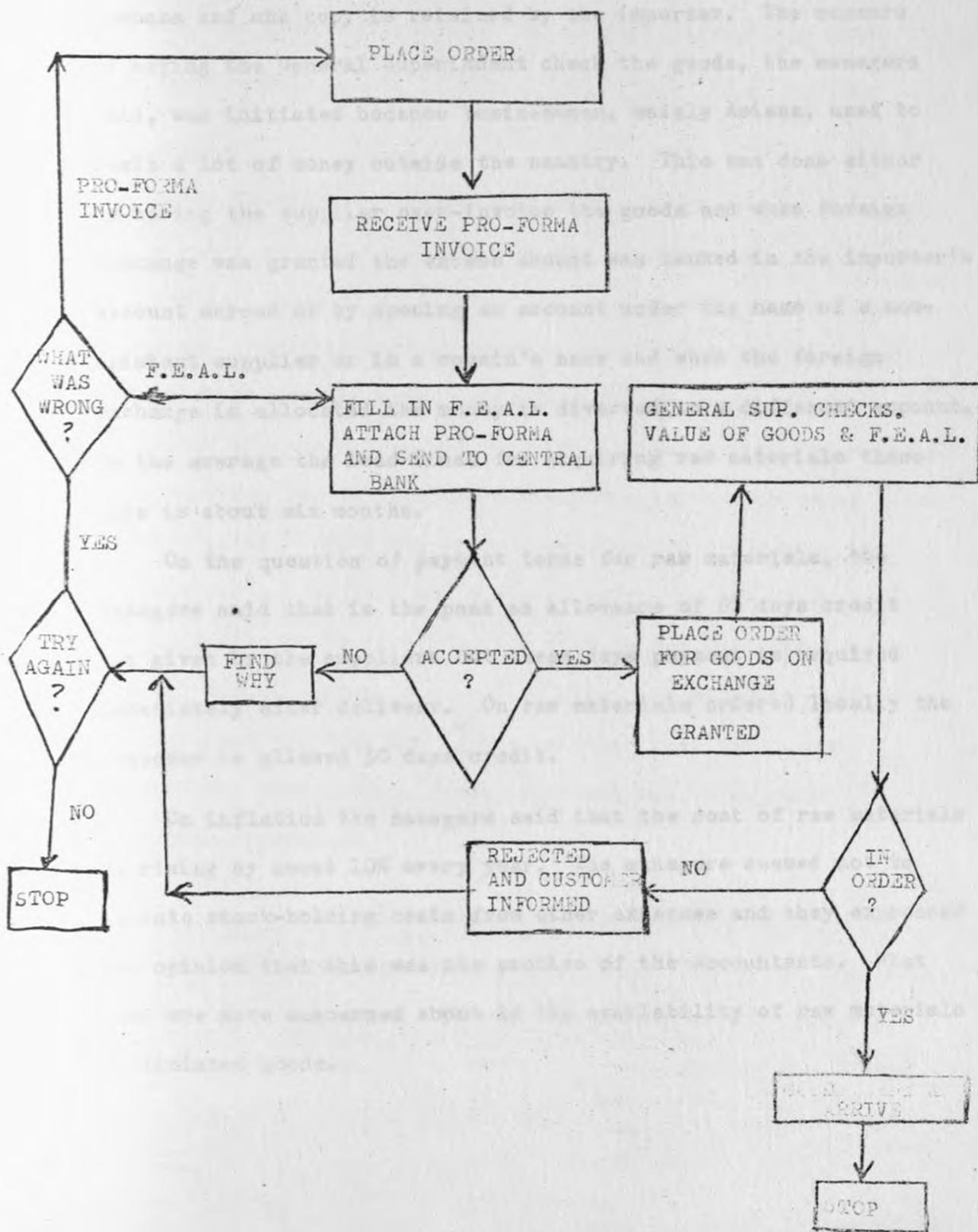
The flow-chart shown above gives an indication of the lead times

involved in acquiring raw materials. When the importer fills in

F.E.A.L. and the application is accepted one copy of F.E.A.L. is

sent to the General Superintendant, one copy to the Customs at

Mombasa and one copy is retained by the importer. The measure

of having the General Superindant check the goods, the managers

said, was initiated because businessmen, mainly Asians, used to

remit a lot of money outside the country. This was done either

by having the supplier over-invoice the goods and when foreign

exchange was granted the excess amount was banked in the importer's

account abroad or by opening an account under the name of a non-

existant supplier or in a cousin's name and when the foreign

exchange is allocated the money is diverted to a different account.

On the average the lead times for acquiring raw materials these

days is about six months.

On the question of payment terms for raw materials, the

managers said that in the past an allowance of 60 days credit

was given by the suppliers but these days payment is required

immediately after delivery. On raw materials ordered locally the

customer is allowed 30 days credit.

On inflation the managers said that the cost of raw materials

is rising by about 10% every year. The managers seemed not to

isolate stock-holding costs from other expenses and they expressed

the opinion that this was the problem of the Accountants. What

they are more concerned about is the availability of raw materials

or finished goods.

In the manual, there is a fixed lead time of three months in raw
materials acquisition. This enables the participants to use
simple inventory control models they have learnt from a course of
Quantitative Methods. The participants can either pay immediately
for raw materials or one month later. The cost of raw materials
will continue to rise throughout the play to reflect the real
world situation.

4.54. - Labor

Labor is hired by advertising in the local papers and inter-
viewing those who have responded to the advertisement. Those hired
are given the terms of employment and made to sign to show their
acceptance. Normally workers serve a one-year probation period,
although shift workers have a probation of one month. During
this period the worker can terminate his services with the company
or his services can be terminated without prior notice being given
by either party. After the probationary period the worker is
confirmed and he can join the workers' union, if one exists. It
is quite difficult to fire a worker once he has been hired on
permanent terms. Before a worker is fired the personnel office
must show evidence that during one calendar year the worker
committed the same offence three times and was given warnings
during these occasions.

On the question of strikes, the managers pointed out that
the present ban on strikes may be temporary. They added that even
if strikes were not banned, the machinery laid out for dealing
with worker grievances are so rigid that most strikes are illegal

and results in victimisation of the union leaders. The Central
Organisation of Trade Union (C.O.T.U.) is supposed to co-ordinate
the efforts of other unions throughout the country but this body
is so weak and disorganised that the unions do not expect much
help from it. In the manual, there exists labor unrest, and there
is a possibility of a walk-out strike. The workers' union is
a strong one and during the play it can make demands for wage
increases.

4.55. - Price Control:

The price control system operates by the manufacturer
informing the Price Control Board of his unit costs of production.
The Board makes an allowance for profit margin and stipulates the
wholesale and retail prices. When the manufacturer feels that his
costs of production have risen he approaches the board and
convinces them that it is necessary for him to raise the price of
his product. The tricky aspect of this price-setting system is
that the manufacturer still has to quote a competitive price
otherwise he will be out of production. In the manual, the
participants are informed that parliament is debating the Price
Control Bill. The parliament can pass the bill stipulating what
prices should be charged.

4.56. - Building and Equipment:

Building and equipment are usually in the ratio of 3:1.
Payment for building is done on the basis of 10% down payment
at the time of signing the contract and the remainder when the
contract is completed.

In the manual, buildings and equipment are in the ratio of 3:1.
Payments for these are spread over a six-month period.

5.1. - Mathematical Models:

Three mathematical models are built; the production model,
the demand model and the market share model.

5.2. - Production Model:

Production is a function of available raw materials, labor
force, number of shifts operated, preventive maintenance
expenditures, and plant facility.

Production = f(DLH, PPC, ROPN, SHIFTS OPERATED, PLANT FACILITY)[5]

Because of constraints in plant capacity as mentioned in the case
output varies in the range (3500-4500) units per month. One short
run measure to increase production is expenditure on preventive
maintenance. This expenditure improves the output range to
(4,000-5,000)units. 5,000 units is the maximum production possible
with the greatest expenditure on preventive maintenance.

Preventive Maintenance Expenditure:

Decision on preventive maintenance expenditure has a time
cumulation effect. The formula used is:

$$\text{EFFECTIVE MAINTENANCE EXPENDITURE} = \frac{3}{4}\left[\text{THIS MONTH'S MAINTENANCE EXP.}\right] + \frac{1}{4}\left[\text{LAST MONTH'S MAINTENANCE EXP.}\right]$$

Production as a result of the maintenance expenditure increases
as maintenance expenditure increases. The maximum possible
production due to preventive maintenance expenditure is given by
the formula:

$$\text{MAXIMUM POSSIBLE PRODUCTION} = \text{MINIMUM CAPACITY PROD.} + \left[\frac{\text{EFF. EXP.}}{\text{EFF. MAIN. EXP.}+500}\left(\frac{\text{MAX.}}{\text{CAP.}} - \frac{\text{MIN.}}{\text{CAP.}}\right)\right]$$

The maximum possible production is adjusted for shift effeciency. Actual production is the lesser of the scheduled and maximum possible production, and is constrained by the availability of raw materials and labor force. Labor force is assumed 20 and therefore variations will have an effect on the production. Goods available for sale is then the sum of goods produced and the opening inventory of finished goods.

5.3. - Demand Model:

Demand in each of the regions is a function of unit price, expenditure on promotion, seasonal variation, random adjustment and company adjustment.

6      $DEMAND = f(PR, PROM, SEAD, RMA, COAD)^{7}$

In the models price and promotional expenditure have more significant effects on demand then any other factors.

5.31. - Seasonal Effects:

Appendix C shows a graphical representation of the seasonal effects during a simulated year. Demand is affected by values ranging from 1.00 down to 0.79. These effects depict a parabolic relationship.

5.32. - Random Adjustment:

If the relationships in the demand model become obvious to the participants then the purpose of applying a random adjustment is to conceal these relationships.

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5.33. - Company Adjustment:

Since SIGMEA is an inter-active game the idea of competition is encouraged. If there is only one firm in the region the demand due to that firm is reduced by a greater factor than if there were competing firms in that region.

Seasonal effects, company adjustment, and random adjustment have the same effects on demand due to price and promotional expenditure. After making these common adjustments; adjustments are not made for price and promotional expenditure effects. The assumption made in both cases is that there is a basic demand already existing in each of the regions andthe adjustments are made on these figures.

5.34. - Price Adjustment on Demand:

The demand for the product is price sensitive. At the price of 20/- the price elasticity of demand for the product is 1. Since SIGMEA.is an interactive game the price decisions of the firm as well as those of the competitor have an effect on demand. If both firms charged 20/- per unit per region then the price elasticity of demand will be 1, using the formula shown below:-

$$\text{Price Adjustment} = \frac{20P(A) + 20P(B)}{P(A)^2 + P(B)^2}$$

P(A)-price of Firm A

P(B) - " " Firm B.

The author takes a number of hypothetical price decisions and plots price adjustment versus average prices of the two firms. The price decisions are shown in TABLE I. Reference to Appendix B. will show the graph of <u>Price Adjustment Vs Average Price.</u>

TABLE I

REGION:NAIROBI	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7
Price A(P(A))	20	19	20	21	20	19	18
Price B(P(B))	20	21	22	21	22	21	20
Average Price	20	20	21	21	21	20	19
ADP= $\frac{20P(A)+20P(B)}{P(A)^2+P(B)^2}$	1.00	0.9975	0.950	0.9976	0.9502	0.9975	1.0497

The purpose of this exercise is to show that as the average price
of the product rises as the demand for the product falls and
vice-versa. Regional demands are adjusted by these price factors.
The good the participants are marketing is a "normal" good.

REGIONAL DEMAND

$$\text{(PRICE GENERATED)} = (BDM * SEAD * RMA * COAD)^8 * PRICE\ FACTOR$$

5.35. - Promotional Demand Adjustment:

Expenditure on promotion is assumed to have a bigger impact
on demand than prices. Promotional expenditure and expenditure on
sales representatives are considered in calculating demand due to
promotion. The concept of historical dependency is brought into
the model by using the formula:-

$$\text{EFFECTIVE PROMOTIONAL EXPENDITURE} = \frac{3}{5}\left[\text{THIS MONTH'S PROMOTIONAL EXP.}\right] + \frac{2}{5}\left[\text{LAST MONTH'S PROMOTIONAL EXP.}\right]$$

$$+ 500*\left[\begin{array}{l}\#SALES\ REP.\\ THIS\ MONTH\end{array}\right] + 1000\left[\begin{array}{l}\#\ SALES\ REP.\\ LAST\ MONTH\end{array}\right]$$

Promotional effects on demand will be the sum of the firm's
promotional effectiveness.

- INDUSTRY EFFECTIVE = $\sum_{J=1}^{N}$ FIRM (J) EFFECTIVE
- . PROMOTIONAL EXP.   PROMOTIONAL EXP.

Basic demand in each region increases due to industry's effective
promotional expenditure but only up to a point. Graphs of
Demand Vs Industry's Effective Promotional Expenditures[9] are shown in
Appendix E. From the graphs a linear relationship is assumed to
exist between the demand and industry promotional expenditure and
factors by which the demand increases due to promotional expendi-
ture have been calculated.

These are shown in Table 2 below:-

TABLE 2

REGIONAL TOWNS	(BDM) BASIC DEMAND	(FTC) FACTOR	(TPM) MAXIMUM DEMAND
NAIROBI	2000.	1.741	5700.
MOMBASA	1800.	1.814	5000.
KISUMU	1500.	1.184	4300.
KAMPALA	4000.	2.368	11500.
DAR-ES-SALAAM	6000.	3.485	17000.

REGIONAL DEMAND

(PROMOTION GENERATED)

$$= \left[(BDM + (FTC* \ DEND))* \ C\emptyset AD* \ SEAD* \ RMA \right]$$

5.4. - Demand Shares Model:

Two demand schedules have now been worked out; demand due to
price decisions and demand due to promotional expenditure decisions.
The task now is to share these demands to the companies. The author
proposes that market share be on the basis of price and promotional
expenditures.

Market Share = f(Price, Effective promotional Expenditure).

5.41. - Share of Demand due to Price Decisions:

Clearly if there is no firm in a region, shown by no price
decision being made in that region, no firm receives demand due to
price decisions. The demand due to price is shared on the basis
of the price decisions made by both firms, shown in the formula below:-

DEMAND   = P(A) * REGIONAL   P(A)-Price by A.
  (PRICE) $\overline{P(A)+P(B)}$ DEMAND   P(B)-Price by B.

5.42. - Share of Demand due to Promotion Decisions:

Logically if a firm is not marketing in a region (shown by
price decision of zero in that region) the firms are not expected to
have promotional expenditures or sales representatives in that
region. In this case the share of demand due to promotion is zero
for both firms.

If there is only one firm in the region, then it is likely
that promotional demand in that region is largely generated by
that firm and therefore that firm gets that total share of demand
due to promotion.

When there are competing teams in a region the demand is
shared on the basis of the firms' promotional effectiveness as a
fraction of industry's effective promotional expenditure in that
region.

SHARE OF DEMAND

(PROMOTION)

$$= \frac{FDE}{DEND} * DEMAND$$ (PROMOTION   FDE-Firms effective
promotional expenditure

DEND-Industry effective
promotional expenditure.

If the firm had not made any promotional expenditure
decisions this month and there is no effective promotional
expenditure lasting from last month then the firms receive no share
of demand due to promotional expenditure decisions.

5.43. - Total Demand:

Total demand per firm per region is the sum of demand due to
price decisions and demand due to promotional expenditure decisions.

5.5. - Computer Program:

The calculations for SIGMEA are computerised using FØRTRAN IV
and the program is on magnetic tape. On pages 49-58 is a source
program printout. The flowchart appears in Appendix F. The results
printout can be categorised under the following headings. [10]

5.51. - Decision Printout:

This is a printout of decisions that have an impact on this
month's results.

5.52. - Firm's Results:

The results of the firms are printed out in terms of demand/ supply per region; competitors decisions, cash statement and other information.

5.53 - History Printout:

The programme prints out this month's decisions and results that will be used in calculating results of the next season.

5.6. - Programme Limitations:

There are a number of loopholes in the present programme which may permit cheating as the game is played. These loopholes concern sales representatives, raw material lead time, and overdraft recovery.

First the programme does not check whether the sales representatives have been on training for one month before being assigned. The Game Administrator could easily check this out and warn the teams which are assigning sales representatives before training them. This does not look like a serious drawback in the programme.

Second, there is a lag of three months before the raw materials are received. The programme does not check for this. The printout, however, gives raw materials that are on order during any month. The Game Administrator should check those who are using raw materials without ordering for them.

Third, the participants are supposed to repay the overdraft every month. The programme does not check for defaulters. The printout shows the balance of bank overdraft and inquisitive Board of Directors should question the prominence of the figures in the balance sheet.

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      MASTER SIMPLEX
C THIS PROGRAM CALCULATES RESULT... ... ...
      INTEGER RODISC,...,...,...,...
      ...
     1,...,...,...,...,...
     2MAY(2),...,...,...,...,...
     3TALL(2),...,...,...,...,...
      DIMENSION ...,...,...,...,...
      DIMENSION CHI.(2),...,...,...,...,...
     1SY3PI(2),...,...,...,...,...
      DIMENSION GLO(2,5),...,...,...,...
      DIMENSION ...,...,...,...,...
     1API(2,5),ZER(2)
      DIMENSION ADP(...),...,...,...,...
     1,CLIN(2),...,...,...,...,...
     2,PO..(2),...,...,...,...,...
     3,ALT(10),...,...,XE..(10))
C READ PARAMETE... CA...
      READ(1,10) (...(I),FI.(I),...(I),I=1,5)
10    FORMAT(5(...,...,F5.5,F5.0))
C READ IN TOTAL NUMBER OF INDUSTRIES
      READ(1,15) ...TAB
15    FORMAT(I2)
      DO 949 K=1,...TAB
      WRITE(2,63) K
63    FORMAT(1H1,50X,7HRESULT... FOR INDUSTRY,2X,I2)
C READ IN DECISION DECK
      DO 99 L=1,2
      READ(1,20) ICARD,IFIRM,...,(...(IFIRM,I),I=1,5),(...(IFIRM,I),
     1,5),(...(IFIRM,I),I=1,5),(...(IFIRM,I),I=1,
     2)
20    FORMAT(2I3,I2,5F5.0,5F6.0,5F5.0,2(5I1))
      IF(ICARD.EQ.1) GO TO 24
      GO TO 22
24    READ(1,25) ICARD,IFIRM,...,DISC(IFIRM),RDISC(IFIRM),...(IFIRM),
     1TAX(IFIRM),R...(IFIRM),...(IFIRM),...(IFIRM),...(IFIRM),
     2EXALD(IFIRM),FXOPT(IFIRM),OP(IFIRM),SANT(IFIRM),...(IFIRM),
     3OTEX(IFIRM)
25    FORMAT(2I3,I2,2I1,5F5.0,5F..0,5.0,F5.0)
      IF(ICARD.EQ.2) GO TO 26
      GO TO 22
26    READ(1,27) ICARD,IFIRM,...,(...(IFIRM,...),...=1,5),(...(IFIRM,...),
     1,5),(PPL(IFIRM,...),...=1,5)
27    FORMAT(2I1,I2,5F7.0,5F5.0,5F7.0)
      IF(ICARD.EQ.3) GO TO 99
22    WRITE(2,23)
23    FORMAT(1H1,48HTHERE IS AN ERROR IN CARDS;RUN TERMINATED)
      STOP
99    CONTINUE
C READ IN HISTORY CARDS
      DO 30 L=1,2
      READ(1,11) IFIRM,...(IFIRM),...(IFIRM),...(IFIRM),...(IFIRM),
     1...(IFIRM),(X..(IFIRM,I),I=1,5),(...(IFIRM,M),M=1,5)
11    FORMAT(I1,2F5.0,5F5.0,5F5.0,5F5.0)
30    READ(1,12) IFIRM,(VP4(IFIRM,I),I=1,5),...(IFIRM)
12    FORMAT(I1,5F6.0,F5.0)
      J=IFIRM
      DO 94 J=1,2
94    WRITE(2,...) J,...,(...(I,M),I=1,5),...(I),I=... ,5),...,...,
     1,...,(...(...,I),I=1,5),(...(I,...),I=1,5),...(I),...,
     2TAX(J),...RP(J),RDE(J),...(J),FALP(J),FABLE(J),...(J),...(J),
     3S..T(J),C..SOL(J),ITEX(I),(...(I,M),M=1,5),(...(I,...),...=1,5,
     4(VP2(J,M),M=1,5),...(J),S..A(J),C..(J),...(I),...,...,...,...,
```

