

## Data Entry by 2D Digitizing

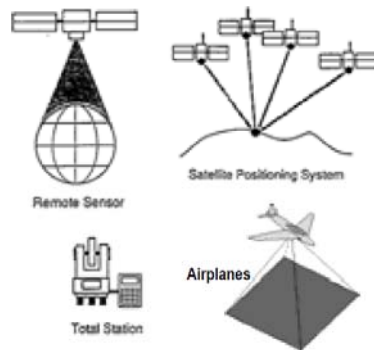
### Content

- Digitizing techniques
  - ✓ On table digitizing
  - ✓ On Screen digitizing
  - ✓ Automatic digitizing
- On Screen digitizing
- Scanning
- Vectorisation

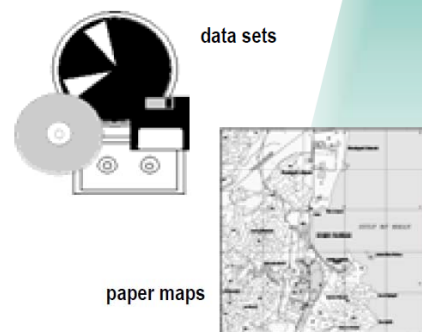
# Introduction

## Spatial Data acquisition

### *Direct data acquisition*



### *Indirect data acquisition*



# Introduction

## Digitising from paper maps

A cost-effective method of data capture might be the **DIGITISING** of existing maps

**DIGITISING:** the conversion of an analogue map into a digital one

# Introduction

## Why paper maps?

### Some advantages:

- Objects are not hidden by shadows, clouds, vegetation cover, overhanging eaves of buildings
- Names of streets and houses, and the position of post offices, fire stations, etc are given
- Administrative, cadastral boundaries, etc are given

### Some disadvantages:

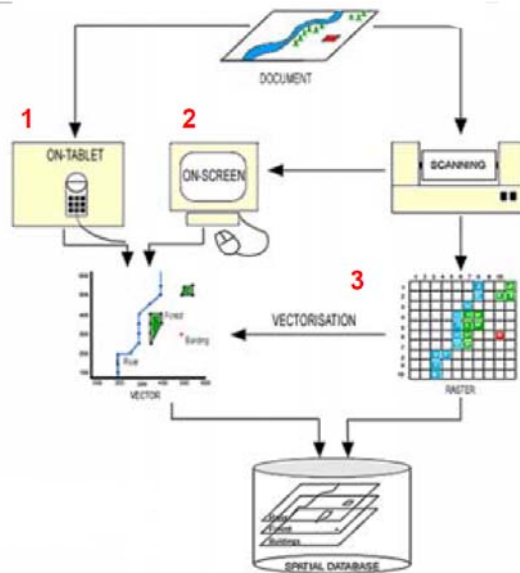
- Objects are generalised
- Objects are not up-to-date



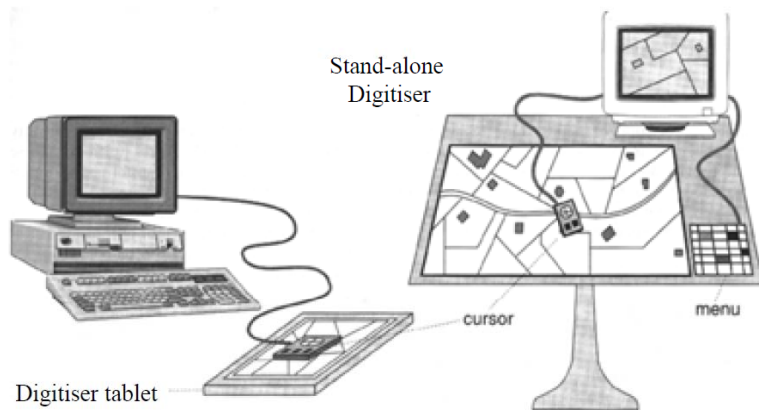
## Digitizing techniques

- On-tablet digitising ( manual )
- On-screen digitising ( manual or semi-automatic )
- Automatic digitising ( automatic )

