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AUTOMATED DATA PROCESSING: ADP SYSTEMS

Computer aided photo typesetting for cartographic purposes

Paper presented by Sweden**

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Abstract

The fact that modern photo type setters are controlled by computers has opened new possibilities to rationalize lettering of maps.

At the Land Survey of Sweden development of software and methods has been carried out in order to introduce computer aided photo type setting. The work is based on the use of photo type setters of the Diatronic-s type. In the paper a short discription is given concerning the software developed for this purpose.

Computer aided photo type setting is now used in the cartographic work at the Land Survey. The paper reviews some of the applications of this technique in the production of official topographic maps.

The experiences hitherto obtained with the new technique are very satisfying. Thus comparatively large economic savings have been shown. Using the new technique all geographic names are successively stored in a data base. This opens new possibilities in map revision, derived mapping as well as in production of gazeteers.

1.   Introduction

Much of the information on a map is shown by the lettering.
Names, labels and notes are added to make the picture shown
by the map complete and usable.

Photo type setters have been used in cartographic activities
during some decades to produce text material used in lettering
of maps. During the last decade computer controlled photo type
setters have been introduced. However, these instrument have
not primarily been constructed to solve pure cartographic
problems but have mainly been developed to carry out setting
for newspapers, books etc. Only to a relatively limited extent
have computer aided techniques so far been utilized to automate
map lettering. There are some few examples from USA where some
special systems for names placement have been developed (1,2).
However, these systems are - at least for the present time - very
expensive and can thus not be afforded by ordinary map producers.

However, the fact that modern photo type setters are controlled
by computers opens new possibilities to make use of such instru-
ments for cartographic purposes. From a cartographic point of
view, it is of great interest that coordinate controlled type-
setting can be performed in such an equipment. Thus if coordinates
are determined for geographic names etc on maps, the lettering
can be performed in a computer controlled setter provided that
software is available to generate control information for the
instrument. Thus at the Land Survey of Sweden comprehensive
development work has been devoted to cartographic applications
of computer aided photo type setting. This work has been based
on the use of a relatively inexpensive instrument, the Diatronic-s
equipment. The development work has shown that it is possible
to rationalize different parts of the text handling typical of
the cartographic production at the Land Survey. Thus the new tech-
nique has already been introduced in different stages of the
production of the national map series.

2.   Photo Type Setter

The photo type setter used by the Land Survey is of the Diatronic-s
type and manufactured by Berthold AG, West Germany. Two instrument
are used in the production. One of them is a complete setter
equipped with both keyboard and paper tape reader for input of
data. The other instrument has only a paper tape reader.

In this kind of photo setter, characters (letters, figures etc)
stored on symbol discs are exposed on light sensitive material.
In the Diatronic system each symbol disc contains 126 characters
of a certain type face. The characters are stored in negative
form on the disc at a size of 8 didot points. Zoom optics are
used to expose the symbols at sizes varying from 6 to 20 points.
8 different discs can be stored at the same time in a special
magazine.

The setting can be controlled via a keyboard or an 8-channel
paper tape. In the complete setter all functions such as change
of type face or character size are controlled via keyboard or
control tape. The exposure is made on light sensitive film or
paper with a maximum size of 30 x 30 cms. All setting has to be
made on straight horisontal lines.

Exposure of characters can be made in arbitrary positions. This
facility makes it possible to place names etc in positions the
coordinates of which are known. However, the information needed
to make the equipment usable for such an application is so
complex that a computer must necessarily be used to generate
the control information.

3.   Software for computer aided photo type setting

The exposure device of the photo type setter must be fed with
appropriate information to carry out correct exposure of charact-
ers. This information can, as mentioned, be fed into the system
through the keyboard or via paper tape. Using the keyboard the
information passes through a small computer unit which processes
the information so that the exposure device gets appropriate
orders. If information is provided on paper tape a host computer
takes care of the work, otherwise it is carried out by the computer
unit of the photo setter. This also means that it is possible
to carry out additional computations in the large computer in
order to make the photo setter more useful for cartographic
purposes. This is for instance the case if names are to be placed
in positions with known coordinates.

To make computer aided generation of control information possible
adequate software must be available. The manufacturer did not
foresee such an application of the photo type setter and was
consequently not in a position to provide suitable software.
Thus the Land Survey had to develop the software needed. The
software has been developed on the Prime 400 computer system
at the Land Survey. Programmes are written in FORTRAN.

The layout of the control information to the Diatronic-s is
relatively complex, thus it is not possible to give any details
here. In short each order consists of 2-8 characters and must
be given on 8 channel paper-tape. Two important parts of the
orders are called operational and value information respectively.