```
0147              0  TO 120
0148       116    IFAP(J)=1.575.
0149              GO TO 120
0150       115    IFAP(J)=0.0
0151       120    CONTINUE
0152    C CALCULATION OF AVERAGE
0153              CALL PRODUC(XP ,PO ,OER,  ,
0154              PRO(J)=FGT (J)+GT (I)
0155              COST(J)=0 T(J)+1. )
0156              DO 50  I=1,5
0157    C COST OF HIRING SALES REPRESENTATIVES
0158              IF(I.IT.4) GO TO 121
0159              SIAP1(I)=SSAPL(I)+1.0/10.*DEP(I,I)
0160              GO TO 122
0161       121    SAP(J)=SAP(I)+7/10.*REP(J,I)
0162       120    FEL(I)=CFSU/S(J)+..P(J)
0163              IF(I.LT.4)GO TO 123
0164    C COST OF MAINTAINING SALES OFFICES
0165              UFA (J)=USAC(J)+1.0010.*SLF(J,I)
0166              GO TO 124
0167       126    UFEL(I)=USFC(J)+2.500.*SIFI(J,I)
0168       124    PROS(J)=U. A (J)+ FFC(I)
0169              EFGR(J)=EFFR(J)+PROR(I,I)
0170    C COMPANY ADJUSTMENT
0171              IF(PR(1,I).EQ.0..AND.PR(2,I).EQ.0.) GO TO 127
0172              IF(PR(1,I).GT.0..AND.PR(2,I).GT.0.) GO TO
0173              COAD=0.50
0174              GO TO 129
0175       127    COAD=0.0
0176              GO TO 129
0177       128    COAD=0.75
0178    C CALCULATING DEMAND DUE TO PROMOTIONAL FACTORS
0179       129    CALL PROJST(PROP,XPM,RED,XEP,POE,DEND)
0180              REGD(I)=G  (I)+(DEND(I)*PTC(I))
0181              IF(REGO(I)-TPM(I))130,130,131
0182       131    REGD(I)=TPM (I)
0183       13     CALL EPMCR#(X)
0184              KP EN.91+(0.17*X)
0185              CALL PRADJ(ADP,PR)
0186              AMD(I)=REG (I)*COAD*ADP(I)*SF  .*RAT
0187              XFM(I)=REGO(I)+COAD*SFAD*RAT
0188    C*SHARING DEMAND DUE TO PRICE EFFECTS
0189              IF(PR(1,I).EQ.0.)GO TO 132
0190              GO TO 133
0191       132    IF(PR(2,I).EQ.0.)GO TO 134
0192       133    GO TO(135,136)J
0193       135    ASA(J,I)=(PR(1,I)/(PR(2,I)+PR(1,I)))* SD(I)
0194              GO TO 137
0195       136    ASA(J,I)=(PR(2,I)/(PR(2,I)+PR(1,I)))+      (I)
0196       137    GO TO 138
0197       138    RSA(J,I)=0.0
0198    C SHARING DEMAND DUE TO PROMOTIONAL EFFECTS
0199       139    IF(PR(1,I).EQ.0..AND.PR(2,I).EQ.0.) GO TO 141
0200              IF(PR(1,I).EQ....AND.PR(2,I).GT.0.) GO TO 146
0201              IF(PR(1,I).GT.0..AND.PR(2,I).EQ.0.) GO TO 141
0202              IF(PR(1,I).GT.0..AND.PR(2,I).GT.0.) GO TO 147
0203              GO TO 150
0204       141    USA(I,I)=0.0
0205              GO TO 150
0206       144    GO TO(160,161)J
0207       160    USA(J,I)=0.0
0208              GO TO 150
0209       161    USA(J,I)=XEM(I)
```

```
105    JSA(J,I)=3.
       GO TO 150
142    GO TO(146,147)I
146    IF(BPEG(I).EQ.0.)GO TO 148
       JSA(J,I)=CPOE(1,I)/DEMG(I)*AEP(I)
       GO TO 150
148    JSA(J,I)=0.0
       GO TO 150
147    IF(SEMG(I).EQ.0.)GO TO 149
       JSA(J,I)=CPOE(2,I)/DEMG(I)*AEP(I)
       GO TO 150
149    JSA(J,I)=0.0
150    FTA(J,I)=JSA(J,I)+ATA(J,I)
C PEETING PEGIONAL DEMANDS:IF DEMAND NOT MET STOCKOUT PENALTY INCURRED
       IF(POP(I)-FTA(J,I))151,151,152
152    SOLD(J,I)=FTA(J,I)
       POP(J)=POP(J)-SOLD(J,I)
       GO TO 153
151    SOLD(J,I)=POP(J)
       POP(J)=0.0
       STC(J,I)=FTA(J,I)-SOLD(J,I)
       SOC(J)=SOC(J)+(0.5*STC(J,I)*PR(J,I))
153    IF(I.LT.4) GO TO 154
C COST OF HIRING AGENTS
       FHDR(J)=FHDR(J)+(0.15*PR(J,I)*SOLD(J,I)*AG(J,I))
       GO TO 155
154    SALX(J)=SALX(J)+(0.10*PR(J,I)*SOLD(J,I)*AG(J,I))
155    ZDR(J)=FHDR(J)+SALX(J)
C CALCULATION OF ACCOUNTS RECEIVABLES
       IF(DISC(J).EQ.1)GO TO 156
       RCST(J)=0.0
       WAIT(J)=WAIT(J)+(PR(J,I)*SOLD(J,I))
       GO TO 157
156    RCST(J)=0.93*PR(J,I)*SOLD(J,I)
157    CONTINUE
       ZEB(J)=ZEB(J)+RCST(I)
       TRANS(J)=TRANS(J)+(V*SOLD(J,I))
       TSP(J)=TSP(J)+SOLD(J,I)
       TMY(J)=TMY(J)+FTA(J,I)
98     Y=Y+0.10
       SAC(J)=ZEB(J)+ACRV(I)
C ADJUSTING FOR GOODS AVAILABLE FOR SALE AND BAL.OF RAW MAT.AND FIN.
       CALL PRODCE(XPM,PPC,DLM,SPID,POP,,KIE,GOT,AVG)
       POP(J)=FGIN(J)+GOT(J)
       CFG(J)=POP(J)-TSP(J)
       CLIN(J)=AVP(J)-GOT(J)
90     CONTINUE
C RESULTS PRINTOUT
       CALL RESALT(TMY,BANK,SANT,CAB,DEPT,COST,EMPLY,FRU,MAT,TRANS,
      1ZDR,PLUS,ITL,FHCR,VENT,ADMIN,FFZ,TREST,CAPEX,TAX,DIVD,PR,PROF,
      2SOFI,AGN,CFL,WAIT,CLIN,LFA,FIN,SOLD,STC,SAP,ACG,PPC,RSF,CO,
      3SAC,SOC,FHLRD,TSP,DTEX,K)
99     CONTINUE
       STOP
       END
```

```
              SUBROUTINE PRODC:(XPR,PPC,DLR,SPRD,ROPR,RRL,GOT,AVR)
              DIMENSION XPR(2,5),PPC(2,5),DLR(2,5),SPRD(2,5),ROPR(2,5),RRL(2)
       *    TGOT(2),EFET(2,5),TP(2,5),TPAD(2,5),ACP(2,5),TOTPD(2),AVR(2)
       C CALCULATING GOODS PRODUCED
              CALL FPRCRW(X)
              CAMH=3500.+(1000000.*X)
              TAMH=4000.+(1000000.*X)
              DIFPD=TAMH-CAMH
              DO 213 J=1,2
              TOTPD(J)=0.0
              DO 212 M=1,5
       C ADJUSTING FOR MAINTENANCE EXPENSES
              EFET(J,M)=(0.75*PPC(J,M))+(0.25*XPR(J,M))
              TP(J,M)=CAMH+((EFET(J,M)/(EFET(1,1)*500.))*DIFPD)
       C SHIFT EFFICIENCY
              GO TO (201,202,203)
       201    TPAD(J,M)=TP(J,M)*1.00
              GO TO 204
       202    TPAD(J,M)=TP(J,M)*0.75
              GO TO 204
       203    TPAD(J,M)=TP(J,M)*0.50
       C LABOR CONSTRAINTS
       204    IF(SPRD(J,M)-TPAD(J,M))205,205,206
       205    ACP(J,M)=(SPRD(J,M)*DLR(J,M)/20.)
              GO TO 207
       206    ACP(J,M)=(TPAD(J,M)*DLR(J,M)/20.)
       207    GO TO(210,211)J
       210    TOTPD(J)=TOTPD(J)+ACP(1,M)
              GO TO 212
       211    TOTPD(J)=TOTPD(J)+ACP(2,M)
       212    CONTINUE
       C CHECKING FOR AVAILABLE RAW MATERIALS
              AVR(J)=ROPR(J)+RRL(J)
              IF(TOTPD(1)-AVR(J))213,213,214
       213    GOT(J)=TOTPD(J)
              GO TO 215
       214    GOT(J)=AVR(J)
       215    CONTINUE
              RETURN
              END


SEGMENT, LENGTH   500, NAME  PRODUCE
```

```
0309                    SUBROUTINE PRJUST(PROM,ZPN,REP,XEP,FDE,DEND)
0310                    DIMENSION PROM(2,10),ZPN(2,10),REP(2,10),XEP(2,10),FDE(2,10),
0311              1DEND(10)
0312              C  CALCULATING PROMOTIONAL EFFECTIVENESS:PRICES FOR INDUSTRY'S
0313                    DO 301 J=1,2
0314                    DO 301 I=1,5
0315                    FDE(J,I)=2.0*PROM(J,I)+0.4*XPN(J,I)+500.*REP(J,I)+800.*ZEP(J,I)
0316         301        DEND(I)=FDE(1,I)+FDE(2,I)
0317                    RETURN
0318                    END
```

END OF SEGMENT, LENGTH   120, NAME PRJUST

```
      SUBROUTINE RESULT(IVY,BANK,SANT,CAB,DEBT,COST,EMPLY,HEAD,PMT,T
     1,ZU,PLUS,TTL,CRED,VENT,ADITS,FFZ,TREST,CAPE,TAX,DIV,P
     2,SOFT,AGN,DEL,WAIT,CLIN,CP,FER,SULE,FTC,SAP,ART,PPC,HEAD,CP,
     3SAC,SOC,HEGRD,TSP,OTEX,IA
      INTEGER SOFT,AGN
      DIMENSION IVY(2),BANK(2),SANT(2),CAB(2),AFDD(2),DEBT(2),COST(
     1EMPLY(2),HEAD(2),PMT(2),TRAVS(2),ZU(2),PLUS(2),TTL(2),CRED
     2VENT(2),ADITS(2),FEZ(2),TREST(2),CAPE(2),TAX(2),DIVE(2),PP(
     3RITE(2),PS(2,10),PROM(2,10),REP(2,10),SOFT(2,10),AGN(2,10),
     4CBB(2),CBIV(2),CLIN(2),FEG(2),C22(2),TTL(2,10),SULE(2,10),SO
     5),SAP(2),ARN(2),PPC(2,5),UD(2),DRAF(2),SEC(2),SOC(2),HEGRD(
     6TSP(2),OTEX(2)
C RESULTS PRINTOUT
      DO 354 J=1,2
C CALCULATING AVAILABLE CASH
      AFDD(J)=CAB(J)+BANK(J)+SANT(J)+SAC(J)
C CALCULATING TOTAL CASH DISBURSED
      DIS(J)=DEBT(J)+COST(J)+EMPLY(J)+TRAVS(J)+PMT(J)+TREST(J)+ZU(
     1PLUS(J)+SAP(J)+HEGR(J)+VENT(J)+ADITS(J)+FFZ(J)+TREST(J)+CAPE
     2TAX(J)+DIVE(J)+SOC(J)+OTEX(J)
      CBB(J)=AFDD(J)-DIS(J)
      CBIV(J)=(DRAF(J)+SANT(J))-UD(J)
      C22(J)=CBB(J)-ARN(J)
      WRITE(2,845)
845   FORMAT(1H1,48X,24HBUSINESS SIMULATION GAME//1H0,45X,27HKENYA
     1LE LOCK INDUSTRY//1H0,54X,3H(SIGMA)//1H0,53X,1H(RESULTS FO
      WRITE(2,01)
01    FORMAT(51X,14H==============)
      WRITE(2,804) K,J,MONT
804   FORMAT(1H0,6X,9HINDUSTRY=,I2,5X,5HFIRM=,I7,5X,6HMONTH=,I2)
      WRITE(2,02)
02    FORMAT(5X,11H===========,5X,6H======,50X,8H========)
      WRITE(2,803)
803   FORMAT(1H0,6X,8HREGIONS:,16X,7HNAIROBI,7X,7HMOMBASA,6X,6HK
     1,7HKAMPALA,7X,13HDAR-ES-SALAAM)
      WRITE(2,05)
05    FORMAT(7X,8H========,16X,7H=======,7X,7H=======,5X,6H======,
     1,7H=======,7X,13H=============)
      GO TO(801,802)J
801   WRITE(2,806) (FIN(1,I),I=1,5),(SOLU(1,I),I=1,5),(STC(1,I),I=
     1(PR(2,I),I=1,5),(PROM(2,I),I=1,5),(REP(2,I),I=1,5),(SOFT(2,I
     25),(AGN(2,I),I=1,5)
806   FORMAT(1H0,6X,6HDEMAND,16X,F7.0,4F14.0/1H0,6X,6HSUPPLY,16X,
     14F14.0/1H0,6X,10HSTOCK-OUTS,14X,F7.0,4F14.0/1H0,6X,22HOPERATI
     2 DECISIONS/1H0,6X,6HPRICES,16X,F7.0,4F14.0/1H0,6X,10HPROMOTIO
     3X,F7.0,4F14.0/1H0,6X,10HSALES REPS,14X,F7.0,4F14.0/1H0,6X,13H
     4 OFFICES,11X,I7,4I14/1H0,6X,6HAGENTS,16X,I7,4I14///)
      GO TO 821
802   WRITE(2,822) (FIN(2,I),I=1,5),(SOLU(2,I),I=1,5),(STC(2,I),I=
     1(PR(1,I),I=1,5),(PROM(1,I),I=1,5),(REP(1,I),I=1,5),(SOFT(1,I)
     25),(AGN(1,I),I=1,5)
822   FORMAT(1H0,6X,6HDEMAND,16X,F7.0,4F14.0/1H0,6X,6HSUPPLY,16X,F7
     14F14.0/1H0,6X,10HSTOCK-OUTS,14X,F7.0,4F14.0/1H0,6X,22HOPERATI
     2 DECISIONS/1H0,6X,6HPRICES,16X,F7.0,4F14.0/1H0,6X,10HPROMOTIO
     3X,F7.0,4F14.0/1H0,6X,10HSALES REPS,14X,F7.0,4F14.0/1H0,6X,13H
     4 OFFICES,11X,I7,4I14/1H0,6X,6HAGENTS,16X,I7,4I14///)
821   WRITE(2,807)
807   FORMAT(1H1,50X,23HCASH STATEMENT FOR FIRM,2X,I1)
      WRITE(2,04)
04    FORMAT(51X,26H==========================)
      WRITE(2,818)CAB(J),SAC(J),BANK(J),SANT(J),AFDD(J),VENT(J),C
     1EMPLY(J),HEAD(J),PMT(J),TRAVS(J),ZU(J),PLUS(J),TTL(J),SOCK(
     2VENT(J),ADITS(J),FFZ(J),TREST(J)
```