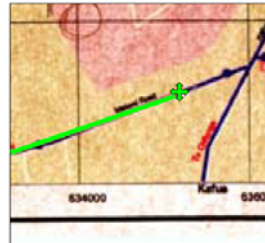
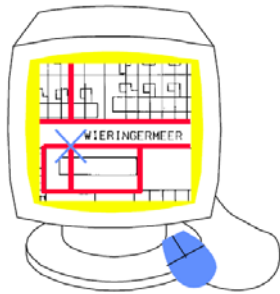
## Digitizing process



## On-tablet digitising (manual)



## On-screen digitising



Digitising on an interactive screen with the source document as background

## On-screen versus on-tablet digitising

- **more comfortable for the operator**
- **more accurate ( *zooming facilities* )**
- **faster ( *semi-automatic, digitising and editing at the same time* )**
- **up-dating procedure ( *geometrically corrected satellite imagery and scanned aerial photo's can be overlaid with the old vector data* )**

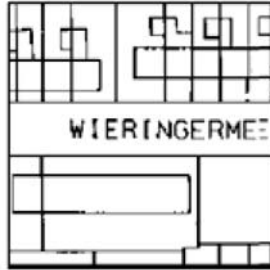
## Selecting a digitising technique

Complex document,  
requires interpretation



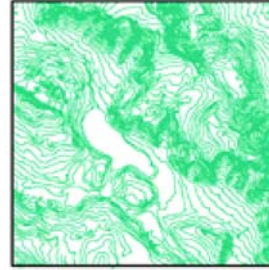
Manual digitising  
(on-screen or tablet)

Simple document,  
some interpretation is  
required



Semi-automatic  
digitising

Simple document, many  
lines, requires little  
interpretation



Automatic digitising

## On-screen Digitising

- Document pre-processing
- Scanning
- Map registration (or photo rectification)
- Digitising
- Attribute entry
- Editing

## Document pre-processing

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- Enlarge complex maps or use the original separates.
- Indicate the information ( points, lines, etc ) that should be recorded.
- Mark features using predefined colours and add feature codes.
- Indicate how features have to be generalised.
- Indicate reference points for the map registration.
- Reconstruct missing parts of features.

## Document pre-processing

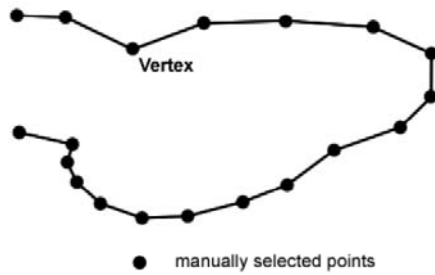
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**Every uncertainty on the map has to be resolved before digitising !**

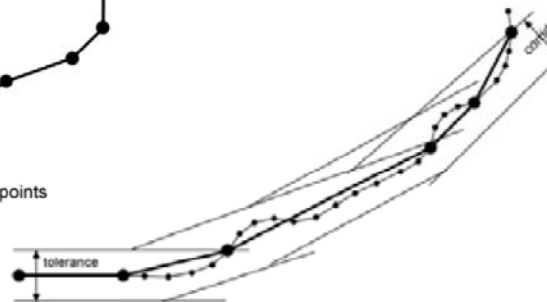
**Interpretation Model**

## Point and stream mode digitising

### Point mode digitising

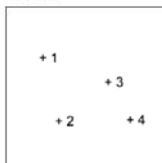


### Stream mode digitising



## Point, line and polygon features

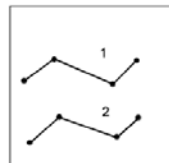
### Points



### Point number x, y coordinates

1	2,4
2	3,2
3	5,3
4	6,2

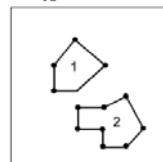
### Lines (Arcs)