Operational information is used to give details concerning the
setting. This includes such information as

- direction of movement (left, right etc)
- choice of type face and size
- choice of line weight and
- choice of character.

The so called value information is utilized to give the size of
movement. The movement must be computed for each single character,
which means that detailed information about the size of all
characters must be available. In direct setting via the keyboard
so called breadth boxes are used to give character sizes. Thus for
each type font character sizes in units of 1/16 mm are given
in a corresponding breadth box. Using EDP to generate control in-
formation the corresponding breadth values must be stored in
the computer.

The software developed to take care of computerized generation
of control tapes is integrated into a general software system
for computer aided map production. This system is called AUTOKA
(3) and has been developed and installed on the Prime 400 computer
system at the Land Survey. The system is based on a data base
management modul which allows direct access to disc stored
information.

Part of the software is a basic software package especially
developed to handle EDP specificly for photo type setting.

4.   Data acquisition

To use computer aided photo setting for coordinate controlled
placement of names it is necessary to determine coordinates
for the points to which the text is to be located. Thus avail-
able maps, manuscript etc have to be measured in digitisers.
At the Land Survey digitisers such as Bendix, GTCO or Altek-
tables are used for this purpose.

The data acquisition also includes such information as codes
for category, type face and size. Category codes are used to
identify the various classes of names such as lakes, islands,
mountains etc. The reason for adding category codes is mainly that
the presence of such information makes possible to additional
use of the data for instance in the production of gazeteers.

When digitising it is necessary to have a possibility to indicate
which point has been measured to define the location of a name.
Normally, the starting point i.e the lower left corner point of
a name is measured. However, normally one does not know the
exact length of a name after setting. Therefore also the mid
or end point of name may be measured. Code numbers are used in
the digitising work to indicate if the start, middle or end point
has been determined. These code numbers are then used by the
computer in addition to tables defining character sizes to deter-
mine the coordinates of the starting point of each name since
the setting has to be carried out from the left to the right.

5.   The use of computer aided photo type setting at
          the Land Survey

The system for computer aided photo type setting now used at the
Land Survey has been under development during a number of years.
During this period the new technique has been tested in several
applications. Here a short review is given of the present utili-
zation of computerized type setting in the production of national
maps at the Land Survey.

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maps at the Land Survey.

As already mentioned, the fact that the Diatronic setter is controlled via paper tape makes it possible to produce the control information in a separate computer. This fact can be used to facilitate the production of text material in the setter. Thus it is possible to write the text manuscript on a separate typewriter equipped with i.a. paper tape output or on a computer terminal. The host computer can then generate control information according to the manuscript. This facilitates the work of the operator of the photo setter and it gives a better utilization of the real capacity of the instrument as well.

In Sweden a national data base system containing land information has been established by the Central Board of Real Estate (CFD). In this system, coordinates and other data for all real estate units are stored. It is possible to make us of this data base in the production of the Land Use Map (Ekonomiska kartan) at the scale of 1:10 000 or 1:20 000 which for instance gives details concerning real estate properties.

One application is automated photo setting of real estate registration numbers. Hitherto so called stock text has been used for this purpose. This means that the main part of all possible combinations of registration numbers has been copied once and for all on strip film and placed in files. During text stick-up one has to find the appropriate number combination in the file, cut it out and stick it to the text separation.

Now information from the real estate data base is used to facilitate registration number stick-up. Thus data concerning all real estate properties on each map sheet is retrieved from the data base and transferred to the Land Survey on magnetic tape. The information is then handled in the Prime computer system and control information to the Diatronic setter computed. In the computer, registration numbers are sorted in numerical order and put out in three different type sizes to give flexibility in the stick-up (see figure 1).

1:416	1:418	1:420	1:425	1:428	1:429	1:439	1:442	1:444	1:482	1:483	1:491	1:502	1:507	1:515	1:516	1:517	1:528	1:529
1:532	1:533	1:558	1:559	1:574	1:580	1:588	1:590	1:606	1:607	1:624	1:625	1:626	1:627	1:628	1:636	1:639	1:640	1:641
42	aå	146B	236	g	140B	234	an	145H	138B	184H	245M	ay	ø	ar	235	148C	229	245K
8A	145	ad	233G	7A	181	7B	184D	254	am	ai	7C	16A	167A	at	7E	158	233	15B
143H	162	ak	aa	143	143B	9B	ab	9	ac	9C	143M	227	7	9A				
121 1/2	171 2	120 1/2	118 1/3	124 2	120A 2	119 2	119 3	96 1/3	118 3	113+135 1/4	113+135 3	100+155+180 3			171 1/3	110 1/2	171 3	1360 1/2
110 2	109 1/2	109 2	136D 2	113+135 4	100+155+180 8		108 1/2	68 1/2	100+155+180 4		108 2	226 1/2	67 2	63 1/2	107 1/3	245 3		
100+155+180 2		106 1/2	106 2	107 2	226 2	8+137+167 3		255 2	104 2	104 3	103 1/2	104 1/4	103 2	101+154+170 2				