```
0399        2 2X,F5.0/1H0,30X,27HAVAILABLE FOR DISBURSE...1ST3...,FX.0/1H0,4..X,1...
0400        31DISBURSEMENTS/1H0,30X,16HACCOUNTS PAYABLE,28X,F8.0/1H0,30X,15HVARI...
0401        ...ABLE COST,29X,...,.0/1H0,30X,31HLABOR,37X,...,.0/1H0,30...,15HOVERHEAD C
0402        5OST,29X,F8.0/1...,30X,11HMAINTENANCE,31X,F8.0/1H0,30X,9HTRANSPORT,3...
0403        ...32X,F5.0/1...,30X,5HRENTS,35X,F6.0/1H0,30X,7HUTILITIES,35X,F5.0/1H0,3
0404        70X,11HSALES REPS,...,51X,F8.0/1H0,30X,10HPROMOTIONS,32X,F8.0/1H0,30X,
0405        8HINVENTORY,33X,F...,0/1H0,30X,14HADMINISTRATION,28X,F8.0/1H0,30X,11
0406        9HDEPR SUITABLY,31X,F5.0/1H0,30X,8HINTEREST,34X,F8.0)
0407              WRITE(2,51 )SO...(J),CAP...(J),...X(J),...(J),...(J),...(J),...(J),
0408        1ARN(J),F2 (J),CRO V(J),WAIT(J),DEL(J),PHORD(J)
0409    51    FORMAT(1H ,30X,1...1STOCK-OUT COST,2.X,F6.0/1H0,30X,21HCAPITAL EXPEN
0410        1DITURES,22X,F8.0/1H0,30X,12HINCOME TAXES,30X,F8.0/1H0,30X,9HDIVIDE
0411        2NDS,33X,...0/1H0,3?X,15HTOTAL EXPENDITURES,24X,F8.0/1H0,30X,15HTOT
0412        3AL DISBURSEMENTS,30X,F9.0/30X,11H-----------/1H0,30X,28HCLOSING BA...
0413        4LANCE BEFORE 0...,31X,F5.0/1H0,30X,8HINTEREST,34X,F6.0/30X,11H-----
0414        5------/1H0,30X,20HCLOSING CASH BALANCE,27X,F9.0/30X,11H-----------
0415        6/30X,11H-----------///1H0,48X,17HOTHER INFORMATION/1H0,30X,24HCLOS
0416        7ING BALANCE OF OVERDRAFT,10X,F8.0/1H ,20X,34HOUTSTANDING ACCOUNTS
0417        8RECEIVABLES,...X,F5.0/1H0,20X,27HOUTSTANDING ACCOUNTS PAYABLE,...X,F
0418        9.0/1H0,20X,22HRAW MATERIALS ON ORDER,16X,F8.0)
0419              WRITE(2,323) CLE...(J),...V(J),CFG(J),ISD(J
0420    823   FORMAT(1H0,25X,22HVAL. OF RAW MATERIALS=,F7...,10X,15HTOTAL DEMAND
0421        10=,17.0/1H0,25X,25HVAL. OF FINISHED GOODS=,F7...,1.X,11HTOTAL-DEMAND=
0422        2,F7..)
0423              IF(CAPIT(J).GT. .)GO TO 64...
0424              WRITE(2,641)
0425    641   FORMAT(1H ,20X,...HUNABLE TO PARTICIPATE IS//1H0,...X,...HWE HAVE
0426        10T YET DONE SO//1HEST IN PLANT FACILITY,REFER TO CASE FOR DETAILS)
0427              WRITE(2,6..)
0428    06    FORMAT(21 ,73H=========================================
0429        1=======================)
0430    C PRINTOUT OF HISTORY
0431    64    WRITE(2,642)J,...,CLE...(I),CFG(I),C2?(I),...IT(I),...(J),...EP(J,I),I=1
0432        1,5),(PPE(I,I),I=1,5),.,(PRO...(I,I),I=1,5),CROV(J)
0433    642   FORMAT(1H1,35HTHIS IS HISTORY PRINTOUT FOR ,1H.,1X/1H0,35HELL CSE I
0434        1EAR IT 0,F/1H0,70H1 ....I1.....I1......I1......I1......I1,.I1,.I1,
0435        2.I1.I1.....I1.....I1..... /1H0,I1,20X,5.,3F6...,...,F8.0,3F6.0/1H,I1,F5.
0436        3,F5.0/1H0,25H1I1....I1....I1....I1....I1....I1......)
0437    65    CONTINUE
0438              RETURN
0439              END
```

5.7. - Summary:

This chapter presented the major features that are incorporated into SIGMEA. The chapter next presented the findings from the interviews and some of these findings were incorporated into the case and the mathematical models. Three mathematical models were built; production model, demand model and market share model. In these models the decisions of the participants were used and some adjustments (seasonal effects, random adjustment, company adjustment) were also incorporated in the models. The Chapter closed by presenting the Source Program and its limitations.

5.8. - Notes and References:

1. In designing SIGMEA, the author has drawn largely from Paul S. Greenlaw, L.W. Herron, R.H. Rawdon, "Business Simulation in Industry and University Education", London, Prentice-Hall(1962) p. 68-119.

2. Ibid., p.73

3. See Daily Nation No.1440 Jan. 16, 1975 p.1.

4. The Case referred to here appears in the Participants Manual Chapter 5.

5. Refer to Appendix B for full names of variables.

6. MAX. CAPACITY: POSSIBLE PRODUCTION LEVEL WITH MAXIMUM MAINTENANCE
   MIN. CAPACITY: "   "   "   "   O MAINTENANCE.

7. Refer to Appendix B for full names of variables.

8. Refer to Appendix B for full names of variables.

9. The Demand and Industry's effective promotional expenditure figures used in plotting the Graphs were figures employed in the initial version of this Business Game. In that version an approximate cubic relationship was assumed to exist between the demand and promotional expenditure.

10. Refer to Participants Manual in chapter 5 for Decision and Results Printout.

CHAPTER 5

Introduction:

This chapter contains the participants' manual, the
Administrator's manual and the Board of Directors manual.
In the participants' manual, the participants are told the
requirements for playing the game. The participants are
informed of the educational requirements of the game.
They are next advised how to organise their teams for
decision-making and how to enter their decisions in the
decision forms. The participants' manual contains the
case that defines the environment in which they are to
make decisions.

The Administrator's manual tells the Administrator
how to administer the game. The Board of Directors manual
tells the Board of Directors the roles they are supposed
to play in the simulation exercise, and what areas of the
participants' performances to look into.

PARTICIPANTS MANUAL

1.0. - Letter From the Shareholders.

Registered Officer,

Box 12345,

NAIROBI.

Dear Sirs,

It is with much pleasure that we welcome you to the
Management of our Company (Kenya Bicycle Lock Assembly
Industry Ltd.). Our company is publicly owned and until
recently sixty percent of the shares were owned by an
Asian non-citizen family. This family has since left the
country and the shares were bought by African businessmen.
Few of us, shareholders have ever managed a company of this
size before. Most of us were operating "dukas" in the
various towns of the country and are largely ignorant
about book-keeping, stock-control, return on investment etc.
We are confident, gentlemen, that with your expert
knowledge you will manage this company well and guarantee
us, the shareholders, greater dividends and an appreciation
in the value of our shares.

Yours faithfully,

1. J. Kamau

2. M. Onyango

3. F. Mutiso

4. J.M. Mahero

5. Sheikh Rajab

On behalf of the shareholders.

1.1. - Introduction to Business Games:

Dear Participant,

You are about to play a business simulation game, a decision making exercise in which you assume the role of managing a simulated operation. In this exercise you are managing a hypothetical company, Kenya Bicycle Lock Assembly Industry, and are expected to make decisions about marketing, finance, investment, and production using the principles and tools that you have learnt from your business studies courses. Your company is in competition with another company so your results will be affected by your decisions as well as the decisions of your competitor.

Business simulation games draw their originality from War Games and Operations Research. War Games date back as early as 1811 when Von Reisswitz Sr. built war games where opposing teams of military personnel were given an imaginary mission and called upon alternately to make decisions in an effort to accomplish a mission. A documented application of War Games comes from Japan where a War Game was played in the Total War Research Institute in October 1940. In the play; on the one hand were the enemies and on the other hand was Japan. Japan represented an uneasy coalition of the Army, Navy, Cabinet, constantly disagreeing on economic,

educational and financial issues. In a business simulation game, like in a War Game, the participants make decisions in certain areas and using mathematical models these decisions are manupulated and results are produced. The participants make decisions again for the next period and so on.

Business simulation games borrow the concept of "simulation" from Operations Research. Simulation models are models of a system which involves abstraction of aspects of the system one is studying and replicating these aspects by other means e.g. words or mathematical models. Simulation models are widely used in the field of engineering. Some of the advantages of using simulation models rather than real world situations are: economy, visibility, safety and reproducibility.

One word of caution; although called "Games", Business simulations are a serious educational exercise which is not designed to be played just for fun.

1.2. - Educational Objectives of Sigmea:

Before one can effectively play SIGMEA one has to know the areas of business studies outlined below:-

1.21. - Marketing:

The participants must be aware of the traditional $4p^s$ of Marketing (Price, Promotion, Place, Product). They should

vary these $4p^s$ with the aim of increasing sales. In the process
of marketing their product the participants should become aware of
the controllable and uncontrollable factors and decide on how
to deal with these factors. The participants
should be clear of the various methods of promotion and the
effectiveness of each of these methods in securing sales.
Sales forecast must be made on the basis of expected demand taking
into account factors like seasonal effects on demand.
Through the use of Economic Order Quantity (EOQ) the partici-
pants should be able to reduce capital tied up in stock
while guarding against stock-outs.

1.22. - Accounting:

The participants should use accounting information for,
among other things, control purposes. The participants are
expected to prepare cash flow statements, budgets and forecasted
Income Statements. The participants should compare actual
and planned and generate variances that should help them improve
on decision-making in the next season.

Routine statements like income statement and balance
sheet for external reporting purposes must be produced.

Cost accounting is necessary for controlling costs,
choosing from among alternatives and price setting. The
participants should find out whether they need bother about
price-setting or take the market prices.

1.23. - Finance:

Methods of financing open in the exercise are debt
financing and equity financing. Each method has costs asso-
ciated with it and so a choice should be made on the type of
leverage between debt financing and equity financing desired.
During the play of the game the participants will get involved
in a capital investment decision and techniques learnt on
project appraisal must be used before a decision is reached
on whether to invest or not.

1.24. - Production:

Production must be carried on the basis of the sales
estimates. There is a time lag of three months in the
acquisition of raw materials. A production plan should be
prepared for a period of at least a year, and it is
necessary to compare the actual with the planned to improve
on future budgets. Plant maintenance increases the
productivity of plants in the short-run but in the long run
participants should be thinking about building a new plant.

1.25. - Personnel:

The participant will find it necessary to set down personnel
policy as the Board of Directors will want to know how
they plan to deal with the demand of the Union.

1.26. - Systems:

The participants should be familiar with the systems
approach to management whereby decisions made in the sub-
systems of production, marketing, finance, affect the

objectives of the total enterprise. The point in question
is how to achieve the objectives of the sub-systems without
conflicting with the objectives of the total systems.

1.3. - The Case:

The Case overleaf defines the environment that you will be
operating in.   Read it   · carefully before you embark on
the task of decision-making.

KENYAN BICYCLE LOCK INDUSTRY

S I G M E A

There are currently two firms in Kenya involved in manufacturing bicycle locks. The privately owned firms are located in the industrial area. The companies have similar history and the information given below applies equally to both.

Market:

Kenyan bicycle locks have mainly been sold in small shops in the towns of Nairobi, Kisumu and Mombasa. The marketing strategy pursued was to divide Kenya into three marketing regions supplied from Mombasa, Kisumu and Nairobi. The locks are normally transported to these regions from Nairobi and distributed from the towns. Figure 1 shows the geographical division of the marketing areas.
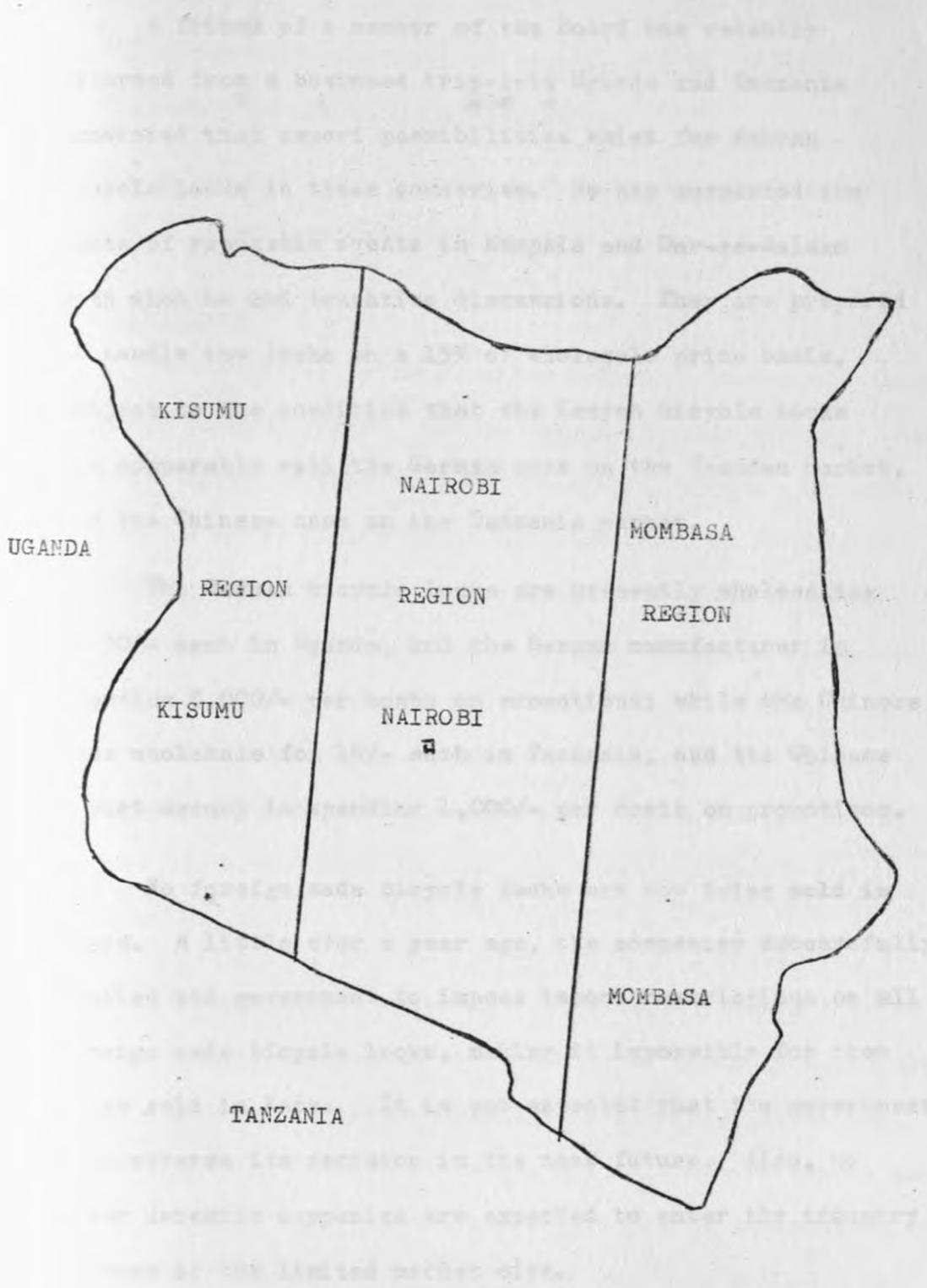
KISUMU

NAIROBI

MOMBASA

UGANDA

REGION   REGION   REGION

KISUMU   NAIROBI

MOMBASA

TANZANIA

A friend of a member of the Board has recently
returned from a business trip into Uganda and Tanzania
convinced that export possibilities exist for Kenyan
bicycle locks in these countries. He has suggested the
names of reputable agents in Kampala and Dar-es-Salaam
with whom he had tentative discussions. They are prepared
to handle the locks on a 15% of wholesale price basis,
subject to the condition that the Kenyan bicycle locks
are comparable with the German ones on the Ugandan market,
and the Chinese ones on the Tanzania market.

The German bicycle locks are presently wholesaling
at 30/- each in Uganda, and the German manufacturer is
spending 5,000/- per month on promotions; while the Chinese
ones wholesale for 15/- each in Tanzania, and the Chinese
export agency is spending 1,000/- per month on promotions.

No foreign made bicycle locks are now being sold in
Kenya. A little over a year ago, the companies successfully
lobbied the government to impose import restrictions on all
foreign made bicycle locks, making it impossible for them
to be sold in Kenya. It is not expected that the government
will reverse its decision in the near future. Also, no
other domestic companies are expected to enter the industry
because of the limited market size.

Demand for bicycle locks in East Africa has been
slightly seasonal. Bicycle thieves seem to prefer warm and dry

weather to cool and wet for their "operations". Demand for locks varies with the level of bicycle thefts, as well as other factors such as the bicycle population.

In Kenya the weather has been quite wet and cool between the months of April and October.

Distribution:

The companies maintain sales office in downtown Nairobi to cover Nairobi region, and in Mombasa for the Mombasa region. Sales offices cost the companies 2,500/- per month per region. A sales office could be established in Kampala for 10,000/- per month to service all of Uganda, and in Dar-es-Salaam for 10,000/- for all of Tanzania. Agents, working on a 10% of wholesale price commission basis, are now covering Nairobi region and Kisumu region. Agents can be appointed in any other Kenya region on the same basis. Sales offices and agents perform the same functions, and are equally effective in securing sales.

Although the companies do not presently have any sales representatives because of the policies of their recently retired sales managers, each representative would cost 7,500/- per man per month per region in Kenya, and 10,000/- in Uganda and Tanzania. More than one representative may be assigned to any one region. Men can be readily hired for this position, but must be trained at "head office" for one month before being assigned to the "field."

The bicycle locks are normally transported by road from the factory to the retailer's outlet. The present transport rate structure being charged for this service is:

Marketing Towns	Transport Charges (Shs./lock)
Kenya:	
Nairobi	-/50
Mombasa	-/60
Kisumu	-/70
Foreign:	
Kampala	-/80
Dar-es-Salaam	-/90

Inability to deliver enough to meet customers' demands results in a direct loss of 50% of the sales revenue that would have accrued from the unfilled quantity as a stock-out penalty. For example, if, in a particular region, a company sets the wholesale price at 20/- per lock and its demand is 1,000 locks but its supply is only 600, that company would receive a gross revenue of 20/- x 600 = 12,000/- but would be charged a stock-out penalty of 50% x 20/- x (1,000-600)=4,000/-. Therefore, the company would receive a net revenue of 12,000/- - 4,000/- = 8,000/-.

The companies are only concerned with the wholesale price of their bicycle locks. They assume that retail prices are set relative to the wholesale price. Prices may be varied

independently in each region in multiples of 1/-.

At their next meeting the parliament is going to debate
the Price Control Bill which has already been tabled. If
passed, the act will make it illegal to charge above a certain
price for a production. The manufacturer can however, put his
case before the Price Control Board for price rises. The
manufacturer will have to convince the Board (represented by
the Game Administrator) that his production costs are high
compared to sales price.

A limited amount of advertising and other forms of
promotion can be undertaken. This may be varied independently
in each region by multiples of 500.

Production:

The company's factories are located in the "industrial
area" of Nairobi. It is presently using one plant unit; that
is. working one eight-hour shift per day with a nominal output
of 5,000 bicycle locks per month. However, owing to machinery
breakdowns, delays in some supplies, difficulties in scheduling
production, labor disputes, and other problems, actual output
ranges between 3,500 and 4,500 units per month.

The factory manager has suggested to the executive board
that money could be well spent on preventive maintenance, and
production planning and control. This has never been undertaken
before, but he estimates that it may increase the plant

productivity by up to an average of 500 bicycle locks per month. These expenditures can be undertaken in multiple of 1,000/-.

A second shift can be added. The extra labor is readily available and would be fully productive immediately. However, the second shift would only be 75% as efficient as the first shift to start with. A third shift is possible but only 50% as efficient as the first shift.

The present machinery is three years old and is estimated to be productive for another two years, at which time major overhauls will be needed.

Duplicate plants can be built adjacent to the present sites for 300,000/-; (100,000/- for the land, 150,000/- for the building, and 50,000/- for the equipment). A contractor has estimated that it will take six months from the time of the decision to build to the time when the additional facilities are in full production. Payments for the new factory would be on the following schedule:

MONTH	LAND	BUILDING	EQUIPMENT
0........	100%	25%	
1........		10%	
2........		10%	
3........		10%	
4........		10%	
5........		10%	50%
6........		25%	50%
Total	100%	100%	100%

Note: At the end of month 6 (start of month 7),

        the additional production facilities are

        ready for use.

Smaller or larger plants can be built; but, building
and equipment must remain in the ratio of 3:1, and land can
only be purchased in discrete lots. That is, 100,000/-
worth of land can contain building and equipment up to a
maximum of 150,000/- and 50,000/- respectively. Any
increase in building and equipment above these amounts
necessitates buying one more full lot, or more. It would
take six months for the additional capacity to come into
production, irrespective of its size.

Production is ready for sale in the month it is
produced. Raw materials must be ordered three months before
the delivery date. For example, raw materials ordered in
August are not delivered until November. They may be used in
the month of delivery, and are normally paid for in the
following month after delivery is taken. The supplier has
offered a 2% discount if payment is made in the month of delivery,
instead of one month later.

One unit of raw materials, enough to produce one
finished bicycle lock, ~~tons~~ costs5/-. However, starting
immediately, the govenment is raising its duty on this
class of imports (the raw materials are imported from
Europe). This will have the effect of raising the cost to

7/50. Other variable manufacturing costs are 1/- per unit produced.

Monthly inventory handling and storage charges, calculated on the end of the month balance, are -/20 per unit of raw materials and -/10 per unit of finished goods.

Labor costs are fixed at 900/- per man per month on the first shift, second and third shifts by an old labor union contract. There can be no hiring and firing of employees during the month, only at the beginning or end of a month.

Lately, much labor unrest existed at the factories, and rumours of a possible walk-out have been circulating. The Board of Directors are bothered by this situation, especially since the union contract expires in six months.

Factory overhead is 5,000/- per month with one shift in operation, 10,000/- with two shifts, and 12,500/- with three.

General Administration:

With one plant in operation, administrative expenses are 10,000/- per month.

Finances:

The company has raised capital through shareholder contributions, a government loan and bank overdrafts. The 100,000/- government loan carries a 10% interest charge per year, payable at the end of each June. It is secured against the land and matures in two years.

The companies have negotiated a 20,000/- bank overdraft limit. Under the conditions of the overdraft, interest is payable monthly at 1% of the outstanding end-of-month balance, and the overdraft must be secured against "Quick" assets.

Other normal sources of funds are available. Application for more capital requires a written submission to the game administrator stating the proposed terms. The company will be advised as to the acceptability of its proposal.

Usually, any distribution of earnings has been declared in December and paid in February. No defined dividend policy has been consistently followed in the past, but certain influential shareholders have recently exerted pressure on the Board of Directors to have the companies set down guidelines for the future.

Excess working capital may be invested in a bank on a fixed deposit of 6 months. The interest on such monies is 3% per annum and the investment and interest are collectible at the end of the 6 month period. This money can be invested only in January or July.

Other information:

Depreciation is allowed for annually at 20% of the net book value. This rate is acceptable to both the auditors and tax authorities. Normal tax laws apply, and tax is payable in February of each year.

Normal trade terms are one month and there has been no
slow payers or bad debts. The company has been considering
a 2% discount for immediate payment, and the retailers
have indicated they would take advantage of this if it were
offered.

Consultations are provided by The Game Administrator
who will provide consultation on managerial problems. He charges
a basic fee of 2,000/- and a fee of 150/- for every 10
minutes of consultations. The consultant is available for
a maximum of 60 minutes for consultations during any month.

Should you desire to sell shares, write to
The Game Administrator informing him of this decision and
furnishing the details of number of shares to be sold and
par value of each share.

Unless specified otherwise, all costs are paid in the
month of their occurence.

The following is the statement of financial position
from one year ago. The up to date financial statements will
be provided directly to the teams.

STATEMENT OF FINANCIAL POSITION

AS OF THE END OF MONTH 24

ASSETS

Current Assets

Cash	25,898	
accounts receivable	65,625	
raw material inventory	5,000	
finished goods inventory	5,000	101,523

Fixed Assets

land			100,000
depreciable fixed assets			
building	150,000		
equipment	50,000	200,000	
accumulated depreciation	72,000	128,000	228,000
Total Assets		Shs.	329,523

EQUITIES

Current Liabilities

Accounts payable	20,000	
dividends payable	15,000	
income tax payable	20,869	
interest payable	5,000	60,869

Long-term Liabilities

government loan		100,000
Total Debt		160,869

Owners' Equity

paid-up capital	134,825	
retained earnings	33,829	168,654
Total Equities	Shs.	329,523

1.4. - Preparation for Decision Making:

In preparing for decision making you should be thinking about; organisation of Management Team, Objectives and Goals of Company, Setting policies, laying down strategies and preparation of forecasts, budgets and plans.

1.41. - Organisation of Management Team:

One of your problems will be how to organise your team for decision making. You could have a domecratic arrangement whereby proposals are based upon general discussions and decisions reached by majority vote. In this case, the leader is responsible for conducting the discussion and the voting. You could have a functional arrangement whereby the proposals are made by functional people; the discussions are democratic and the decision by the majority. In this case the role of the leader is the same as in the democratic arrangement. An appropriate arrangement for this game may be the line-type organisation whereby you assign functional officers roles and require them to report to the leader. The leader is the final decision-maker. If you follow this arrangement you may find it useful to appoint the following officers; General Manager, Manager - Finance Department, Manager - Marketing Department, Manager - Production Department, and Company Secretary. Structure your organisation in any way you feel is appropriate for decision-making.

1.42. - Objectives and Goals of Company:

Before making decisions you should set down the
objectives and goals of your company. Your Board of Directors
will request that you present this.

These objectives and goals should be explicitly stated.
Avoid using vague expressions like, "to make a satisfactory
return on investment", and where possible include some figures
in the statement of your goals. After some play you may
find it necessary to revise your goals.

1.43. - Policies and Strategies:

The policies and strategies must aid in the attainment
of your objectives and goals. Such policies and strategies
must be explicit to guide management action in all areas.
Where possible you must lay down decision rules. An example
of a decision rule is:

> "... ·to maintain a mark up of 40% over production
> cost, plus transportation costs without regard to
> competitors pricing policy."

You may find it necessary to revise your policies as
the game progresses. Maintenance of definite policies
effectively serves the decision making process.

1.44. - Preparation of Forecasts, Plans and Budgets:

Preparation of forecasts and Budgets aids in the
decision-making process. You should prepare forecasts
and budgets in as many areas as you feel are relevant.
Some of the areas to consider are:-

1.441: - Cash Budgets:

In order to meet your expenses and cash outlays required by your investment plans, it is necessary to prepare a Cash Budget. Worksheet A attached overleaf is relevant for this purpose.

COMPANY: WORKSHEET A

                            Cash Budget

Sources of Funds	M O N T H S					
	1	2	3	4	5	6
Accounts Receivable (past month)						
Accounts Receivable (this month)						
Bank Loans						
Sale of Shares						
Interest on Investments						
Opening Cash Balance						
Total Sources						
Uses of Funds						
Accounts payable (past month)						
Accounts payable (this month)						
Variable Manufacturing Costs						
Labor Expenses						
Overhead Cost						
Maintenance						
Transport						
Agents						
Sales Offices						
Sales Representatives						
Promotional Expenditure						
Inventory Holding Costs						
Administration						
Consultancy						
Interest on Govt. Loan						
Capital Expenditures						
Income Taxes						
Dividends						
Repayments						
Total Allocations						
Ending Cash Balance						

Cash Budget

Sources of Funds	M O N T H S					
	7	8	9	10	11	12
Accounts Receivable (past month)						
Accounts Receivable (this month)						
Bank Loans						
Sales of Shares						
Interest on Investments						
Opening Cash Balance						
Total Sources						
Uses of Funds						
Accounts payable (past month)						
Accounts payable (this month)						
Variable Manufacturing Costs						
Labor Expenses						
Overhead Cost						
Maintenance						
Transport						
Agents						
Sales Offices						
Sales Representatives						
Promotional Expenditure						
Inventory Holding Costs						
Administration						
Consultancy						
Interest on Govt. Loans						
Capital Expenditures						
Income Taxes						
Dividends						
Repayments						
Total Allocations						
Ending Cash Balance						

Cash Budget

Sources of Funds	Y	E	A	R	S	
	2	3	4	5	6	7
Accounts Receivable (past year)						
Accounts Receivable (this year)						
Bank Loans						
Sale of Shares						
Interest on Investments						
Opening Cash Balance						
Total Sources						
Uses of Funds						
Accounts payable (last year)						
Accounts payable (this year)						
Variable Manufacturing Costs						
Labor Expenses						
Overhead Cost						
Maintenance						
Transport						
Agents						
Sales Offices						
Sales Representatives						
Promotional Expenditures						
Inventory Holding Costs						
Administration						
Consultancy						
Interest on Govt. Loan						
Capital Expenditures						
Income Taxes						
Dividends						
Repayments						
Total Allocations						
Ending Cash Balance						

1.442. - Production Schedule:

Production schedules should be on the basis of sales forecast made. Worksheet B attached overleaf shows what could be considered in preparing a production schedule.

1.443. - Capital Budget:

When planning to expand productive capacity it is necessary to prepare a Capital Budget. In preparing a Capital Budget the sources of funds for financing the investments must be indicated. Worksheet C overleaf shows what could be considered in preparing a Capital Budget.

1.444: - Proforma Financial Statements:

Preparation of projected balance sheet helps in analysing how the expected structures and levels of assets and liabilities affect the financial position of the company. Worksheet D overleaf shows how to prepare a proforma Balance Sheet. It is advisable to prepare a proforma income statement as well.

COMPANY:

Production Plan.

	MONTHS												YEARS			
	1	2	3	4	5	6	7	8	9	10	11	12	2	3	4	5
SALES FORECAST																
EXPECTED BEGINNING INVENTORY																
LESS SAFETY STOCK DESIRED																
GOODS AVAILABLE FROM INVENTORY																
MINIMUM PRODUCTION NEEDED																
PRODUCTION TO BE SCHEDULED																
TOTAL NUMBER OF WORKERS																

WORKSHEET C

OMPANY:

CAPITAL BUDGET (Work Sheet)

	FUNDS REQUIRED IN YEAR				
	1	2	3	4	5
Capital Expenditures planned					
Plant Construction and Expansion					
Total Funds Requirements					
Amount to be financed By:					
Internal Cash from Operations					
Sale of Shares					
Bank Overdraft					

WORKSHEET D

PROFORMA BALANCE SHEET

MPANY:

	NOW	Y E A R S 1	2	3	4
ASSETS					
Cash 25,898					
Accounts Receivable 65,625					
Raw Material					
Inventory 5,000					
Finished Goods					
Inventory 5,000					
TOTAL CURRENT ASSETS	101,523				
FIXED ASSETS					
Land 100,000					
Building 150,000					
Equipment 50,000					
200,000					
Less					
Deprecia-					
tion 72,000 128,000	228,000				
TOTAL ASSETS	329,523				
LIABILITIES & NET WORTH					
Current Liabilities					
Accounts payable 20,000					
Dividends payable 15,000					
Income Tax payable 20,869					
Interest payable 5,000	60,869				
Long-Term Liabilities					
Government loan	100,000				
Bank Overdraft					
TOTAL DEBT	160,869				
OWNERS EQUITY					
Paid-up Capital 134,825					
Retained earnings 33,829	168,654				
TOTAL EQUITIES	329,523				

1.5. - Decision-Making

Computer input cards are punched directly from information on the decision forms. Overleaf are attached sample decision forms. There are three decision forms for each firm; Form A. Form B, Form C. Form A for decisions in the areas of Marketing; Form B for decisions in the area of Investment and Finance, and Form C for decisions in the area of Production.

1.51. - Form A: Marketing Decisions:

The areas to be considered for Marketing Decisions are shown in the flowchart below.
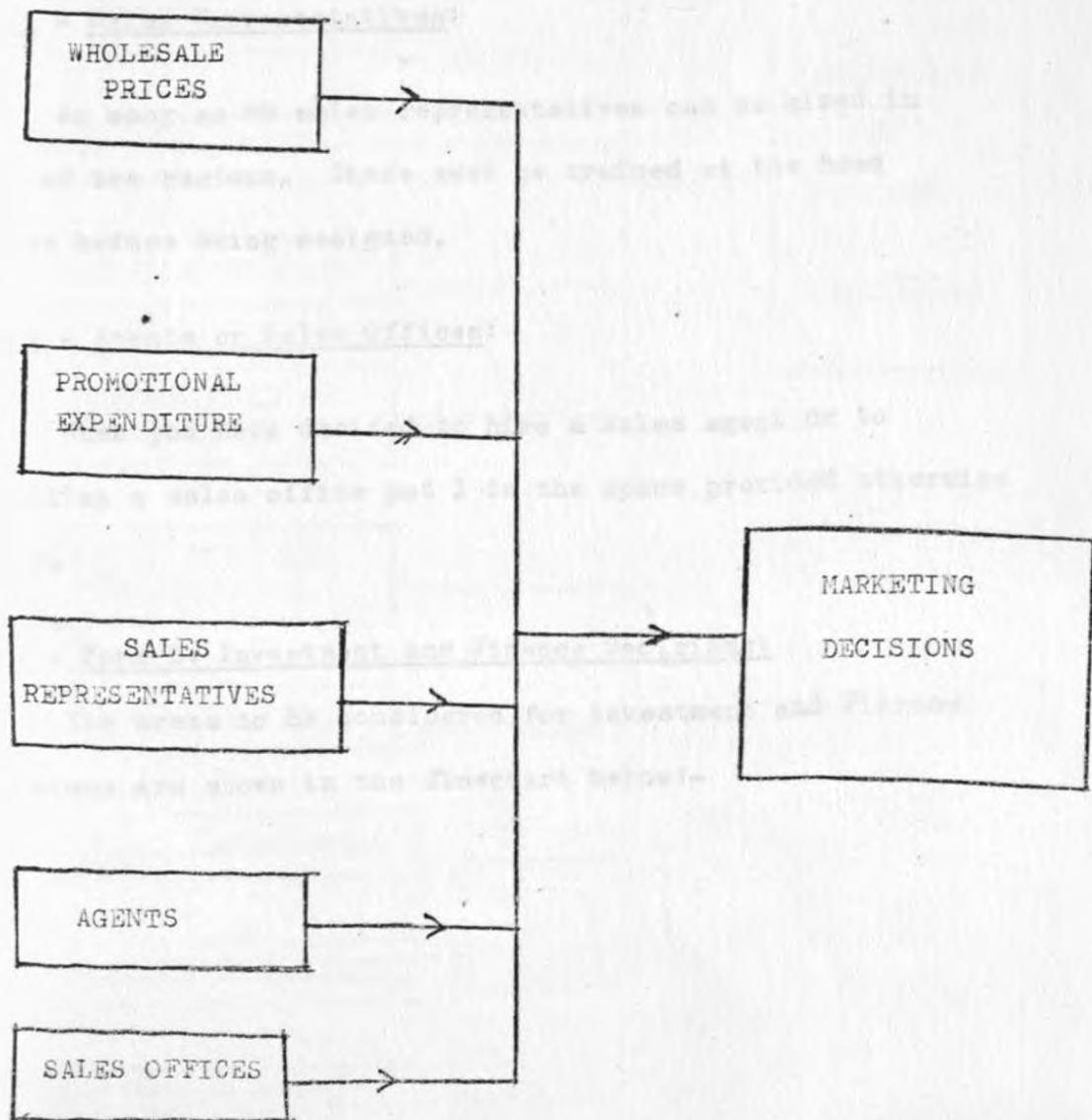
1.511 - Wholesale Price:

Price must be set in each of the regions the firm has decided to market in. Such prices can be set up to 99/- and can be varied in units of 1/- each simulated month.

1.512 - Promotional Expenditure:

This can be set in each of the regions and the maximum in each region is 99,500/- but this expenditure can be varied only in multiples of 500/-.

### 1.513 - Sales Representatives:

As many as 99 sales representatives can be hired in each of the regions. These must be trained at the head office before being assigned.

1.514 - Agents or Sales Offices:

When you have decided to hire a sales agent or to establish a sales office put 1 in the space provided otherwise put 0.

1.52 - Form B: Investment and Finance Decisions:

The areas to be considered for investment and Finance decisions are shown in the flowchart below:-

RETAIL DISCOUNT

RAW MATERIALS DISCOUNT

DIVIDENDS

INCOME TAX

RAW MATERIALS ORDERED

RAW MATERIALS DELIVERED

CASH INVESTMENT

EXPENDITURE ON LAND

EXPENDITURE ON BUILDING

EXPENDITURE ON EQUIPMENT

OVERDRAFT REPAYMENT

OVERDRAFT SANCTIONED

MANAGEMENT CONSULTANCY

OTHER EXPENDITURES

INVESTMENT AND FINANCE DECISIONS
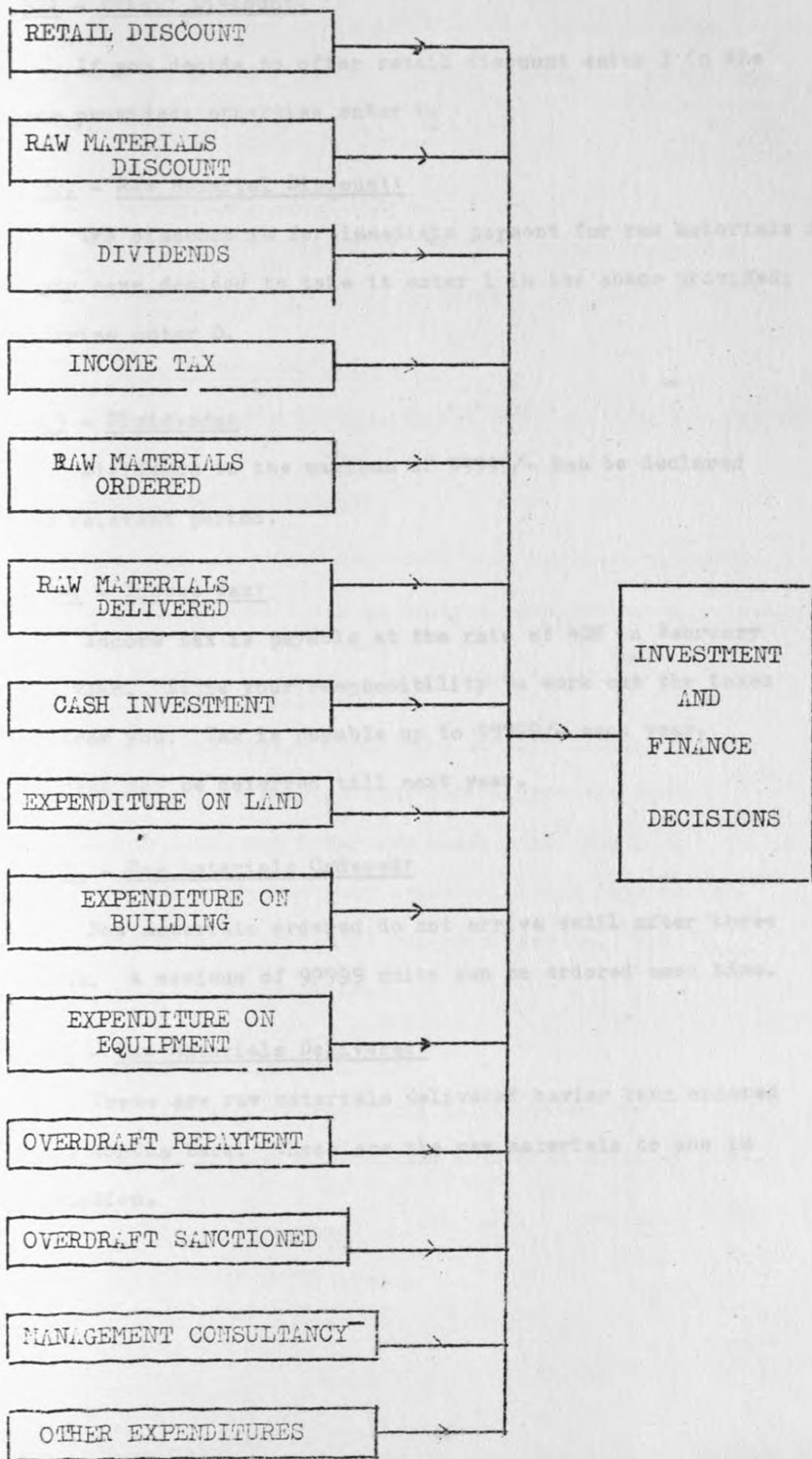
1.521 - <u>Retail Discount:</u>

If you decide to offer retail discount enter 1 in the
space provided; otherwise enter 0.

1.522. - <u>Raw Material Discount:</u>

The discount is for immediate payment for raw materials delivered.
If you have decided to take it enter 1 in the space provided;
otherwise enter 0.

1.523 - <u>Dividends:</u>

Dividends to the maximum of 99999/- can be declared
each relevant period.

1.524. - <u>Income Tax:</u>

Income tax is payable at the rate of 40% in February
each year. It is your responsibility to work out the taxes
due from you. Tax is payable up to 99999/- each year.
The rest may be deferred till next year.

1.525. - <u>Raw Materials Ordered:</u>

Raw materials ordered do not arrive until after three
months. A maximum of 99999 units can be ordered each time.

1.526 - <u>Raw Materials Delivered:</u>

These are raw materials delivered having been ordered
three months back. These are the raw materials to use in
production.

1.527 - Cash Investment:

Excess cash may be invested on the terms provided in the case. A maximum of 99,999/- can be invested during the investment period.

1.528. - Expenditure on Land:

Land can be purchased on the terms outlined in the case. A maximum of 999,999/- is payable for purchase of land.

1.529 - Expenditure on Equipment:

Maximum payable is 999,999/-. Refer to case for details.

1.530 - Overdraft Repayment:

You must repay the overdraft that had been extended. A maximum of 999,999/- can be repayed each month.

1.531 - Overdraft Sanctioned:

Should you desire funds make an application to the Game Administrator stating what you require the funds for and the terms you offer for repayment. The Game Administrator processes your application and informs you in writing of the results of your application. You must leave this space blank.

1.532 - Management Consultancy:

The Game Administrator can be consulted for a maximum of 60 minutes during each simulated month of play.

1.533 - Other Expenditures:

Explain what these are.

1.54 - Form C: Production:

The areas to be considered for Production Decisions
are shown in the Flowchart below:-