### Line number x, y coordinates

1	1,5 3,6 6,5 7,6
2	1,1 3,3 6,2 7,3

### Polygons



### Polygon number x, y coordinates

1	2,4 2,5 3,6 4,5 3,4 2,4
2	3,2 3,3 4,3 5,4 6,2 5,1 4,1 4,2 3,2



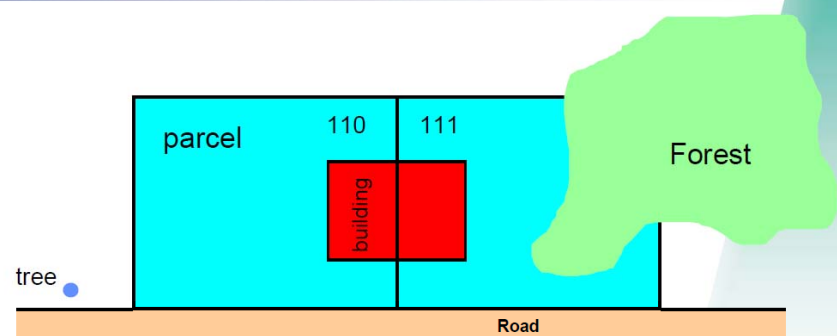
## Basic digitising rules

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- Every line should be digitised only once
- Avoid undershoots and overshoots

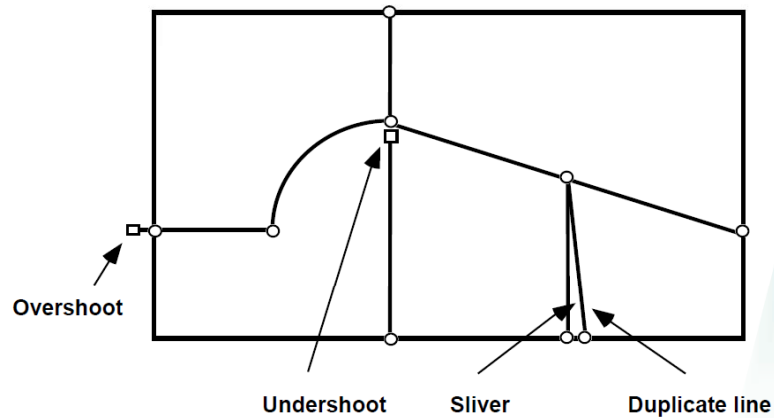
## How to digitize?

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Every line should be digitised only once !

## Undershoots, overshoots, etc

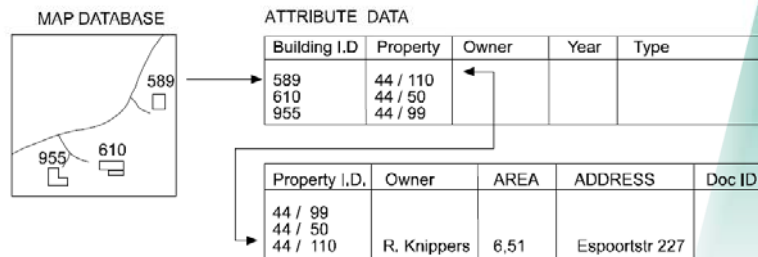


## Digitising strategies

- Digitise all polygons as lines and construct the polygons from the lines.
- Digitise the simple polygons as polygons (e.g. individual buildings or land use) and the complex polygons (e.g. roads) as lines.

**What strategy to follow?**

## Associating attributes to features



Additional attribute information may be entered into relational tables.

An identifier addresses the attributes to the positional data

## Corrective editing

### ● Positional errors

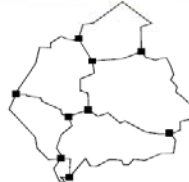
- blunders
- inaccurate tracing
- aesthetical errors

### ● Attribute errors

## Corrective editing



I Spagetti data



II Spagetti data ( cleaned )