Figure 1. Example of computer controlled photo setting of registration numbers to be placed on the Land Use Map at 1:10 000. The computer sorts the numbers in numerical and alphabetical order.

This relatively simple application of computer aided photo type
setting has been used in production for about a year and has re-
sulted in comparatively large savings in the manual stick-up process.

A more advanced cartographic application of real estate data
is to use the coordinates of the property units to place the
registration numbers in the right position on the map. The soft-
ware for such an application has been developed and the experi-
ments carried have shown it possible to introduce this method
in production.

The result of automated photo setting of registration numbers is
shown in figure **2.** However, the coordinates stored in the real
estate data base do not for, several reasons, always represent
the best position from a cartographic point of view. This means
that the coordinates taken from the data base can not be used
without changes. As a matter of fact, it has shown that only about
25 % of the numbers have a position acceptable from a carto-
graphic point of view. Thus to achieve a good result it is
necessary to change the positions of the numbers the locations
of which can not be accepted. This editing is relatively easy.
New locations have to be measured in a digitizer and the data
base fed with new coordinates. In the digitising coordinates
are used to identify the register numbers which are to be relocated.
Once the data base has been up-dated a new photo type setting
is carried out, see figure **3.**

The topographic mapping at scales of 1:50 000 - 1:25 000 at the
Land Survey now comprises only revision of existing maps. In
this revision exchange of text is commonly performed since the
type face used on the old maps has been replaced by other type
faces. Thus the digitising can be made on the old maps since
the main part of the names can remain in the same position on
the revised map. Data acquisition is followed by a verification
output on the photo setter, see figure **4.** As seen in this figure,
the verification shows not only the names but also a small point
defining the point measured in the digitizer. This point is of
course omitted in the final setting but is needed in the editing
for this definite output. The verification output is used to
check data and to edit the text. This editing may include changes
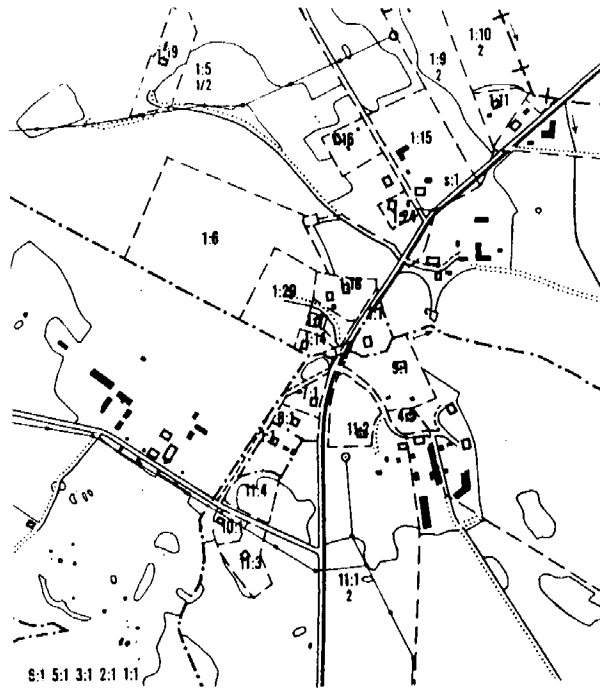of type face, size as well as position.

Figure 2. Example of computer controlled setting of registration
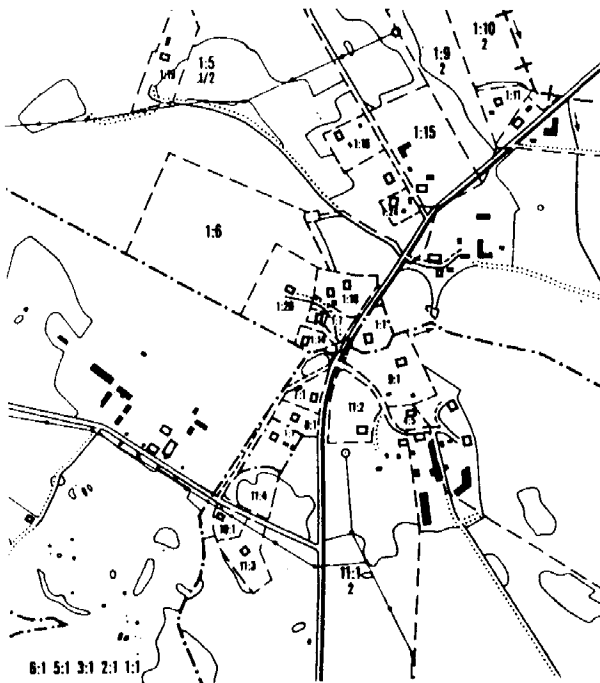numbers using coordinates of the national real estate
data base.