```
┌────────────────┐
│  SCHEDULED     │────────┐
│  PRODUCTION    │        │
└────────────────┘        │
                          │      ┌──────────────────┐
┌────────────────┐        ├─────→│                  │
│  LABORERS      │───────→│      │  PRODUCTION      │
└────────────────┘        │      │  DECISIONS       │
                          │      │                  │
┌────────────────┐        │      └──────────────────┘
│  PREVENTIVE    │────────┘
│  MAINTENANCE   │
└────────────────┘
```
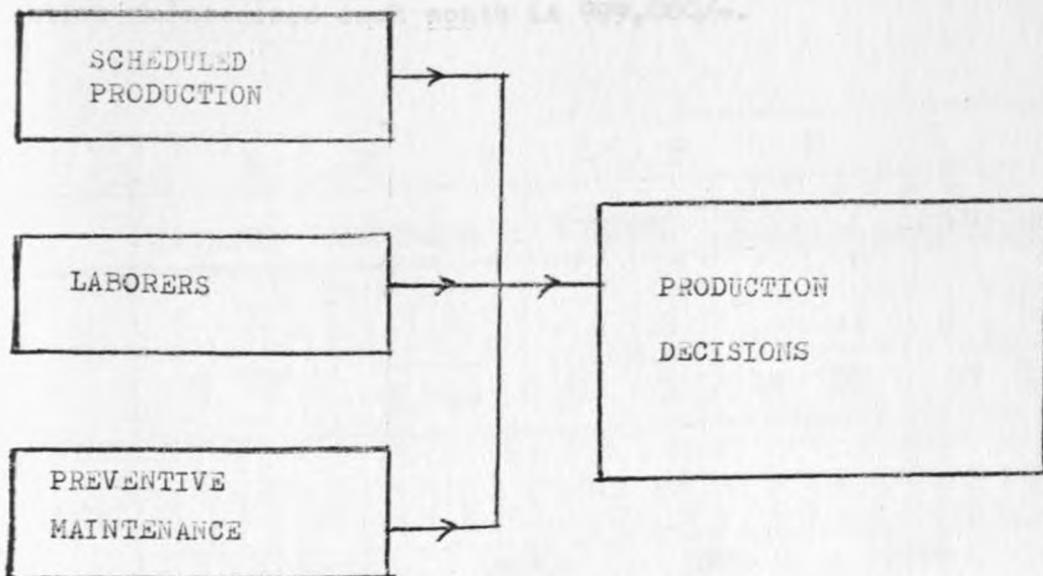
1.541 - Scheduled Production:

Schedule your production on the basis of demand and
available raw materials. Production can be scheduled to
a maximum of 999,999 units. You can run all three shifts
to increase your production but make sure you have men to
operate these shifts.

1.542 - Laborers:

Workers can be hired for each of the shifts you have
decided to operate. You can hire to a maximum of 99 men
on each shift.

1.543 - Preventive Maintenance Expenditure:

Preventive maintenance helps you improve your production level in the short run. This can be varied in multiples of 1,000/- and the maximum you can spend on preventive maintenance each month is 999,000/-.

FORM A

M A R K E T I N G

CARD NUMBER | 1 |
1

COMPANY NUMBER | |
2

MONTH | | |
3 4

DECISION AREA		NAIROBI	MOMBASA	KISUMU	FOREIGN KAMPALA	DAR-ES-SALAM	REMAR
		R	**E**	**G**	**I O N**	**S**	
WHOLESALE PRICE PER UNIT PER REGION	PR	| | |•| 5 7	| | |•| 8 10	| | |•| 11 13	| | |•| 14 16	| | |•| 17 19	VARIE BY 1/ EACH MONTH
PROMOTIONAL EXPENDITURE PER REGION	PROM	|||||•|| 20 2526	|||•|| 3132	||||•| 3735	||||•| 4344	||||•| 49	VARIE IN MULTI LES OF 500
SALES REPRESENTATIVES PER REGION		| | |•| 50 52	| | |•| 53 55	| | |•| 56 58	| | |•| 59 61	| | |•| 62 64	MUST BE TRAINE AT H.O FIRST
AGENTS PER REGION (YES OR NO)*	AGN	|_| 65	|_| 66	|_| 67	|_| 68	|_| 69	SEE KEY BELOW
SALES OFFICES PER REGION (YES OR NO)*	SOFI	|_| 70	|_| 71	|_| 72	|_| 73	|_| 74	SEE KEY BELOW

HAVE YOU GOT SALES REPRESENTATIVES TRAINING AT HEAD

OFFICE THIS MONTH?

HOW MANY? _____

*KEY

IF "YES" WRITE 1

IF "NO" WRITE 0

DECISION FORM

FORM B

INVESTMENT AND FINANCE

CARD NUMBER |2|

COMPANY NUMBER |_| MONTH |3|4|

DECISION AREA	F O R M A T	R E M A R K S	VARIABLE NAME
RETAIL DISCOUNT (YES OR NO)°	|_| 5	SEE KEY BELOW	DISC
RAW MATERIAL DISCOUNT (YES OR NO)°	|_| 6	SEE KEY BELOW	RDISC
DIVIDENDS	|_|_|_|_|_|•| 7 ⋯ 12	SEE CASE	DIVD
INCOME TAX	|_|_|_|_|_|•| 13 ⋯ 18	SEE CASE	TAX
RAW MATERIALS ORDERED	|_|_|_|_|_|•| 19 ⋯ 24	DOES NOT ARRIVE UNTIL AFTER 3 MONTHS	RMORD
RAW MATERIALS DELIVERED	|_|_|_|_|_|•| 25 ⋯ 30		RDE
CASH INVESTMENT	|_|_|_|_|_|•| 31 ⋯ 36	FIXED DEPOSIT OF 6 MONTHS. SEE NOTE BELOW⁺	CHIN
EXPENDITURE ON LAND	|_|_|_|_|_|•| 37 ⋯ 43	SEE CASE	EXLD
EXPENDITURE ON BUILDING	|_|_|_|_|_|•| 44 ⋯ 50	SEE CASE	EXBLD
EXPENDITURE ON EQUIPMENT	|_|_|_|_|_|•| 51 ⋯ 57	SEE CASE	EXQPT
OVERDRAFT REPAYMENT	|_|_|_|_|_|•| 58 ⋯ 64	SEE CASE	OD
OVERDRAFT SANCTIONED	|_|_|_|_|_|•| 65 ⋯ 71	LEAVE THIS BLANK	SANT
MANAGEMENT CONSULTANCY	|_|_|•| 72 — 74	NUMBER OF MINUTES OF CONSULTANCY	CONSOL
OTHER EXPENDITURES	|_|_|_|_|_|•| 75 ⋯ 80	EXPLAIN BELOW	OTEX

DECISION FORM

FORM O

PRODUCTION

CARD NUMBER |3|

COMPANY NUMBER |2| MONTH |3 4|

DECISION AREA	VARIABLE NAME	SHIFTS			REMARKS
		1	2	3	
SCHEDULED PRODUCTION	SPRD	⌊⌊⌊⌊⌊⌊·⌋ 5 11	⌊⌊⌊⌊⌊⌊·⌋ 12 18	⌊⌊⌊⌊⌊·⌋ 19 25	
LABORERS	DLH	⌊⌊·⌋ 26 28	⌊⌊·⌋ 29 31	⌊⌊·⌋ 32 34	
PREVENTIVE MAINTENANCE EXPENDITURE	PPO	⌊⌊⌊⌊⌊⌊·⌋ 35 41	⌊⌊⌊⌊⌊⌊·⌋ 42 48	⌊⌊⌊⌊⌊·⌋ 49 55	VARIES IN MULTIPLES OF 1000/=

Rules and General Instructions for Filling Decisions Forms.

1.71 - The entries in the decision forms are to be "right-adjusted".
This means that the entries must be made left of the
decimal points. For example, if expenditure on promotion is
500/- in region 1 the entry will be made as shown below:

$$\underline{\left|\,\,0\,\,\right|\,\,0\,\,\left|\,\,5\,\,\right|\,\,0\,\,\left|\,\,0\,\,\right|\,\,.\,\,\right|}$$

20   25

  It is not necessary to fill in the first two zeros
shown above.

1.72 - Each company is given a company number and told the
month of operation. The company number must be entered in
column 2 and the month in columns 3 and 4. Your company
will be referred to by the number it is alloted throughout
the exercise. Your results printout will always contain
your company number. You must make sure that you do not
confuse your company number, otherwise the computations
will not be done.

1.73 - If a space is left unfilled it will be assumed that
the number in it is zero. This means that even if you
do not change the decision you had made in the past
season you stil have to make that entry this season.

1.74 - You must enter only 1 digit per space provided in
the decision forms.

1.75 - The rules outlined must be studied carefully and followed to the letter. Submission of incorrectly completed forms will yield unanticipated results.

1.76 - Refer to the sample decision form referred to earlier in section 1.6 for filled-in decision forms of two firms.

1.77 - The completed decision forms must be submitted to the Game Administrator promptly to avoid delay on the other teams and the computing centre staff.

1.8 - Computer Printout:

The results for your company for each simulated month will be handed back to you in form of computer printout. The computer printout attached overleaf for your scrutiny contains the following:

1.81 - Decision Printout:

These are the decisions you had made at the beginning of the simulated period. Variable names indicated in the decision forms are used. Check the decisions printout against the decisions you had made.

1.82 - Marketing Printout:

This printout contains the supply and demands per region. Where your supply was short of demand a stockout figure is indicated. You are told the competitor's decisions in some areas.

1.83 - Cash Statement:

This shows the flow of cash during the simulated period. The balance of cash shown may not be the same as the one calculated by you due to rounding done by the computer.

1.84 - Other Information:

This section tells you; the closing balance of bank overdraft, outstanding accounts receivables, and payables, raw materials on order, balance of raw materials and finished goods, total demanded and supplied, information on capital expenditures.

BUSINESS SIMULATION ...

KENYA BICYCLE LOCK INDUSTRY

RESULTS REPORT

(SIGNED)

INDUSTRY= 1   FIRM=1

REGIONS:	NAIROBI	MOMBASA	KISUMU	KAMPALA	DAR-ES-SALAAM
DEMAND	2245.	2754.			
SUPPLY	2245.	2754.			
STOCK-UNITS					
COMPETITOR'S DECISIONS					
PRICES					
PROMOTIONS					
SALES REPS					
SALES OFFICES					
AGENTS					

CASH STATEMENT FOR FIRM 1
=============================

OPENING CASH	6000.
ACCOUNTS RECEIVABLES	277271.
INTEREST	0.
FINANCINGS	90000.
AVAILABLE FOR DISBURSEMENTS	373271.
DISBURSEMENTS	
ACCOUNTS PAYABLE	4000.
VARIABLE COST	6342.
LABOR	33300.
OVERHEAD COST	10000.
MAINTENANCE	600.
TRANSPORT	9556.
AGENTS	4267.
OFFICES	22500.
SALES REPS.	82500.
PROMOTIONS	27000.
INVENTORY *	1850.
ADMINISTRATION	10000.
CONSULTANCY	2300.
INTEREST	0.
STOCK-OUT COST	0.
CAPITAL EXPENDITURES	180000.
INCOME TAXES	8000.
DIVIDENDS	9000.
OTHER EXPENDITURES	0.
TOTAL DISBURSEMENTS	387216.

CLOSING BALANCE BEFORE O.D	-13945.
INTEREST	600.

CLOSING CASH BALANCE	14545.

OTHER INFORMATION

CLOSING BALANCE OF OVERDRAFT   150000.

OUTSTANDING ACCOUNTS RECEIVABLES   0.

OUTSTANDING ACCOUNTS PAYABLES   45000.

RAW MATERIALS ON ORDER   500.

    BAL. OF RAW MATERIALS=   5653.   TOTAL DEMANDED= 12802.

    BAL. OF FINISHED GOODS=   40.   TOTAL SOLD= 12802.

2.0. - Administrator's Manual:

The Administrator must familiarise himself with the history, development and educational values of business Games. Material on this will be found in Chapter 2 and 3. In SIGMEA, the Administrator can have upto 99 industries each industry having two competing firms. The Administrator must read the participants manual thoroughly and consider the following things:

2.1. - Physical Facilities and Team Size:

The Administrator must decide on the sizes of the teams to use. The author suggests that each team must have not less than three people and not more than six people. This ensures that the vital departments of production, marketing, finance, are managed. The assignment of individuals to teams should be on the basis of the experiences or educational background of the participants.to ensure that talented people are equally divided. The Administrator should find separate rooms for each of the teams and these rooms should be chosen such that discussions of one firm cannot be overhead by another firm, and if possible the rooms allocated should be close to the computer room to minimize the time in taking the decision forms to the computing center. The participants need hand calculators to aid them in making calculations.

2.2. - Time Consideration:

Time consideration involves determining the length of decision time, number of periods of play, and time interval between decisions.

2.21 - Length of Decision Time:

It is difficult to determine how much time should
be allowed for decision-making each simulated month. Because
this game has not been run before it is difficult to
include all the practical requirements for running the game.
If the time allocated is compressed the participants will
find that they need to develop specialisations of effort and
that there is not enough time for everybody to participate
in decision-making. If too much time is alloted the partici-
pants may spend much time on gathering data that is irrelevant
to decision-making. The author recommends that the time
allowed for decision-making should be thirty minutes although
in the initial periods of play the Administrator will find
that he needs to allocate more time for decision-making since
the participants are unfamiliar with the exercise.

2.22 - Number of Periods of Play:

The participants should not be told the number of
periods of play since they may adopt "end-game" strategies
which destroys the educational value of the game. The
game should take at least 2 years so that the participants
are forced to invest in plant capacity. A longer period
of play ensures that those participants who had adopted
wrong strategies can correct these strategies and stand a
chance to catch up.

2.23 - Time Interval between Decisions:

If possible the Administrator should schedule for
2 decision periods a day. The determining factor is the
time period between completing the decision forms and
getting the results back. If the computer staff are
busy it may take a long time to punch the cards and run
the job. The schedule should, however, allow the
participants to individually consult text books and work
out their plans before coming for the decision-making
process. If the Administrator schedules one game a day
then the exercise will have to run daily for 24 days
before the participants can be expected to gain from the
exercise. In this case the game is being run alongside
other management training methods.

2.3. - Briefing:

Although most things have been explained in detail
in the participant's manual there is still need for the
Administrator to re-emphasize some of the areas so as to
fully familiarise the participants with the game. The
Administrator should tell the participants the history
of simulation games and their educational values. On
introducing the participants to the case the Administrator
should point out factors like; time lags in ordering raw
materials, need for expenditure on preventive maintenance,
and a need for investment in plant capacity.

2.4. - Decision Forms:

Most important of all the Administrator should re-emphasize the need for filling the decision forms correctly. He must show the participants an example of a decision form that has been filled in. Sample decision forms are included in the Participants' Manual. The Administrator should allocate numbers to competing firms. Since there will be two competing firms per industry, one firm will be given the number 1 and the other 2. The Administrator must emphasize to the firms the necessity of entering their firm number in the decision forms.

2.5. - Organisation of Cards:

Before running the Administrator should code and punch a number of cards. The Parameter Card (shown overleaf) contains five sets of three variables having ;five fields, five fields and six fields respectively. The Administrator must then punch a card that shows the number of industries in operation. The Administrator can have a minimum of two industries and a maximum of ninety-nine industries. This variable occupies two fields. The Administrator should, then code history data and punch the history deck. The Administrator should use the coding forms provided overleaf . Initially he will have to code history information from the case but subsequently he can code from the computer printout. A sample of the history printout is shown overleaf.

PLEASE TEAR IT OFF

11....01....01.....01......01......01.01.01.01.01.01....01....01.....8
1 5656.   40. -14565.   0.   63000. 4. 0. 3. 2. 1. 6000.   0.   600.
1 5000,   0. 9000. 5000. 5000. 150000.
11....01....01....01....01....01.....8

CODING FORM FOR HISTORY PRINTOUT

Four cards must be punched: 2 per firm

VARIABLE NAME	CARD NO. 1	EXPLANATION
IVIRM		Number of Company
ROPN		Raw materials opening inventory
FGIN		Finished goods opening inventory
CAB		Cash Balance
AORV		Opening Accounts Receivables
AOPY		Opening Accounts payables
XEP		Sales reps in region 1 last month
XEP		Sales reps in region 2 last month
XEP		Sales reps in region 3 last month
XEP		Sales reps in region 4 last month
XEP		Sales reps in region 5 last month
XPM		Last month's expenditure on maintenance in shift 1
XPM		Last month's expenditure on maintenance in shift 2
XPM		Last month's expenditure on maintenance in shift 3

CODING FORM FOR HISTORY PRINTOUT

VARIABLE NAME	CARD NO.2	EXPLANATION
IFIRM	1	Firm Number
XPN	2 ─ 7	Last month's expenditure on promotion in region 1
XPN	8 ─ 13	Last month's expenditure on promotion in region 2
XPN	14 ─ 19	Last month's expense on promotion in region 3
XPN	20 ─ 25	Last month's expense on promotion in region 4
XPN	26 ─ 31	Last month's expense on promotion in region 5
DRAF	32 ─ 39	Balance of Bank Overdraft.

2.6. - Card Arrangement:

When the cards have been punched they should be arranged in the order shown below before submission for running.
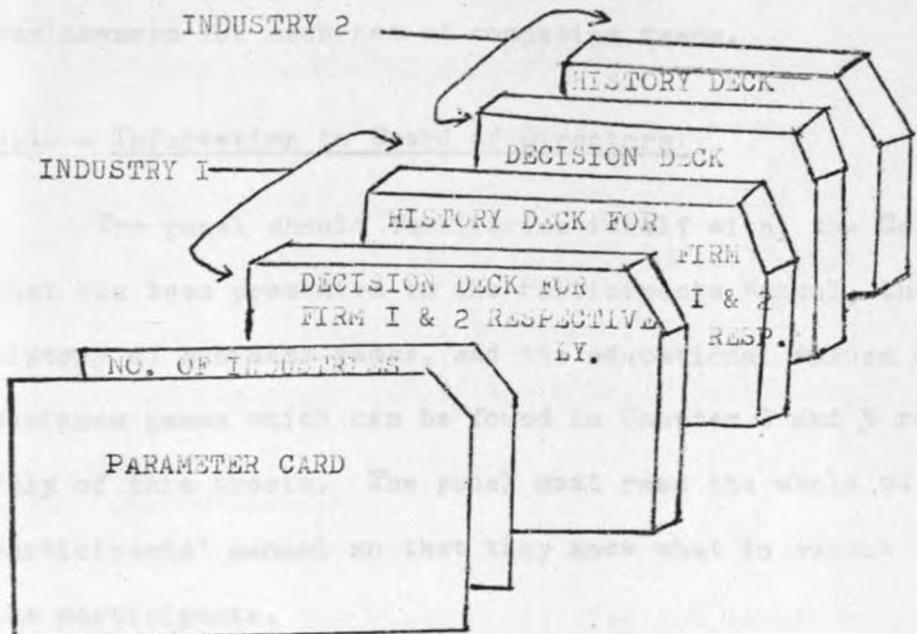
2.7. - Computer Printout:

The computer printout contains the decision printout; history printout; parameter printout; supply demand printout; cash statement printout; and printout of history data for the next season. The Administrator should hand to the participants the decision printout, supply demand printout and cash statement printout. The two history printouts and the parameter printout must be retained by the Administrator.

3.0. - Board of Directors' Manual

The role of the Board of Directors is to examine
the performances of the companies and offer critiques.
There must be one panel of Board of Directors consisting
of Academecians, professional people and practising
businessmen for each set of competing teams.

3.1. - Information to Board of Directors:

The panel should familiarise itself with; the Case
that has been presented in the Participants Manual, the
history of business games, and the educational values of
business games which can be found in Chapter 2 and 3 respecti-
vely of this thesis. The panel must read the whole of the
participants' manual so that they know what to expect from
the participants.

3.2. - What the Participants Must Present to the Board:

In asking the participants about their present
problems, progress and growth the panel must ask them to
produce forecasts, plans and statements about their
company's past history. The participants must present an
analysis of the history of their company and their plans
for the future.

3.3. - Questions to Participants:

The panel should ask the participants to give answers to the following questions:

3.31 - Objectives:

1) What were the initial short and long range

objectives developed by your firm: Why?

2) What operating policies were developed to

establish a framework meeting these objectives?

3) What, in your best judgement, were the objectives

of the other firm? Why did you decide this?

3.32 - Organisation:

1) How is your firm organised? Why?

2) How were the responsibilities and tasks assigned?

3.33 - Planning, Budgeting, Forecasting:

1) What short and long range plans did your firm

develop to meet its objectives? Why?

2) Were alternate plans developed? Used?

3) Were specific amounts of cash and other resources

budgeted for decision variables? How? Why?

4) What specific reporting and control systems did

your firm establish? Why?

3.34 - Evaluation:

1) What do you judge to be the significant reasons

for:

- Reaching or not reaching objectives

- Meeting or not meeting plans, forecasts, budgets.

2) Looking back, what would you estimate to be the

most desirable strategy for optimizing the

position of your firm? Why?

3) How would you operate your firm for the next

. five-year period?

Specific Questions.

Marketing and Distribution

1) In what regions are you selling? Why?

2) What channels of distribution is your company using?

Why?

3) What is your company's pricing and promotion

policies? Why?

3.35 - Production:

1) What is your company's production policy? How

is it related to these areas:

- preventive maintenance

- shifts

- factory expansion

- inventory

3.36 - Finance:

1) What is your company's financial policies? Why?

How is it related to these areas:

- government loan.

-Bank Overdraft

- Dividends

- Raw materials discount

- Retail discount

- Cash Investment?

3.37 - Other Information:

The panel may be called upon to assign marks for the performances of teams. What the panel should examine are: consistency in planning, coordination and team work; results as shown by the computer printout; the investment in time that the participants have made for producing meaningful and useful management reports.

4.0. - Summary:

This chapter presented the manuals used in playing SIGMEA: the Participants' Manual, the Administrator's Manual and the Board of Directors' Manual. The participants' manual presented a case used in SIGMEA and information on the process of decision-making. The Administrator's manual contained information on how to administer SIGMEA and the Board of Directors' manual told the Directors their roles in conducting the game.

CHAPTER 6

Introduction:

This chapter examines the organisation of the test-run
of SIGMEA in terms of the observations and experience of the
author during the test-run. It then presents the comments of
the participants and closes by listing recommendations to be
observed to assure good results from the business simulation
game.

1.0. - Organisation for Test-Run:

SIGMEA was tested with a group of twelve students, from
the Masters in Business Administration class at the University
of Nairobi. Because participation in the exercise was not
part of the students' courses, the students were paid a bonus
fee for volunteering their time. The twelve students were
randomly split into two industries, each industry consisting
of two competing firms of three participants each. The
simulation exercise was conducted for six one-hour decision
periods representing six months of business operation. At the
first meeting the participants were given two hours in which
to read the case. The participants were then allowed to
make "trial" decisions. These decisions were punched, the
program run and the results printout handed back to the
participants and the results were discussed by the author.
Subsequently, the participants made decisions every
afternoon, cards were punched, program run and the results
printout handed back to the participants by ten o'clock the

following day.' During the decision periods, the author was
always available to provide consultation.

2.0. - Observation and Experience of the Author:

During the test-run the author made certain observations
and had experiences which are presented under the following
headings; Orientation to Case, Organisation for Decision-
Making, Entries on Decision Forms, Interpretation of
Results Printout, Explanation to Key-Punch Operators,
Periodic Results of One Firm.

2.1. - Orientation to Case:

From the results of the monthly performances of the
participants, the author got an impression that the partici-
pants were not fully versed with facts in the case. The
participants did not seem to take into account factors like;
lead times in raw materials acquisition, discounts on
accounts receivables and accounts payables. It was not
unusual to find that in a decision month a firm had no
balance of finished goods or raw materials and yet no raw materials
on order.

2.2. - Organisation for Decision-Making:

Under this topic the author is referring to; assign-
ment of functional roles amongst the participants, setting down
the firm's goals, laying down policies, preparation of
plans, budgets and forecasts. The author observed that
none of the firms had assigned roles to their members.

Decisions were made on a democratic basis. The author
also observed that no firm had laid down its goals and
besides no firm had prepared plans, budgets or forecasts.

2.3. - Entries on Decision Forms:

The participants did not follow the rules and procedures
outlined in the participant's manual for making entries in
the decision forms. While in some cases entries were just
omitted without reason, in others, the entries made were
illegible. The author thus had to go over all the decision
forms and check for these irregularities before punching.

2.4. - Interpretation of Results Printout:

The participants seemed to have difficulty in inter-
preting the results printout. The author had to explain what
the decision printout was and also point out that the decision
printout employed variable names indicated in the decision forms.
It was also necessary to point out the significance of a stock-
out in each region. The participants' attention had to be drawn
to the information provided about the competitor's decisions in
some areas.

2.5. - Explanation to Key-Punch Operators:

The author found he had to explain to the key-punch
operators where the columns on the decision forms began and ended.
Although punching error occurred only once during the six-month
simulated period, the author had to have all the cards verified
before running.

2.6. - Periodic Results of A Participating Firm:

Since the participants did not plan before decision-making their results were on the whole poor. Frequently, firms ran out of stock of raw materials and finished goods and had no raw materials on order. Most firms had chronic financial deficits which had to be adjusted to zero to allow the participants to continue competing. As the play progressed, the author felt that with these poor results and lack of planning there was no point in engaging a Board of Directors. One firm, however, seemed to have done a better job than other firms and its results are presented in Table 1. Due to lack of planning, this firm had financial deficit in the third month and this had to be adjusted to zero. It is apparent that this firm will have production problems in month seven since by month 6 they had no raw materials on order and no balance of finished goods or raw materials. Looking at the stock-out quantities it is apparent that this firm still has not become aware of factors that generate demand and as such she cannot make effective production decisions.

TABLE I

MONTHS

	UNIT	1	2	3	4	5	6
Cash Balance	SHS	15654	41881	0	33535	64116	30125
Outstanding Accounts Receivables	SHS	109890	130120	125,000	139706	181569	0
Outstanding Accounts Payables	SHS	0	225,000	0	0	0	0
Balance of Raw Materials	UNITS	1500	28,000	21750	14150	6483	0
Balance of Finished Goods	UNITS	3006	0	0	1007	0	0
Total Goods Demanded	UNITS	6400	7442	7069	6593	9672	7506
Total Goods Sold	UNITS	6400	6506	6250	6593	8674	6483
Stockouts	UNITS	0	936	819	0	998	1123

3.0. - Comments of the Participants:

After the six-month period the author organised a meeting with participants during which he revealed the mathematical relationships in the game. He told participants that three mathematical models were employed; the production model, the demand model and the market share model. Detailed explanations of these models were presented in Chapter 4 of this thesis. The comments of the participants were directed to the areas of; Orientation to Case, Organisation for decision making and educational value of the exercise.

3.1. - Orientation to Case:

The participants said that the time provided for orientation to the case was inadequate and besides the exercise was scheduled at a time when they had pressure of work from other areas and so they could not devote much time to digesting facts in the case.

3.2. - Organisation for Decision Making:

The participants confessed that due to pressure of work they could not lay down the goals of their firms or prepare plans, budgets and forecasts before decision making. They agreed with the author that had they done this their results would have been much better. Asked about assignment of functional roles to members of their teams, the partici-pants said they would not do this because the sizes of their

firms were too small. The participants stated that there were
some people who could not be motivated to take part in the
decision-making.

3.3. - Educational Value of the Exercise:

The participants admitted that they were not emotionally
involved in the decision-making exercise, the reason being
that the exercise did not form part of their course. There
was no system for penalizing the participants who had poor
results or for rewarding the ones with good results. The
participants were, however, generally agreed that the
exercise could be a useful learning experience for students of
business studies. As one participant said:

> "This exercise exposes one to forces that shape business
> decisions. One makes decisions in one aspect of the
> business organisation with regard to the impact of such
> decisions on other aspects of the organisation."

Some participants were of the opinion that the exercise could be
a useful one to final year undergraduate business class in that
it gives the students a chance to experience the inter-relatedness
between functional areas of the business organisation.

4.0. - Recommendations for Better Results:

The author recommends that for better results in SIGMEA,
the following points, that have already been raised either in the
participants' manual or the administrator's manual, be re-
emphasized or considered seriously:

1) The participants need adequate orientation to the
   Business Game before play. They should be told about
   the origins of business games and their educational
   value during the orientation period. The participants
   must then be given adequate time to read the case and
   become familiar with factors in the case. The
   Administrator must emphasize out important points in
   the case like; lead times in raw materials acquisition,
   discounts on accounts payables and receivables,
   seasonal effects on demand.

2) The Administrator must emphasize to the participants the
   need for assigning functional roles to their members.
   He should encourage the participants to lay down goals,
   policies and strategies and to make use of worksheets
   provided in their manual. It is important for the
   Administrator to get the participants to submit to their
   Board of Directors copies of their goals, policies,
   strategies, plans and forecasts during the first month
   of operation.

3) The Administrator must emphasize to the participants the
   need for filling the decision forms correctly. Since
   there is no error-detecting subroutine in the
   program, the administrator must check the decision
   forms carefully before cards are punched.

4) The Administrator should explain to the participants
   what the results printout contains.

5) The Administrator should code history data before
   punching the history deck. The coding sheet should be used.

Summary:

This chapter looked at the organisation for testing
SIGMEA. It next presented the observation and experience of
the test-run. The chapter pointed out that the participants
got poor results because they were not actively and emotionally
involved in the exercise. The chapter presented the comments
of the participants about the game and the fact that the
participants were generally agreed that the exercise can be a
useful learning experience. From the observation and
experience of the author and the comments from the participants
the chapter closed by presenting a list of recommendations that
ought to be observed for better results.

CHAPTER 7

Introduction:

This chapter first presents a summary of the thesis,
and it next presents conclusions drawn from the thesis.
The chapter closes by outlining areas in the thesis that
need further research and study.

1.0. - Summary of Thesis:

Thisthesis dealt with the design of a business simu-
lation game in the East African environment. The thesis
opened by arguing that the present rapid technological
development the world over needs a new style of management.
The thesis looked at the common methods of management
education and argued that these methods are inadequate in
meeting the objectives of the needed management education.
The thesis presented Business Games as a relevant educational
method in this era. The thesis then presented the origins
and historical background of business games. The differences
in present-day Business Games were stated to be due to the
following features; Orientation, Interaction, Inclusion of
chance elements, Methods of Calculating Results and
Participants Structure. The thesis designed a Business
simulation game by conducting interviews with practising
managers, and building three mathematical models; production
model, demand model and market share model. A computer
program was written in Fortran IV language to compute the
results. The thesis presented three manuals; the

Administrator's manual, the participants manual and the
Board of Directors' manual, which indicates the roles these
people play in the Business Simulation Game. The thesis
then presented the test-run of the business game with a
group of participants. The general comment from the parti-
cipants was that although they were not actively involved
in the exercise, the game could provide a useful learning
experience for students of business studies.

2.0. - Conclusion:

There is no empirical evidence from the thesis that
Business Games are the most effective management education
methods. Like all other management education methods Business
Games have their limitations. It can be said that SIGMEA
is a relevant management education method in East Africa
having been designed using local material. This thesis
concludes that for better results in management education
Business Games should be included in the curriculum of all
institutions offering management education alongside other
common methods.

3.0. - Areas for Further Research and Study:

The author identifies three areas that need further
research and study; mathematical relationships in the Game,
Computer Program, and Educational Relevance of SIGMEA.

3.1. - Mathematical Relationships in SIGMEA

The author was unable to make modifications on the
mathematical relationships in SIGMEA after the test run
because by then not enough relevant data had been collected
and besides the participants were not actively involved
in the exercise and so their results could have been
unreliable. The areas that need further research and
study are; Production Model and Demand Model.

3.11. - Production Model:

In SIGMEA production is a function of labor and
maintenance expenditures. The maximum output obtainable by
a mix of labor and plant maintenance is 5,000 units. The
model assumes a linear relationship between the inputs and
outputs. A more realistic production function could be
designed using labor and capital as inputs, and such a
model could be designed along the lines of Cobb-Douglas
production function.

$$Y = AK^a N^{1-a}$$

A- rate of capital change

a -elasticity of output with respect to change in
capital stock.

K -Capital, N-labor, Y-Output.

This production function is subject to the law of diminishing returns as is the case in the real world and the function is a homogenous function of degree one. If this change is incorporated in SIGMEA, then the case would have to be remodified especially in the area of capital investment. If this change is not considered feasible then data should be collected to determine the sensitivity of production to labor and maintenance decisions. This sensitivity can be improved by changing the parameter in the production model.

3.12 - Demand Model:

SIGMEA currently has two classes of demand; demand due to price decisions and demand due to promotion decisions.

1) Demand due to Price Decisions:

SIGMEA assumes that the firms are marketing a "normal" good and so the demand for the good declines as the price of the good rises. Improvement on this model could be on the basis of gathering price decisions of both firms, calculating a price adjustment factor using the formula shown in Chapter 4 of this thesis and plotting price adjustment Vs average to determine the sensitivity of demand to price decisions. A change in the parameters will change the sensitivity of demand to price decisions to yield desired results.

2) Demand Due to Promotion Decisions:

SIGMEA currently assumes this demand to be a function of promotional expenditures and sales representatives and the relationship is assumed linear. One of the changes could be to include sales offices and sales agents in the demand function. Another modification could be to design a model that depicts exponential relationship between promotional expenditure and demand as this would approximate more closely to reality. If these improvements are not considered feasible a test of the sensitivity of demand to promotion decisions could be carried out and the parameters changed so that the model yields desired results.

3.2. - Computer Program:

The computer program should be improved on in the following areas; error-detection subroutines, timing of variables, and history punching.

3.21 - Error Detection Subroutines:

The present program lacks subroutines to check for errors on the decisions forms and subsequently the administrator must check for these errors before the cards are punched. The error-detection subroutines should be designed to check for; errors on firm number entry, month of operation entry and entries that exceed the maximum allowable space. The program does check for a price of zero in each region.

3.22 - Timing of variables

The source program has problems of timing
on certain variables; it is mentioned in the case that the
lead times for raw material acquisition is three months,
loans extended to participants should be recovered prior to
the loan expiry date, the participants should train sales
representatives in the head office for one month before
assignment, the present factory must be replaced in two
years time and when this is done payment for the factory
is over a six-month period as indicated in the Participants
Manual chapter 5. The current source program does not allow
for these facts mentioned and so improvement on the program
should be in these areas.

3.23 - History Punching:

Currently history data is coded from the results
printout and then history deck prepared. It should
be possible for history data to go on tape from where it can
be read when demanded.

3.3. - Educational Relevance of SIGMEA:

There is no evidence from the thesis that SIGMEA
teaches the participants what it set out to. One of the
dangers of Business Games was stated in chapter 2 of the
thesis as giving the participants a wrong impression about a
business situation. Research could be done to determine

SIGMEA is a victim of this danger, and if it is, how this impression can be corrected.

3.4. - Summary:

This chapter presented a summary of the thesis. It next presented conclusions that could be drawn from the thesis and the major conclusion is that Business Games ought to supplement other management education methods. The chapter closed by outlining areas for further research and study. These areas are; mathematical relationships in SIGMEA, computer program and educational reference of SIGMEA.

3.5 - Notes

1. For detailed explanation on Cobb-Douglas Production function see, T.T. Dernberg and D.M. McDougall

  " Macroeconomics: The measurement, analysis and control of Aggregate economic Activity"

  McGraw Hill Book Company New York (1968) p.284-285.

A P P E N D I X   A

QUESTIONS TO PRACTICING MANAGERS

1. FINANCING:

   Government Loans:

   (i) What are the interest rates?

   (ii) What are the repayment terms?

2. BANK OVERDRAFT:

   (i) What are the interest rates?

   (ii) What are the repayment terms?

   (iii) What security should be pledged?

3. INVESTMENTS:

   (a) What are the terms for investing excess cash?

   i) Interest rates?

   ii) Collection period?

4. DIVIDENDS:

   (i) When are dividends normally declared and paid?

MARKETING AND DISTRIBUTION

1. FOREIGN MARKETS:

   (i) What are the problems one is likely to meet in the
   foreign markets of Tanzania and Uganda?

2. AGENTS:

   (i) What are the commission rates for engaging agents?

   (ii) On what terms can sales representatives be hired?

   (iii) How about the establishment of a sales office?

3. DISTRIBUTION COSTS:

    (i) What are the increases in patterns of distribution
       costs as from Nairobi?

4. How easy is it for the company to loby the government
   to impose import restrictions?

PRODUCTION

1. (i) What are the possibilities of operating more than
     one shift?

  (ii) What is the efficiency of such shifts?

2. What are the possibilities of working overtime?

3. Do you think that the proposal for payment of new factory
   is reasonable?

4. What is the likely effectiveness of expenditures on
   preventive maintenance and production planning
   and control?

5. (i) What are the lead times in raw materials
     acquisition?

  (ii) What are the payment terms and discount
     offered on raw materials?

 (iii) What is the rate of increase in the cost of raw
     materials due to inflation?

6. What are the likely inventory handling and storage
   charges?

7. (i) What are the terms of hiring and firing labor?

  (ii) What are the labor charges per shift?

 (iii) What are the possibilities of a walk-out strike?

A P P E N D I X   B

VARIABLE NAMES

1. ACP(J,M): Production adjusted for labor constraints per firm per shift

2. ACPY(J): Accounts payable per firm

3. ACRV(J): Accounts receivables per firm

4. ADMIN(J): Administration expense per firm

5. ADP(I): Price Adjustment per region

6. AFDD(J): Total Available for Disbursement this month per firm

7. AGN(J,I): Agents per firm per region

8. ARN(J): Interest on Overdraft per firm

9. ASA(J,I): Share of demand due to price factors

10. AVM(J): Total available raw materials

11. BANK(J): Interest on Investment per firm

12. BDM(I): Basic demand per region

13. C22(J): Closing Cash Balance per firm

14. CAB(J): Opening Cash per firm

15. CAMN: Minimum Capacity Production

16. CAPEN(J): Total Capital Expenditures per firm

17. CBB(J): Closing Balance before Overdraft

18. CBOV(J): Closing Balance of Overdraft

19. CFG(J): Ending balance of finished goods

20. CHIN(J): Cash Investment per firm

21. CLIN(J): Ending balance of raw materials

22. COAD: Company adjustment

23. CONSOL(J): Consultancy minutes per firm

24. COST(J):   Variable Manufacturing Cost per firm

25. DEBT(J):   Accounts paid this month per firm

26. DEL(J):   Accounts payable by firm next month

27. DEND(I):   Industry effective promotional expenditure per region.

28. DIFPD: Difference between Maximum and Minimum Capacity Production.

29. DIS(J):   Total Disbursements per firm

30. DISC(J):   Discount per firm

31. DIVD(J):   Dividends Payable per firm

32. DLH(J,M):   Laborors per firm per shift

33. DRAF(J):   Opening balance of bank overdraft

34. EFFET(J,M):   Effective maintenance expenditure per firm per shift

35. EMPLY(J):   Total labor costs per firm

36. ENCR(J):   Total expenditure on promotions per firm

37. EXBLD(J):   Expenditure on building per firm

38. EXLD(J):   Expenditure on land per firm

39. EXQPT(J):   Expenditure on equipment per firm

40. FDE(J,I):   Firm's effective promotional expenditure per region

41. FEZ(J):   Total consultancy fees per firm

42. FGIN(J):   Finished Goods Opening inventory per firm

43. FIN(J,I):   Demand share per firm per region

44. FOREN(J):   Cost of hiring agents in foreign regions

45. FTC(I):   Factor increase in demand due to promotion

46. GOT(J):   Total Production this month per firm

47. HEAD(J):   Overhead Expenses per firm

48. ICARD: Card Number

49. IFIRM: Firm Number

50. MONT: Month of Simulation

51. OD(J):   Overdraft repayment per firm

52. OFFC(J):   Cost of operating a sales office

53. OTEX(J):   Other expenditures per firm

54. PAY(J):   Accounts paid this month per firm

55. PLUS(J):   Cost of maintaining sales offices per firm
                in the entire area.

56. PMT(J):   Preventive Maintenance expense per firm

57. PPC(J.M):   Expenditure this month on preventive maintenance
                per firm per shift

58. PR(J.I):   Price charged per firm per region

    PROM(J,I): Promotion Expenditure per firm per region

59. PUB(J):   Finished Goods available for sale per firm

60. RCST(J):   Accounts Customers settle immediately per firm

61. RDE(J):   Raw materials delivered per firm

62. RDISC(J):   Raw materials discount per firm

63. REGD(I):   Demand due to industry promotional expenditure

64. RMA: Random Adjustment factor

65. RMORD(J):   Raw materials ordered per firm

66. ROPN(J):   Raw materials opening inventory

67. SAC(J):   Total Accounts due to thefirm this month

68. SALX(J):   Commission to agents in the home market

69. SANT(J):   Overdraft sanctioned per firm

70. SAP(J):   Cost of hiring sales Representatives per firm

71. SEAD: Seasonal Adjustment factor

72. SOC(J):   Stock-out cost

73. SOFI(J,I):   Sales offices per firm per region

74. SOLD(J,I):   Goods sold per firm per region

75. SPRD(J,M):   Scheduled production per firm per shift

76. STC(J,I):   Stock-out per firm per region

77. SWAPO(J):   Cost of hiring sales representatives in
                   foreign regions

78. TAMN: Maximum Capacity production

79. TAX(J):   Income tax payable per firm

80. TOTPD(J):   Total production on all shifts

81. TMY(J):   Total demanded this month

82. TP(J,M):   Maximum possible production per firm per shift

83. TPAD(J,M):   Production after adjusting for shift
                   effeciency per firm per shift

84. TPM(I):   Maximum demand per region

85. TRANS(J):   Transport expenses per firm

86. TREST(J):   Interest on Government loan per firm

87. TSP(J):   Total number of units sold this month

88. TTL(J):   Total cost of hiring sales representatives

89. UGAN(J):   Cost of maintaining sales offices in foreign
                   regions

90. USA(J,I):   Share of demand due to industry effective
                   promotional expenditure

91. VENT(J):   Cost of holding inventory per firm

92. WAIT(J):   Accounts due next month per firm

93. XM(I):   Demand due to industry effective promotional
                   expenditure.

94. XEP(J,I):   Last month's expenditure on sales

  representatives

95. XMD(I):   Demand due to price factor after adjustments

  are made

96. XPM(J,M):   Last month's expenditure on preventive

  maintenance

97. XPN(J,I):   Last month's expenditure on promotion

98. ZUM(J):   Cost of hiring agents per firm

99. ZEB(J):   Total Accounts Receivables this period.

100. NØIND: Number of Industries.
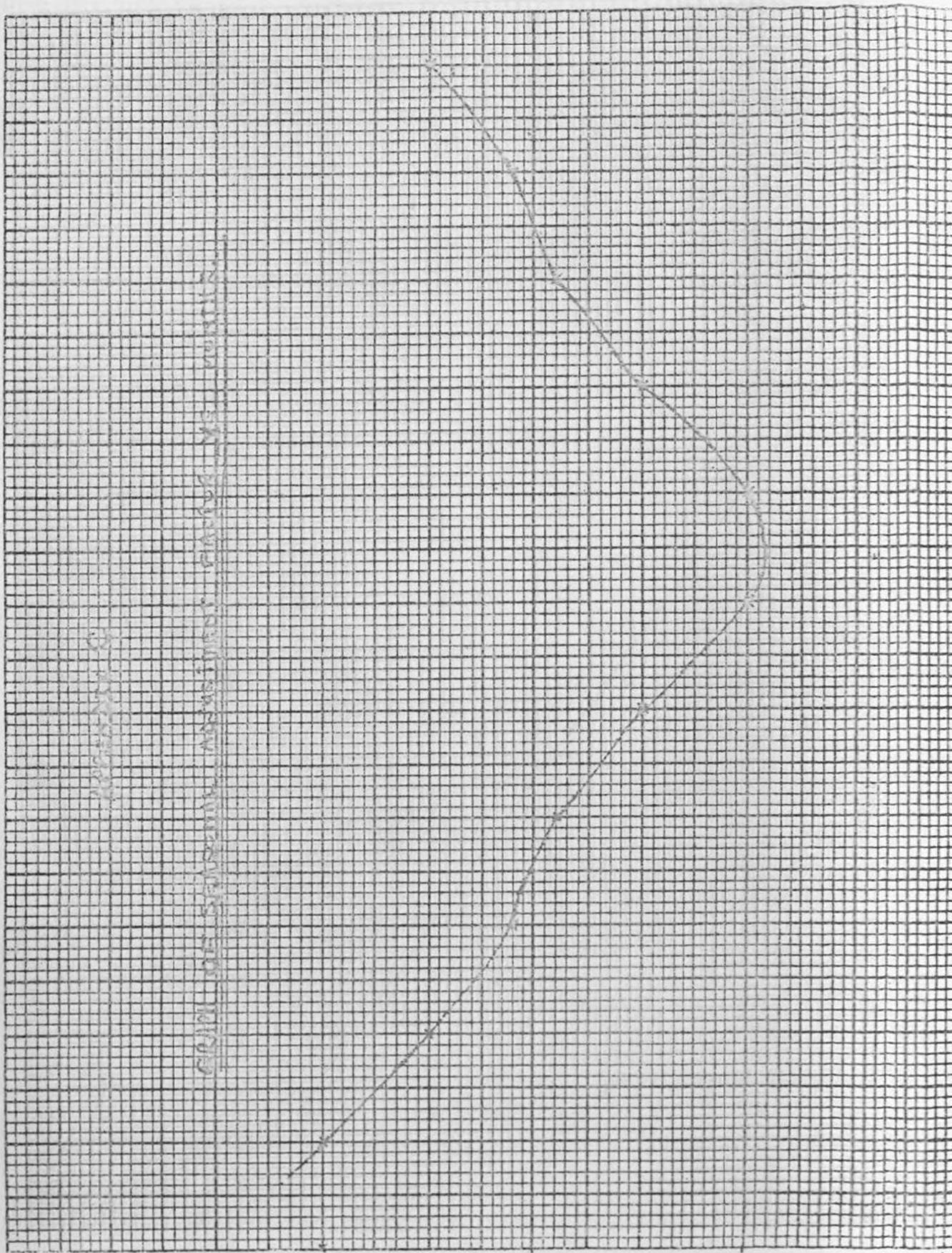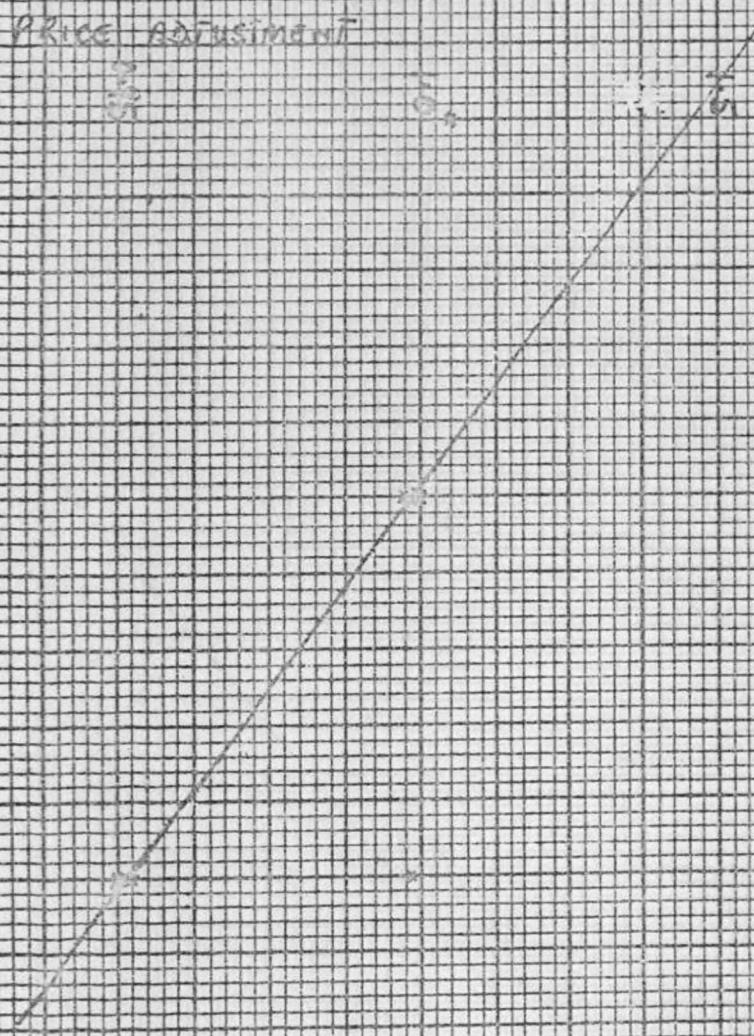
FIGURE 9

COIL AIR SPACING ADJUSTMENT. CATION VS. VOLTS.

SMOLAT LG MS

1 2 3 4 5 6 7 8 9 10 11 12

GRAPH OF PRICE ADJUSTMENT VS AVERAGE PRICE

APPENDIX B

PRICE ADJUSTMENT

APPENDIX.

NAIROBI

GRAPH OF ...

KISUMU

Demand for industry

Promotional expenditure

148

$$FACTOR = \frac{BC}{AB} = \frac{3.8125}{3.215}$$

$$= 1.1842$$

DEMAND VS

FACTOR = $\dfrac{BC}{AB}$ = $\dfrac{11500}{3300}$

APPENDIX F

FLOWCHART FOR SIGMEA.