III Polygons



IV Topology

## Scanning of map document

***On-screen manual, semi-automatic  
or automatic digitising***

***Source documents have to be scanned !***

## Scanner types

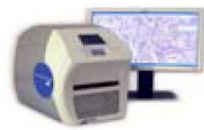
Hand scanner



Flatbed scanner



Drum scanner



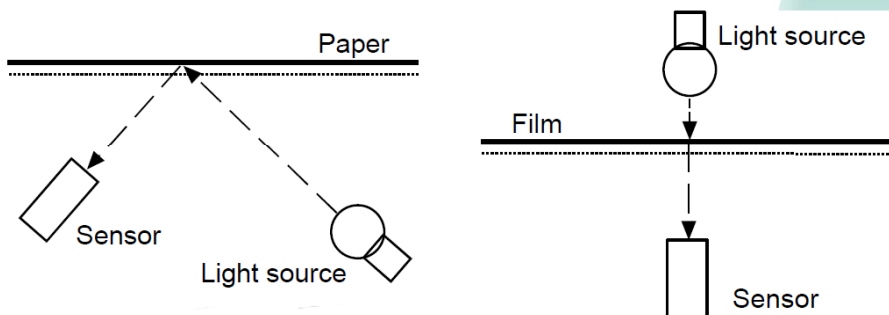
Sheetfed scanner



Slide scanner

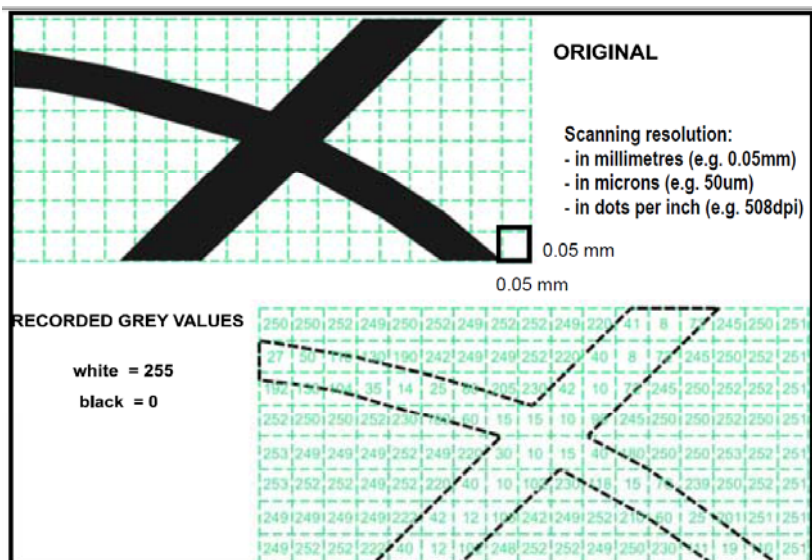
## Working principle

A digital scanner illuminates a to-be-scanned document and measures with a sensor the intensity of the reflected (or transmitted) light

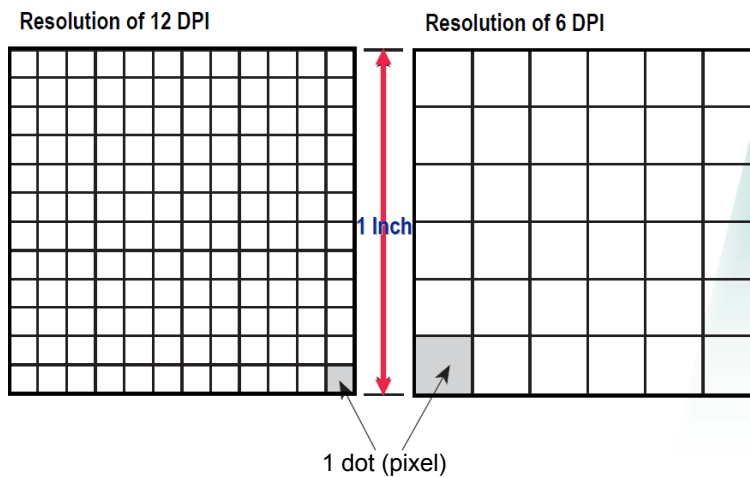


## Set-up scanner

- mount document on scanner
- check the communication
- set up the scanner resolution ( dpi )
- define other parameters ( e.g. scanning mode )
- make a proof scan