Figure 3. Example of computer controlled setting of the same
registration numbers as in figure 3 after editing and
updating of the data base.

Hällmob.
Skålbo.
Skästra
Rossla
Yekelsbo
Rödmyra.
Åsbo
Ojebergel Järvsö.
Kramsta.
Grönås.
Myra.
Hamra
Nybo

Gartsbo.
Säljesta
Vålsjö
Järvsöklacken
Kålsjö
Stene
Sanna
Uvås Kalv.
Vik
Lörstrand Förnebo
Änga

Skiltosb..
Långebo

Nordsjö Stcnsvallen

Nor Gummervallen

Gåddvikavallen Skog.
Östertolbo Yitterary
Stcmnes- Prättingberg Vastan- Oppsjö
vallen äng
Svedja
Råbergsvallen
Nyvallen Alsjö
Kälen Prättingvallen
Hälberget
St. ÖRÅSEN
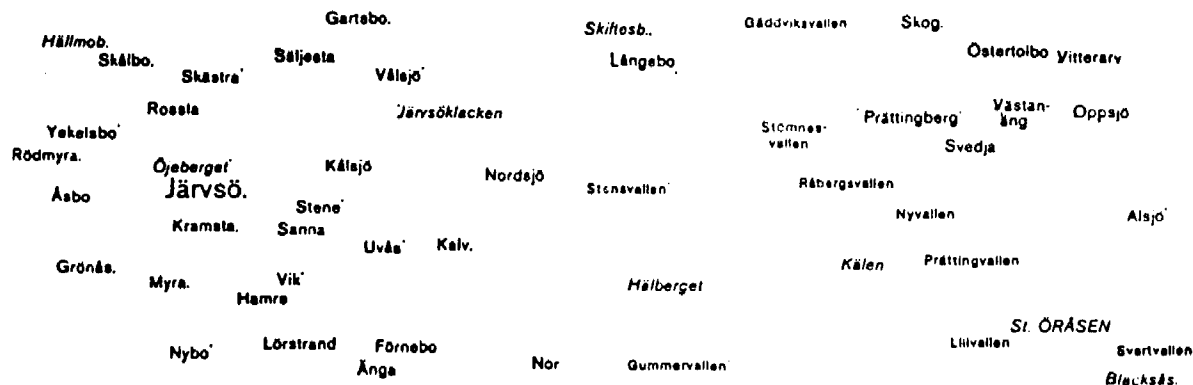Lilivallen Svertvallen
Blacksås.

Figure 4. Verification setting of revised text. In addition
to the name a small point is plotted to define the
point to which the name is located.

6.   Experiences of computerized photo setting

Computer aided photo type setting has many advantages in compari-
son to manual methods.

As far as the use of real estate data for automated setting of
register numbers is concerned, it is quite clear that the new tech-
nique gives very good results. The great advantage is that the
stick-up stock has been replaced by separate stick-up sheets for
each map sheet. This has resulted in a total saving of man power of
about 35 %. Since the average time consumption per sheet is
around 18 hours the saving amounts to about 6 hours. This method
can be used for some 400 sheet annually corresponding to a total
saving of 2 400 hours. This saving must be compared with increased
costs for data processing, photo setting, material etc. As shown
in table 1 these costs amounts to 63 000 Skr. This means cost
savings of some 150 000 Skr (about 35 000 US$).

Table 1.   Costs for automated production of register numbers

Data from the real estate data base	20 000 Skr
EDP	5 000 Skr
Photo type setting	15 000 Skr
Material, handling etc	23 000 Skr
	60 000 Skr

A study of the costs for the setting of lettering in connection
with revision of general maps at the scale of 1:250 000 has been
carried ut. On this map series all names have to be replaced
since a change of type style is made. The cost savings for one
single sheet has been estimated to be as large as 25 000 SCr
(about 5700 US$), which corresponds to a cost saving of about
70 % for the lettering. Although some of the cost estimates are
based on comparatively little experience the comparisons do
indicate that the new technique makes possible a considerable
rationalization of map lettering in this particular case.