```
        ( START )
            │
            ▼
        READ
        DECISION
        DECK
            │
            ▼
        READ
        HISTORY
        DECK
            │
            ▼
        READ
        PARAMETER
        DECK
            │
            ▼
        PRINT
        DECISIONS,
        HISTORY
        PARAMETER
        FIGURES
            │
            ▼
          ( 1 )
```

DO FOR
BOTH TEAMS

1
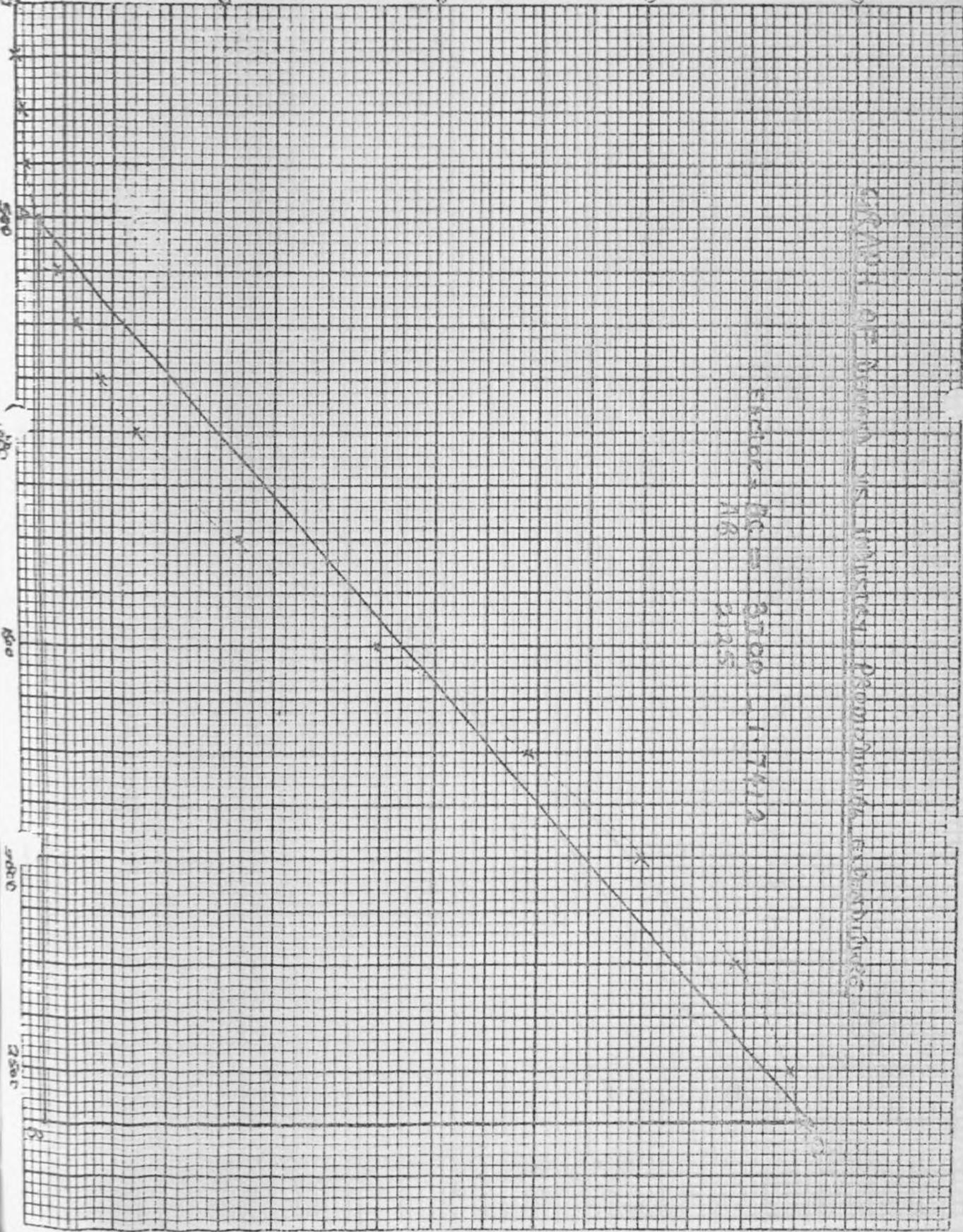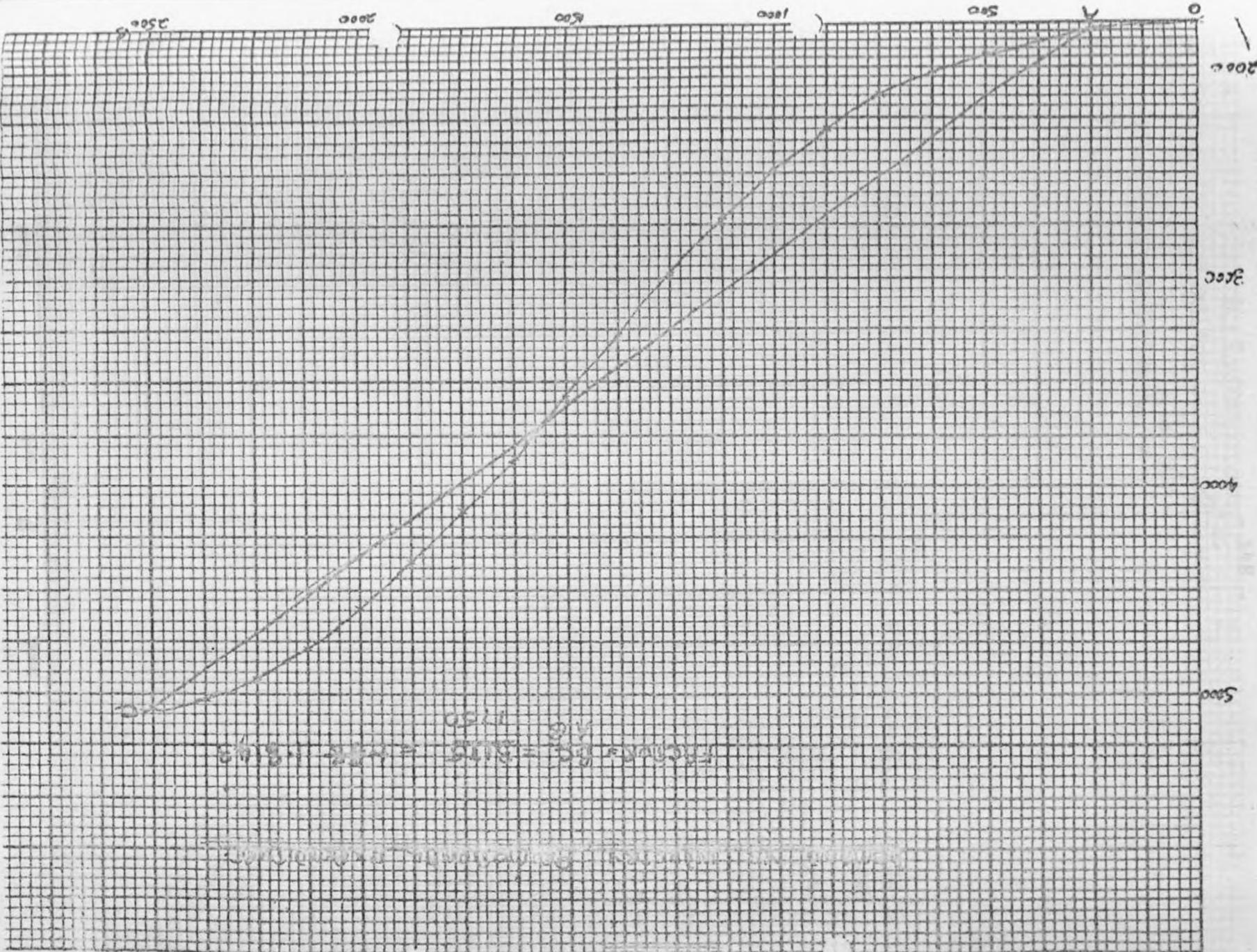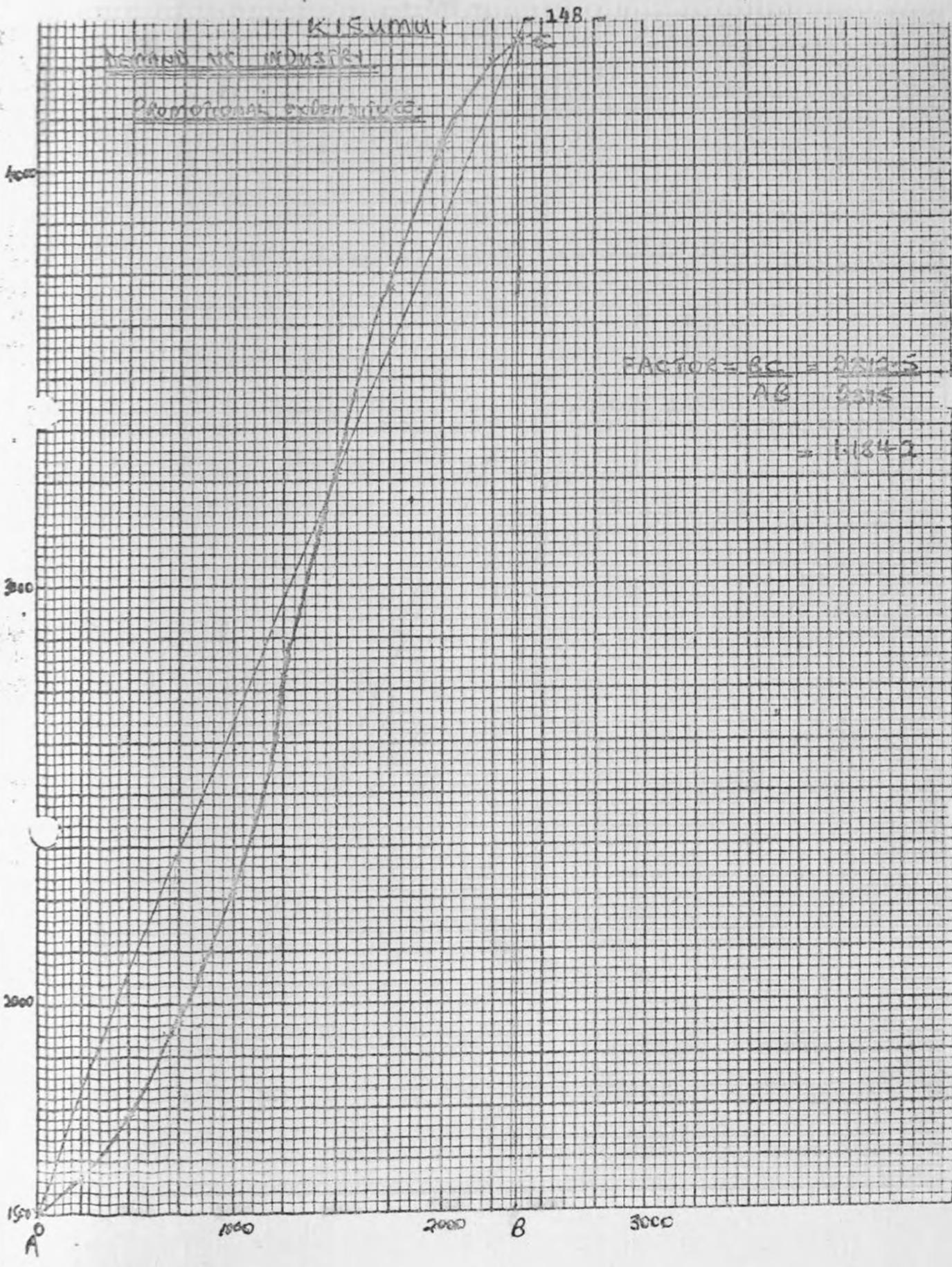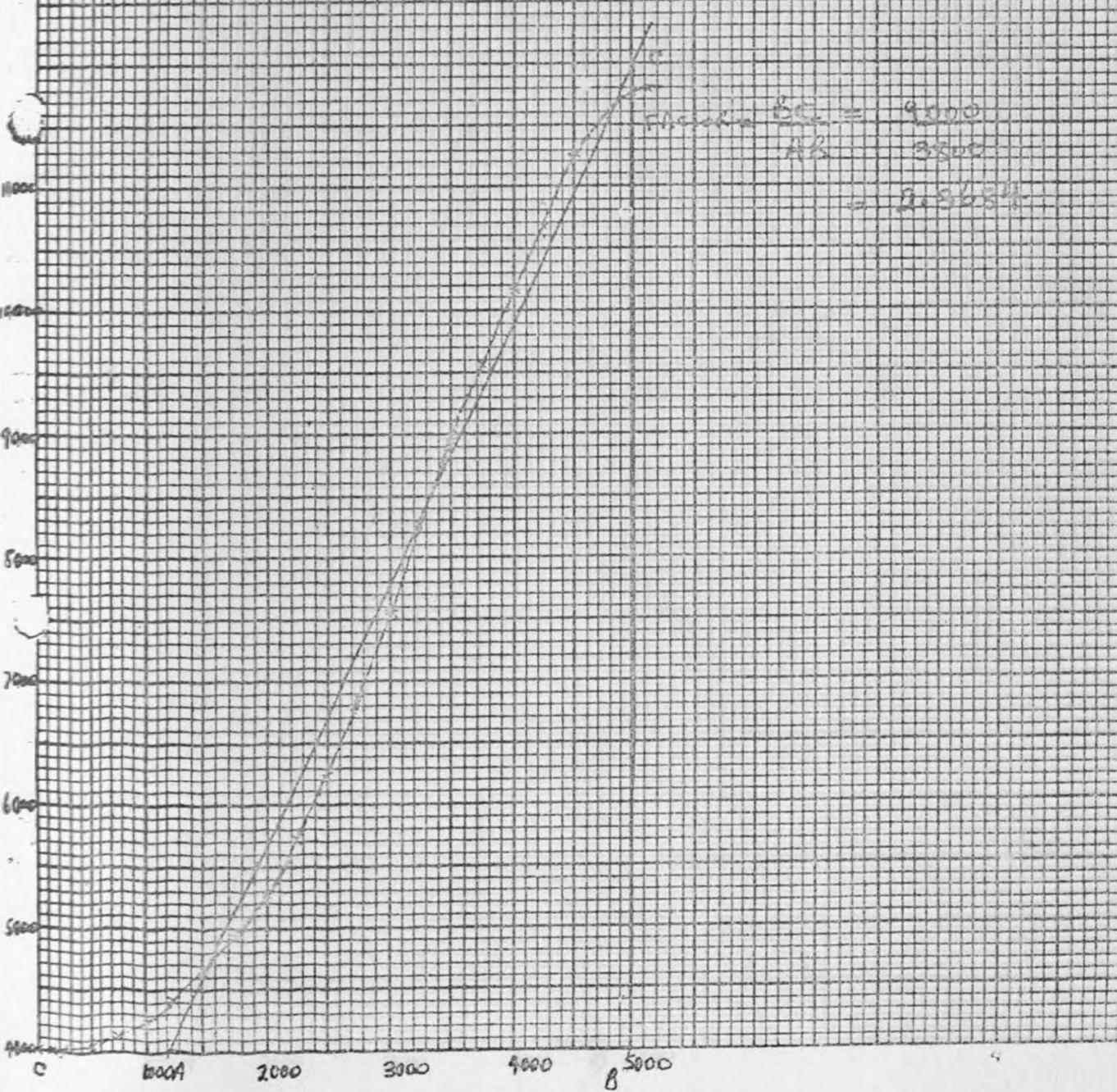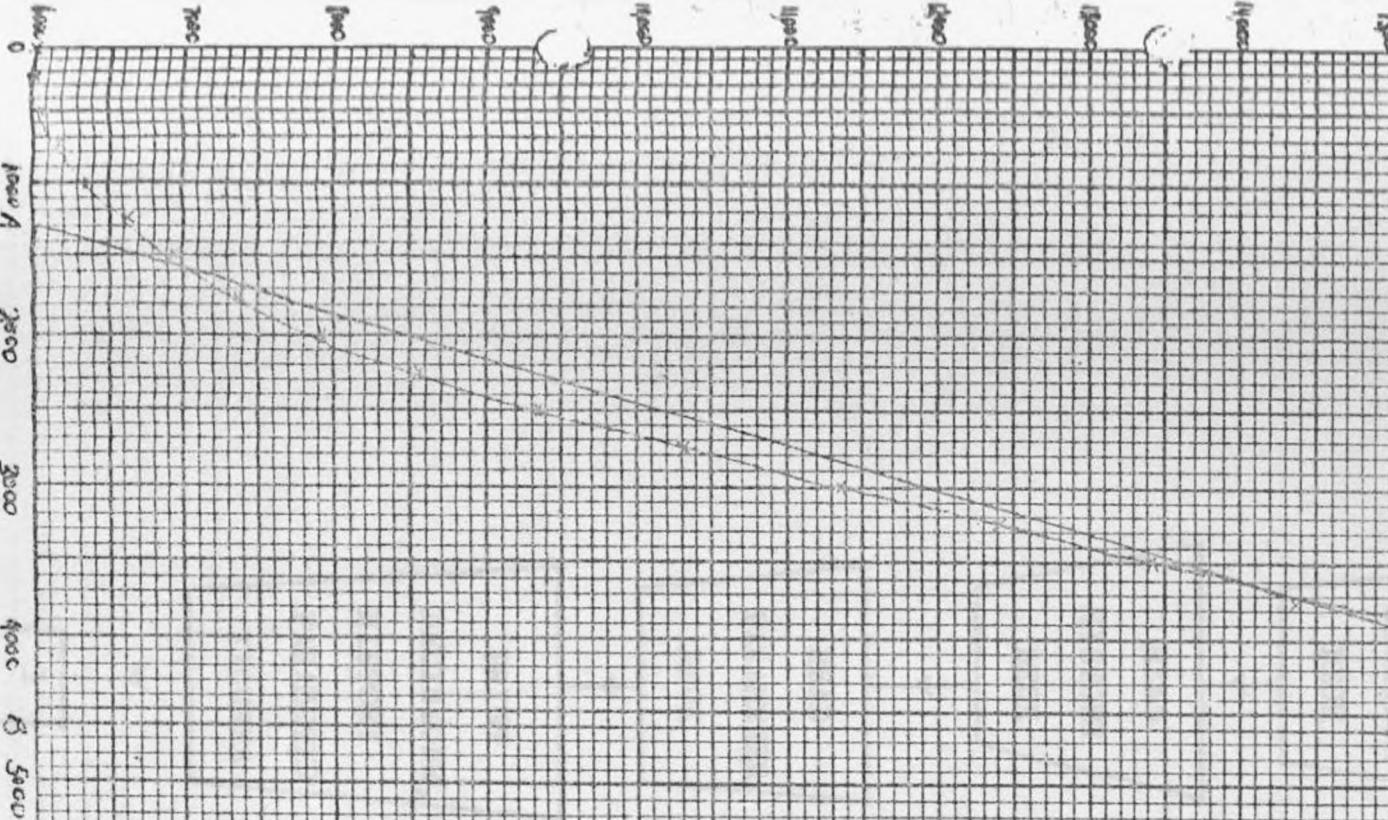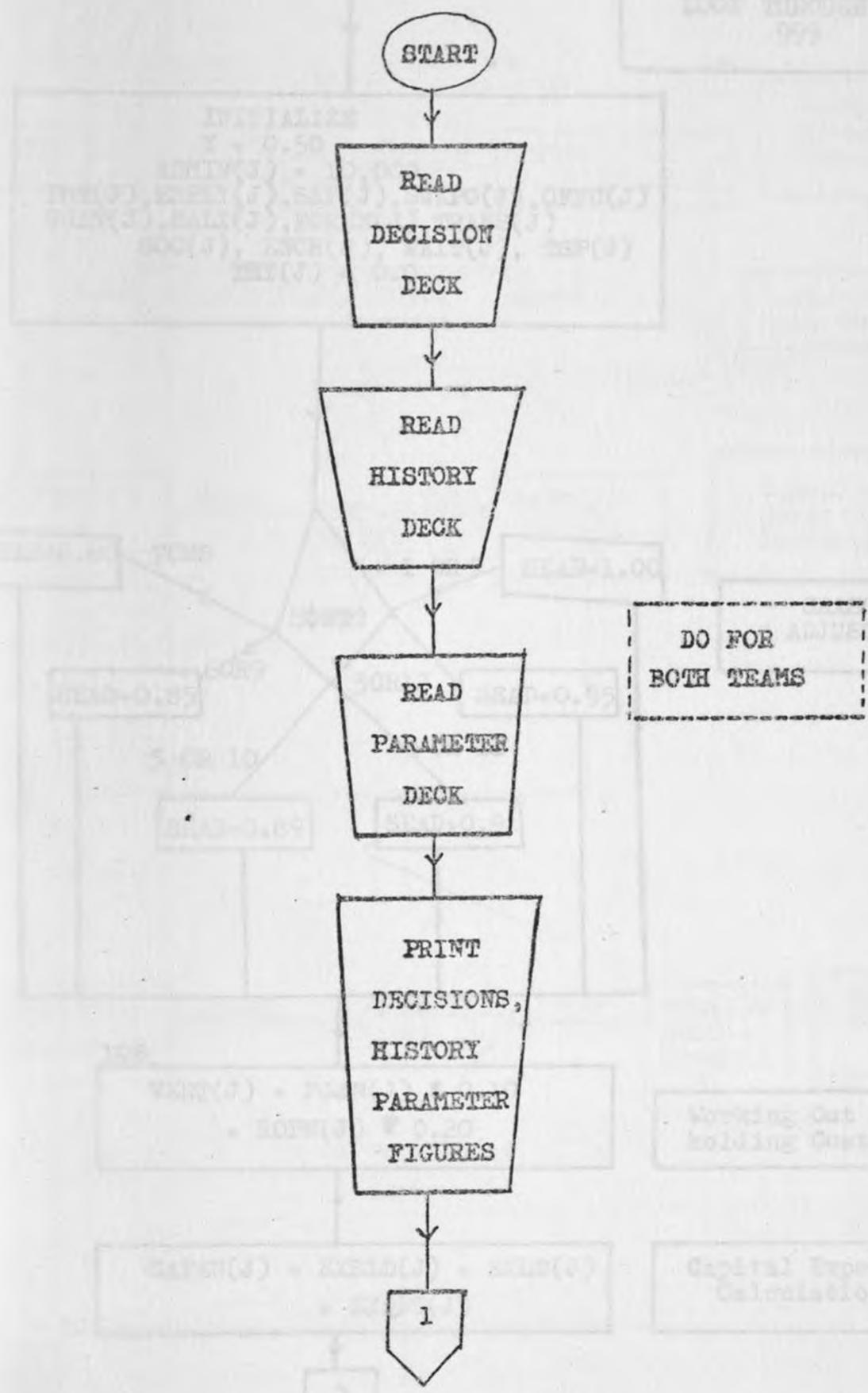
DO THE FOLLOWING
LOOP THROUGH
999

INITIALIZE
$Y = 0.50$
$ADMIN(J) = 10,000$
$PMT(J),EMPLY(J),SAP(J),SWAPO(J),OFFC(J)$
$UGAN(J),SALX(J),FOREN(J),TRANS(J)$
$SOC(J), ENCR(J), WAIT(J), TSF(J)$
$TMY(J) = 0.0$

SEAD=0.80   7OR8

1 OR 2   SEAD=1.00

MONT?

Calculating
Interest on
Investments

SEASONAL
ADJUSTMENT

SEAD=0.85   6OR9

3OR12   SEAD=0.95

5 OR 10   4 OR 11

SEAD=0.89   SEAD=0.91

106

$VENT(J) = FGIN(J) * 0.10$
$+ ROPN(J) * 0.20$

Working Out Stock-
holding Costs

$CAPEN(J) = EXBLD(J) + EXLD(J)$
$+ EXQPT(J)$

Capital Expenditures
Calculation

2

2

TREST(J)=0   FALSE   MONT? TRUE   TREST(J) = 0.10*100000/2 | Calculating Interest on Gvt. Loan

ARN(J)=DRAF(J)*0.01 | Interest on Bank Overdraft

BANK(J) = 0   FALSE   MONT=6 OR 12?   TRUE   BANK(J)= CHIN(J) *0.015 | Calculating Interest on Investments

FEZ(J)=0   FALSE   CONSOL(J) =0?   TRUE   FEZ(J)= 2000 + CONSOL% 15 | Charging Consultancy Fees

3

3

| PAY(J)=0 DEL=RDE*7.5 | RDISC =1 | TRUE | PAY(J)= RDE(J) * 7.50*0.98 DEL(J)=0.0 | Calculating Accounts Payables |

DEBT(J)=PAY(J)+ACPY(J) → Total Accounts Payable

Calculating Preventive Maintenance & labor charges

PMT(J)=PMT(J)+PPC(J,M)
EMPLY(J)=EMPLY(J) + DLH(J,M) *900

DO FOR BOTH FIRMS FOR THREE SHIFTS

HEAD(J) = 5000 ←FALSE— DLH(J,1) >0+ DLH(J,2) >0 ←FALSE— DLH(J,1) =0? —TRUE→ HEAD(J) = 0

TRUE

DLH(J,2) >0 AND DLH(J,3) >0 ? —TRUE→ HEAD(J)=12500

FALSE→ HEAD(J)= 10000 → CONTINUE

4