## Resolution in Dots Per Inch (DPI)

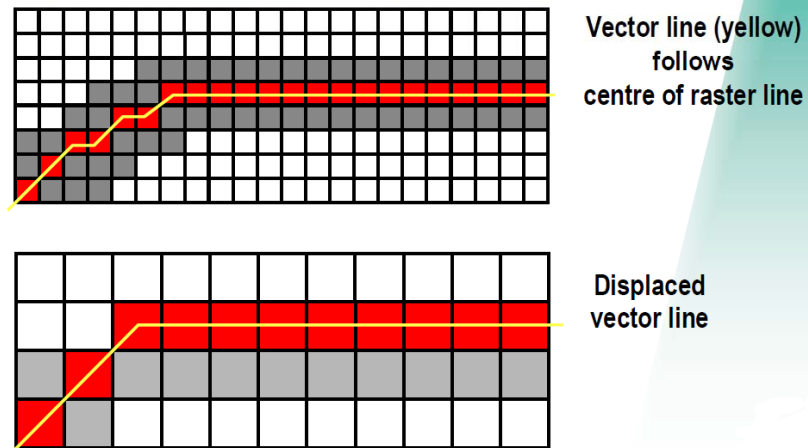


## Scanner resolution (pixel size)

*Minimum required resolution depends on the details in the map and the digitising technique !*

- 200-300 dpi for **manual on-screen** map digitising
- 300-600 dpi for **semi-automatic** or **automatic** map digitising (at least 1/3 of the thinnest line)
- 800-2400 dpi for **photogrammetric** applications

## Vector line displacement



## Scanner output

The scanner output is only a digital copy of the source document in raster cell values

👉 *Data are NOT structured into classified and coded objects*

To obtain this, the data have to be vectorised and further structured

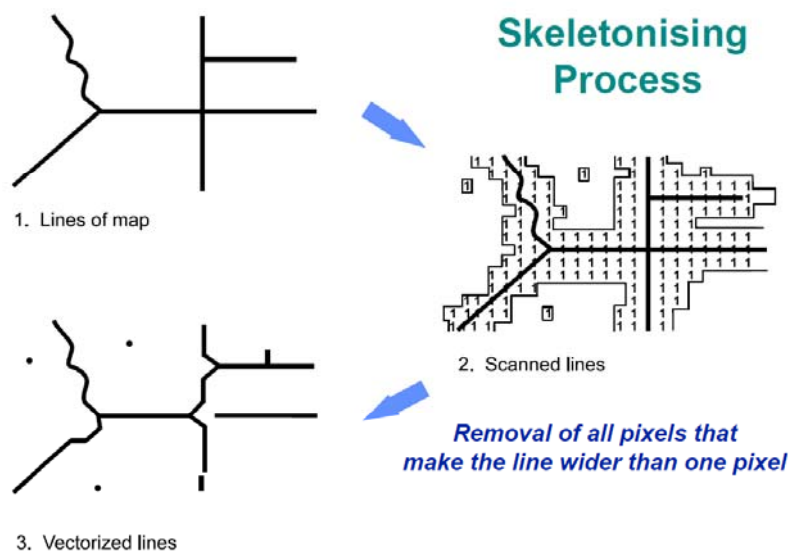


## The vectorisation process

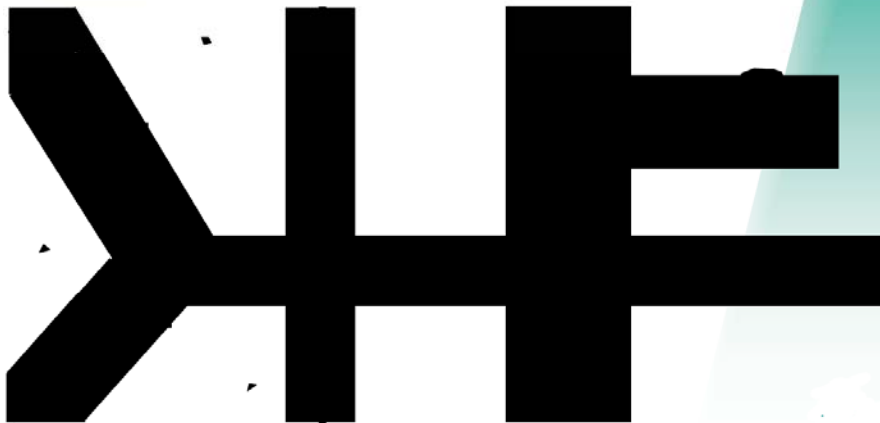
### The conversion from raster to vector