Apart from the cost savings it also has to be kept in mind that
the fact that all information about lettering is stored in
digital form in a data base makes it possible to take greater
advantage of this information in future revisions, derived mapp-
ing as well as for production of gazetteers.

In addition to the advantages presented above some disadvantages
have to be pointed out. Thus the computer aided technique calls
for access to a computer system with adequate software, for a
computer controlled photo type setter as well as for know-how
in computer aided techniques in general. From the Land Surveys
point of view,this has not been a serious problem since computer
controlled methods have been used for quite a long time in diffe-
rent cartographic applications.

A disadvantage with the instrument used is that the size of the
output film is restricted to 30 x 30 cms. Since the normally used
map size is 50 x 50 cms this fact makes it necessary to divide
the setting in four parts which are easily put together. An other
shortcoming is the fact that all names have to be placed on
horisontal straight lines and not on vertical lines or smooth
curves. This means that lettering on nonhorisontal lines must
be completed with manual methods. Although the equipment presently
used at the Land Survey is not the ideal one for cartographic
applications it has shown that the limititations of the instru-
ment are not such that they imply any serious restrictions.

To sum up our experience of computerized photo setting it must
be started that the introduction of this new technique has been
successful and resulted in significant cost savings.

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Annex

by Anders Ek

Since Professional Paper 1980:9 was written two years
ago computer-aided photo-type setting methods have been
in use in map production at the National Land Survey (NLS).
Some development concerning data acquisition has taken place
during this time. Here a short description will be given of
the procedures which are in current use.

The initial operation is that names are coded from the
existing map. At the same time, these names are checked due
to the fact that some new names will be added and some
must be shiffted as a result of changes to the planimetric
details etc. Names and codes are written via a terminal and
stored in the computer (PRIME) in a special text file for
the map sheet in question. Revision and check of the con-
tents of the file is carried out and then the information
is transferred to a floppy disk on an ABC-80 desk-top
computer.

The ABC-80 is used as an aid when digitising, which is the
next step in the process. When digitising each name is recalle
from the storage unit together with its code to the display
of the ABC-80 by using a button on the cursor of the digi-
tiser. The operator locates the name on the map and records
the co-ordinates. Names, codes and co-ordinates are then
stored on a magnetic tape. The contents of the tape are
then fed into the NLS's PRIME computer. This is repeated
name by name. The digitised information is cleaned and
corrected before it is stored in a map data base. From the
base steering information for the photo type setting is
generated.

Up to the present, lettering for 18 sheets of the 1:50 000
topographic map series with a 50x50 cm format and for 14
sheets of the 1:250 000 maps with a 40x60 cm format have
been produced using the method described. A further 18
sheets of the 1:250 000 series have been digitised for
production of a new map series at 1:500 000. A topographic
map sheets contains about 1 000-1 200 names and a 1:250 000
map, 1 200-1 700 names. For each sheet of the 1:250 000
map which is used for the new 1:500 000 map all names are
coded and stored. About 500 names a sheet are digitised. For
the revision of the 1:10 000 Economic Map up to now only
a few experimental sheets have been completed with accep-
table results. Computer-aided photo-type setting will be
introduced in the production for this map series late in 1982.
At the present it is planned to use automated photosetting
methods for the County of Gävleborg which is covered by
about 600 sheets.

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It is too early to draw any definite conclusions re-
garding the viability of the new method. The greater part
of what has been done up to the present has involved
training and debugging of working methods and, therefore,
the result are hardly representative of production results.

Technically the method has worked as expected. With the
exception of the initial digitising of names, it has
normally been sufficient with one correction of the digital
data and small manual corrections to satisfy cartographic
needs. The data base is corrected afterwards to enter the
manual modifications. However, the method has not, as
yet, resulted in the cost reductions that were envisaged
at the planning stage. For a 1:50 000 topographic sheet
with about 1 200 names it takes 150-200 h to position and
check the lettering manually. With the help of the auto-
mated method a little more than 200 h is needed. The
reason for this is, among other things, the additional time
required after each type setting. The problems for personnel
in connection with the introduction of the new procedures
have been insignificant. They have quickly adapted to the
new routines.

The rationalization gains acheived by storing names in
a data base have not yet been evaluated. Up to now no
attempts to use the base for other purposes than carto-
graphic mapping have been made. Future development work
will include the production of gazetteers from the data bank.