```
         ┌─────────┐
         │    4    │
         └────┬────┘
              │
              ▼
  ┌───────────────────────┐      ┌───────────────────────┐
  │     CALL PRDUCE       │      │ Calling for Production │
  │                       │      │ Made                   │
  └───────────┬───────────┘      └───────────────────────┘
              │
              ▼
  ┌───────────────────────┐      ┌───────────────────────┐
  │ PUB(J)=FGIN(J) + GOT(J)│     │ Calculating Total Avalia-│
  │ COST(J) = GOT(J) * 1.00│     │ ble for Sale and Variable│
  │                       │      │ Manufacturing Cost.    │
  └───────────┬───────────┘      └───────────────────────┘
              │
              ▼
```

SAP(J) = SAP(J) + 7500 * REP(J,I)   ← TRUE — I<4? — FALSE →   SWAPO(J)= SWAPO(J) + 10000 * REP(J,I)

TTL(J) =SWAFO(J) + SAP(J)

Calculating Sales Representatives Charges

UGAN(J) = UGAN(J) + 10000 * SOFI(J,I)   ← FALSE — I<4? — TRUE →   OFFC(J) = OFFC(J) + 2500 * SOFI(J,I)

PLUS(J) = UGAN(J) + OFFC(J)

Cost of Maintaining Sales Offices