Step 1. **Skeletonising**

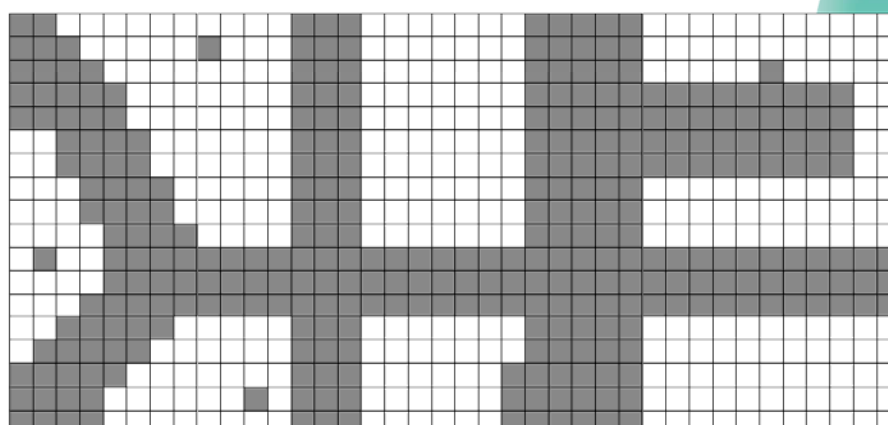
Step 2. **Feature forming**



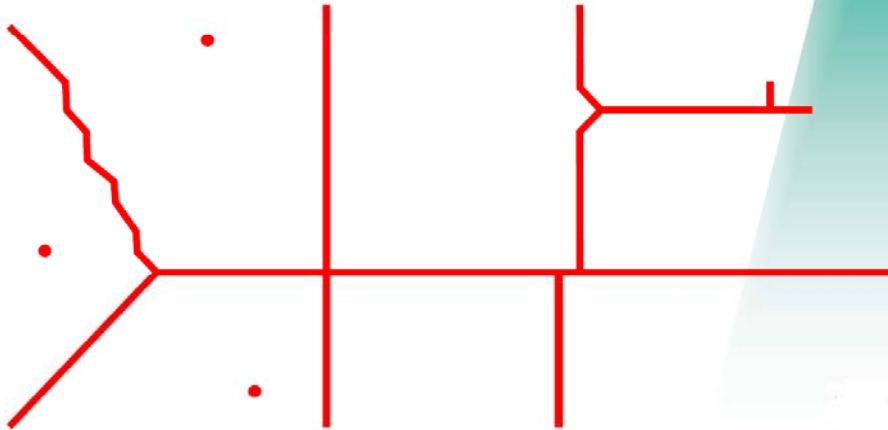
## Original line work



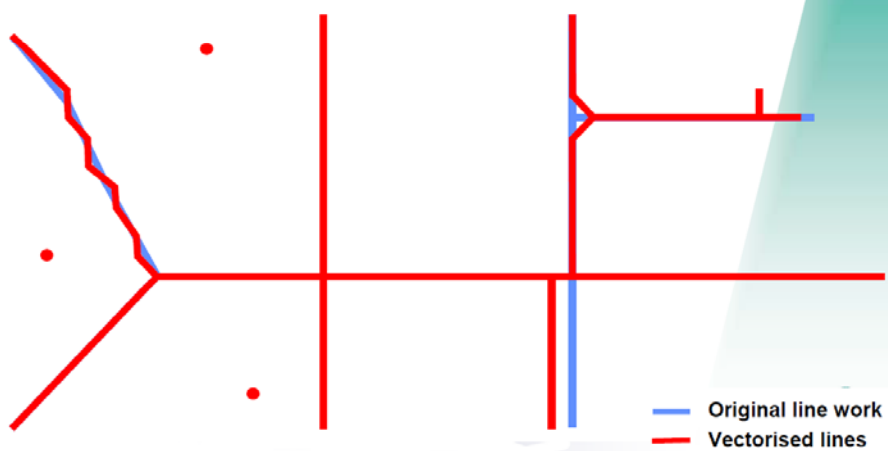
## Scanned line work



## Vectorised lines



## Comparison original and vectorised line work



## Vector editing

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Tools are developed to avoid bumped lines by looking ahead how the lines are followed. Conventional skeleton algorithm detects the centre of the scanned lines. This causes bumped lines in certain cases.

