APPLICATIONS OF AN INTERACTIVE GRAPHICS DESIGN
SYSTEM TO FOREST INVENTORY IN BRITISH COLUMBIA

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## Introduction

The data base of the Inventory Branch, B.C. Forest
Service, is valued at over $50 million and consists of
7320 forest cover maps with descriptive statistics, as
well as detailed information on growth, decay, waste
and depletion.  Data are summarized mainly in terms of
previously defined physical and legal boundaries such
as management units, regions, compartments, ownership,
etc.  However, recent Provincial forest legislation
requires that reports and summaries on forest and
range resources be prepared by boundaries which may
change frequently and/or have not been defined
previously.  Coinciding with the requirement of
flexible data retrieval is the urgent need for
converting the map-related data base from the Imperial
to the metric system, including changes in map sheet
sizes from 7'30" by 7'30" (1:15 840 scale) to 12'
longitude and 6' latitude (1:20 000 scale).  A major
constraint under which this relatively heavy workload
must be implemented is time, i.e., the conversion must
be completed within a 3-year period.

In order to respond to the challenges mentioned above,
the Inventory Branch acquired in 1978 an Interactive
Graphics Design System (IGDS) from M & S Computing
International Ltd.

IGDS Configuration at the Inventory Branch

The Interactive Graphics Design System is an integrated
configuration of hardware and software, featuring
user-controlled interactive graphics combined with
data management and retrieval systems.  The
configuration installed at the Inventory Branch include
the following:  two PDP 11/70 computer subsystems
operating in a dual-port environment with 256K word
memory on each CPU; two 80 and two 300 megabyte disk
drives with packs, operating with data scanners; ten
design/digitizer stations, each consisting of two
Tektronix screens, a 36 x 48 inches Summagraphics
digitizing table with menu and cursor, and a keyboard;
a system console and CRT terminals; a tape drive and
controller; a Calcomp 960 plotter; a card reader,
printer and two hard copy units; and an interface
controller to the IBM 3033 computer.  The software
acquired with the system facilitate interactive
manipulations and editing of graphic elements and
designs, interactive and batch input of map labels
containing thematic details, automatic area
calculations, and the data management and retrieval
capabilities.  Since acquisition, a considerable
amount of user-controlled software have been developed
to enhance site-specific applications.

Production Requirements and Schedules

The 7000+ forest cover maps and their descriptive
statistics must be loaded into IGDS within a period of
3 years.  However, the new forest legislation requires
that forest and range inventory statistics be current
and, hence, basically all maps should be updated
annually.  At present, forest cover maps in mylar form
are being up-dated, in terms of known changes, in the
district offices of the Ministry of Forests and the
relevant information is documented in history files.
These updated maps are still at 1:15 840 scale and the
areas of ."disturbed" forest types are estimated through
dot-counting or by visual methods.  At the same time,
re-inventory work is being carried out in each
of the six forest regions, consisting of
re-stratifying the land on recent aerial photographs
in accordance with the new classification system.
Maps used for the re-inventory are at 1:20 000 scale
and this activity covers approximately 10% of the
Province annually.  In addition, some areas of above

average interest or activity are inventoried at a
higher resolution, using aerial photographs and maps
with 1:10 000 scale.

The production schedule expected of IGDS at the time of
acquisition was to load the existing 7320 forest cover
maps within a period of 3 years, including metric
conversion.  However, the recent forest legislation and
subsequent policy have brought about an increase in the
amount of details that must be entered in the system,
while at the same time created additional demands in
terms of data management and retrieval.  Consequently,
the 3-year deadline for setting up the data base will
require strict adherence to daily production schedules
and a freeze on special requests during the loading
phase.  On the other hand, the Provincial agencies
responsible for planimetric, topographic and other
thematic (e.g., cadastral, soils, landform, etc.)
mapping, are also interested in acquiring a
computerized mapping system and if some of the relevant
data could be supplied by them to the Inventory Branch
in terms of computer compatible tapes, the 3-year
production schedule could be met without adverse
constraints.

Methods of Operation

IGDS is capable of storing each design file in terms of
63 levels, each of which may be retrieved separately
or collectively in any combination.  Formal overlays of
design files can also be created and areas of original
and resultant types and their associated attributes may
be obtained in a matter of minutes.

The forest inventory data base currently utilizes
approximately 30 IGDS levels, separating such details
as aerial photo centres, topography, toponymy,
cadastral survey, forest type polygons and their
descriptions, etc.  Each forest type polygon is
associated with an attribute list containing map sheet
and polygon number, species composition, age, height,
crown closure, number of stems per hectare,
environmental constraints and other relevant
descriptive information.  The process of digitizing is
completely automated by combinations of IGDS and
user-developed algorithms integrated to produce maps
and reports in accordance with Provincial and Forest
Service standards.  Map labels describing forest types

are loaded through the attribute file and placed at the
text nodes associated with the unique polygon numbers.
The Data Management and Retrieval System (DMRS)
software calculates the areas of the closed forest-type
polygons and enters this information into the attribute
file. The graphic designs or maps are plotted on mylar
in two copies, one for the relevant district and the
other manuscript is kept at the Inventory Branch.
Future changes are then marked on the district's copy
and the design and attribute files are updated on an
annual basis thereafter.

Currently two types of manuscripts are being digitized,
i.e., the existing 1:15,840 maps with Imperial labels
and the new 1:20 000 and 1:10 000 series with metric
attributes covering the re-inventoried areas. The time
required to digitize an average forest cover map,
consisting of planimetric, cadastral and thematic
details (approximately 800 polygons), was originally
estimated to be 11-12 hours of uninterrupted production.
Because of staff training and vacancies, it has not
been possible to maintain consistently this production
goal, although it has been achieved with experienced
staff on numerous occasions. The corresponding time to
draw a map manually is about 40 hours; hence, there is
a substantial increase in throughput by using an
Interactive Graphics Design System. However, IGDS
provides the highest benefit/cost ratio during the
update stage, when changes can be implemented in terms
of minutes, followed by approximately 30 minutes of
plotting.

The staffing for IGDS is organized to maximize
throughput. Two persons are assigned to each
design/digitizer station and their time is scheduled
for the continuous operation of the system. Time off
the system is spent on preparation, quality control
and on other relevant activities.

Applications

The Interactive Graphics Design System is producing
high quality maps at any desired scale. Map labels
are being changed automatically by taking any
combination of the variables in the attribute file and
placing the desired information at the text nodes of
the corresponding polygons. Areas of the various
forest types (strata) are calculated through a user

command at the time the complex shapes are closed and the information is placed in the attribute file.

The DMRS software is used extensively to manage the data base and to produce a wide range of reports and graphic summaries.  At the same time, the system provides the necessary tools for the continuous (yearly) updating of over 7000 forest cover maps.