```
         ┌─────────┐
         │    5    │
         └─────────┘
```

6

REGD(I)=BDM(I)+DEND(I) ✳ FTC(I)

Adjusting for
Demand Due to Promo-
tional Expenses

REGD(I) : TPM(I)

> REGD(I) = TPM(I)

<

Calling for
Random
Number

CALL FPMCRV(X)

RMA=0.91+0.17 ✳ X

Calculating the
Random
Adjustments

Adjusting Basic
Demand For Price,
Seasonal, Random
& Company Factors

XMD(I) = BDM(I) ✳ COAD ✳ ADP(I) ✳ SEAD ✳ RMA

Adjusting Promotional
Demand for Company,
Seasonal & Random
Factors

XEM(I) = REGD(I) ✳ COAD ✳ SEAD ✳ RMA

7

7

Sharing Demand Due
To Price Decisions

$PR(1,I) = 0?$ — TRUE → $PR(2,I) = 0$ — TRUE → $ASA(J,I) = 0$

FALSE

FALSE

$ASA(J,I) = PR(1,I)/(PR(1,I) + PR(2,I)) \times XMD(I)$ ← $=1$ — $J?$

$=2$

$ASA(J,I) = PR(2,I)/(PR(1,I) + PR(2,I)) \times XMD(I)$

8

8

SHARING DEMAND
DUE TO PROMOTION
DECISIONS

PR(1,I)
=0
AND
PR(2,I)
=0

TRUE → USA(J,I)=0

FALSE

PR(1,I)
>0
AND
PR(2,I)
=0

FALSE ← PR(1,I)
=0 AND
PR(2,I)
>0 → TRUE

J?

=1 → USA(J,I)
=0

=2

USA(J,I)
=XEM(I)

TRUE

J? = 2 → USA(J,I)
=0

=1

USA(J,I) =
XEM(I)

10

9

14

PUB(J) : FIN(J,I)   >   SOLD(J,I)= FIN(J,I)
PUB(J)=PUB(J)- FIN(J,I)

<

Calculating Stock-
Outs and Stock-
Out Penalty

SOLD(J,I) = PUB(J)
  PUB(J) = 0.0
STC(J,I)=FIN(J,I)-SOLD(J,I)
SOC(J)=SOC(J)+0.5*STC(J,I)*
     PR(J,I)

Commission For
Agents

$I < 4$?   TRUE   SALX(J)=SALX(J)
+0.10 * PR(J,I)
* SOLD(J,I)

FALSE

FOREN(J)=FOREN(J)
+0.15 * PR(J,I) *
  SOLD(J,I)

ZUM(J) = FOREN(J)
  + SALX(J)

12

Calculating
Accounts
Receivables

12

RDISC =1 ? → TRUE → $RCST(J) = 0.98 \cdot PR(J,I) \cdot SOLD(J,I)$

FALSE

$RCST(J) = 0.0$
$WAIT(J)=WAIT(J)+ PR(J,I) \cdot SOLD(J,I)$

$ZEB(J)=ZEB(J)+RCST(J)$
$SAC(J)=ZEB(J)+ACRY(J)$

TRANSPORT COSTS

$TRANS(J)=TRANS(J)+Y \cdot SOLD(J,I)$

TOTAL GOODS SOLD

$TSP(J) = TSP(J) + SOLD(J,I)$

TOTAL GOODS DEMANDED

$TMY(J) = TMY(J) + FIN(J,I)$

ADJUSTING FOR
GOODS AVAILABLE
FOR SALE AND
BALANCE OF RAW
MATERIALS AND
FINISHED GOODS

$Y=Y+0.10$
CALL PRODUCE
$PUB(J) = FGIN(J) + GOT(J)$
$CFG(J) = PUB(J) - TSP(J)$
$CLIN(J) - AYM(J) - GOT(J)$

CALL RESALT

RESULTS PRINTOUT

CALL FPMCRY

STØP

PRODUCTION SUBROUTINE (PRDUCE)

START

Applying
Random
Number

CALL FPMCRY
CAMN=3500+1000000X
TAMN=4500+1000000X
DIFPD=TAMN-CAMN

EFET=0.75^{XPM} + 0.25
⚹ XPM

Adjusting Production
for Maintenance
Exp.

TP = CAMN+ ((EFET/EFET
+500)⚹ DIFPD)

Calculating
Maximum Possible
Production

M?

TPAD(J,M)=
TP(J,M)⚹
0.50

3=

=1

TPAD(J,M)=TP(J,M)
⚹ 1.00

=2

SHIFT
EFFECIENCY

TPAD(J,M) = TP(J,M)
⚹ 0.75

1