To look ahead how the line follows bumped lines can be avoided !

## Vector editing

Aesthetical corrections

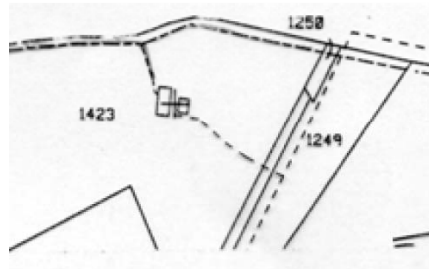
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### Corrections in the vector mode

- establish T and X junctions
- establish sharp corners
- orthogonalisation of buildings
- eliminate small lines
- smooth lines

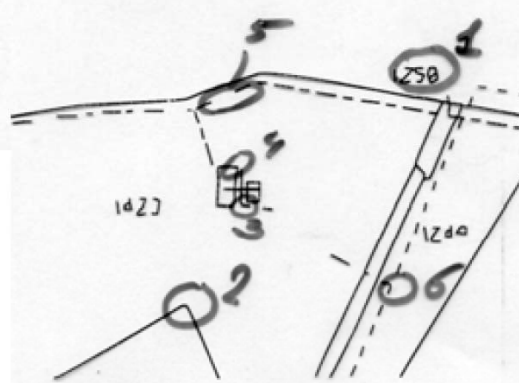
## Vector editing

Aesthetical corrections

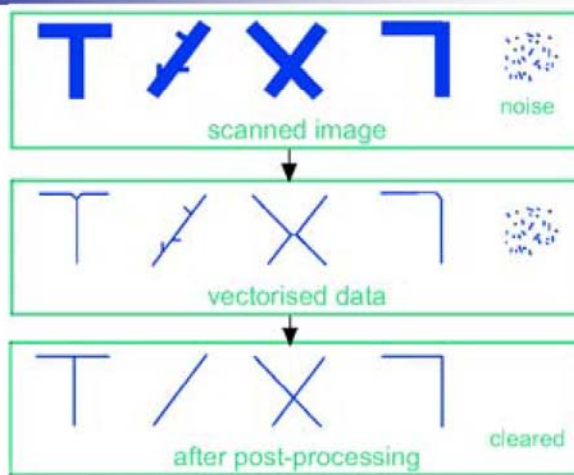


Original document

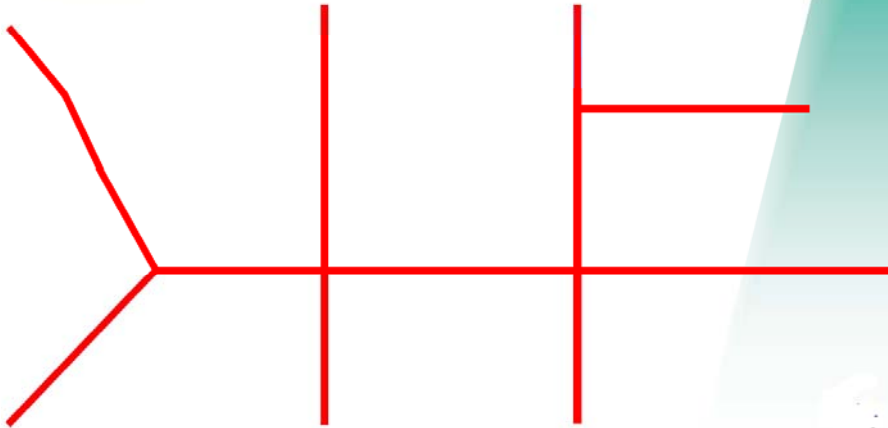
Scanned and vectorised document



## Vector editing



## Vectorised lines (after vector editing)



## Feature forming

- Splitting lines to form line segments and nodes
- Joining line segments to form polygons and features
- Feature coding

## Feature coding

- color detection
- pattern recognition
- line width detection
- semi-automatic or manual coding

## Vectorised lines (after vector editing and data structuring)