```
                              ┌───────┐
                              │   1   │
                              └───┬───┘
                                  │
                                  ▼
   ┌──────────────┐          ╱─────────╲          ┌──────────────────┐
   │ ACP(J,M)=    │◄──  >  ──│ SPRD(J,M)│── < ──►  │ ACP(J,M)=SPRD(J,M)│
   │ TPAD(J,M) *  │          │  :TPAD   │          │ * DLH(J,M)/20     │
   │ DLH(J,M)/20  │          │  (J,M)   │          └──────────────────┘
   └──────┬───────┘          ╲─────────╱                   │
          │                                                │
          ▼                                                ▼
          └──────────────────►      ◄─────────────────────┘
                                  │
                                  ▼
   ┌──────────────┐          ╱─────────╲          ┌──────────────────┐
   │ TOTPD(J)=    │◄── 2= ──│    J?    │── =1 ──► │ TOTPD(J) =       │
   │ TOTPD(J) +   │          ╲─────────╱          │ TOTPD(J)+ACP(1,M)│
   │   ACP(2,M)   │                               └──────────────────┘
   └──────┬───────┘                                        │
          │              ┌──────────────┐                  │
          └─────────────►│ AVM = ROPN   │◄─────────────────┘
                         │   + RDE      │
                         └──────┬───────┘
                                │
                                ▼
   ┌──────────────┐          ╱─────────╲          ┌──────────────┐
   │ GOT = AVM    │◄──  >  ──│  TOTPD  │── < ──►  │ GOT = TOTPD  │
   └──────┬───────┘          │  :AVM   │          └──────┬───────┘
          │                  ╲─────────╱                 │
          │                                              │
          └──────────────────►        ◄─────────────────┘
                                  │
                                  ▼
                             ╭─────────╮
                             │ RETURN  │
                             ╰─────────╯
```

PROMOTIONAL ADJUSTMENT SUBROUTINE (PRJUST)

START

301

$$FDE(J,I) = 0.6 * PROM(J,I) + 0.4 * XPT(J,I) + 500 * REP(J,I) + 1000 * XEP(J,I)$$
$$DEND(I) = FDE(1,I) + FDE(2,I)$$

DO FOR BOTH FIRMS
FOR FIVE REGIONS

RETURN

PRICE ADJUSTMENT SUBROUTINE (PRADJ)

START

FALSE $\leftarrow$
$PR(1,I) = 0$
AND
$PR(2,I) = 0$
?
$\rightarrow$ TRUE

$ADP(I) = 20 * PR(1,I) + 20 * PR(2,I)^2$
$PR(1,I)^2 + PR(2,I)^2$

$ADP(I) = 0.0$

RETURN

RESULTS PRINTOUT SUBROUTINE (RESALT)

START

$$AFDD(J) = CAB(J) + BANK(J) + SANT(J)$$
$$+ SAC(J)$$
$$DIS(J) = DEBT(J) + COST(J) + EMPLY(J)$$
$$+ HEAD(J) + PMT(J) + TRANS(J)$$
$$+ ZUM(J) + PLUS(J) + SAP(J)+ENCR(J)$$
$$+VENT(J)+ADMIN(J)+FEZ(J)+TREST(J)+CAPEN(J)$$
$$+TAX(J) + DIVD(J) + SOC(J) + OTEX(J)$$
$$CBB(J) = AFDD(J) - DIS(J), C22(J)=CBB(J)-ARN(J)$$
$$CBOV(J) = (DRAF(J) + SANT(J)) - OD(J)$$

DO 850
FOR
BOTH
FIRMS

850

PRINT
: DEMAND, SUPPLY STATEMENTS
; CASH STATEMENT
; OTHER INFORMATION
; HISTORY

STOP

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