SEMI-MANUAL DESIGN SUPPORT FOR INCREASING RAILWAYSTATION CATCHMENT & SUSTAINABLE TRAFFIC ROUTING

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ABSTRACT

The shape (‘configuration’), location and direction of the pattern of potential trips by foot or bicycle can help decision makers and designers:
- the shape of such a pattern informs about the potential size of a traffic calming area (such as 30Km-zoning),
- the location of such a pattern refers to the user-groups and specific destinations that a urban network should bring in safe reach for dictated groups,
- the direction of such a pattern, together with shape and location, points to the best routing to raise the Sustainable Traffic Modal Split or to improve the reach of destinations like a railway-station.

The patterns can be generated from zip-code’s of user-groups with obvious and daily destinations (school-children, rail-passengers). The next step confronts the theoretical pattern with the layout of streets and the traffic flow, mapping or listing (potential) confrontations between cars and the non-motorised modes, a basis for economical investment in traffic-safety.

A design can ‘model’ the analysed pattern(s) to a economic, direct and safe base (cycle or pedestrian) network. In co-operation, the Dutch the traffic consultant “Verkeersadviesbureau Diepens & Okkema” in Delft, The Netherlands and the Faculty of Architecture, Delft University of Technology, in Delft, The Netherlands, developed the semi-manual design & decision support system “STAR-Analysis”
“STAR-Analysis” proved to be a handy tool for the planning of cycle-networks for Heerenveen, Drachten and Best. It also gave information about the pedestrians-flow as used to forecast the economics of a proposed shopping-mall at Amsterdam Central Station.

STAR-Analysis runs in MiniCad on Macintosh because of the powerful capabilities of this combination with graphics and maps.

MiniCad allows Pascal-written MACRO’s to enter addresses and manipulate data towards routing.

The uniqueness and intricacy of urban structures makes fully automatic MACRO’s unwieldy. The benefit of the ‘semi-manual’ STAR-Analysis and design-process is the structural insight designers get of the local situation.

1 INTRODUCTION

1.1 Resolving the conflict: function and form of urban layout versus personal mobility and motorised traffic

The development and quality of urban areas is influenced strongly by the contributions of traffic consultants and town planners. Traffic management focusing on aspects such as mobility, links and intersections, connectivity, throughput, capacity and speed, leads to the creation of town plans based on ‘networks’. The shape, organisation, ‘feeling’, and value of public spaces, the ground ownership, and associated decision-making processes, regulate the built fabric of the town and open spaces which can be seen in the town ‘layout’. The summation of ‘networks’ and ‘layout’ are recognisable as the town structure and provide essential information about the conflicts within public space.
Too often the two elements (traffic) network and (functional) layout are not planned with sufficient consideration for each other. This has consequences for the efficient functioning of the traffic network, most noticeable traffic congestion and parking problems. Just as important, however, is the disruption of the functional layout, which manifests itself in traffic nuisance and pollution, isolation (traffic barriers), causes accident statistics, and a loss in spatial orientation.

Figure 2: **Congested TRAFFIC NETWORK versus eroded function and harmony in the TOWN LAYOUT**

Parking and congestion in the TRAFFIC NETWORK  
Erosion of liveability, mobility, and function in the TOWN LAYOUT
1.2 Star Analysis as a tool to communicate disparate interests

In order to bring a sense of equality into the analysis of the conflicting interests represented by NETWORK and LAYOUT, a method of visual presentation is needed that allows a balanced view of the requirements of both parties. The 'interests' that need to be represented visually can include vulnerable 'purposes' such as safe journeys to school, or a direct route to the rail station. Interests like living area environment, and spatial perception and recognition, are also important aspects to be considered, despite their intangibility. The various and variable interests need to be brought together with the more simple to determine "traffic" interests such as journey detours, and motorised journey time losses.

The increased supply of digitised map material and Geographical Information Systems offers the possibility of visual determination and presentation of these interests, but the challenge is to treat the interests equally, and find ways to determine the spatial nature of many of the 'less tangible', or 'difficult to quantify' interests.

Figure 3: After deciphering the complex spatial patterns using Star Analysis, spatial function and journey purpose information can be visualised more clearly and used to determine required infrastructure.

[Diagram showing desired pedestrian journey patterns (residential catchment) plus desired cyclist journey patterns (conflict-free area) equal to extent of daily activity for non-motorised transport]
2 ANALYSIS

2.1 Technique for presenting spatial requirements of urban mobility and neighbourhood functionality

Having determined that the spatial requirements of mobility (particularly motorised transport) and neighbourhood functionality often conflict, the technique to achieve balanced consideration has to be developed. The visual presentation of the desire patterns can lead to a concept plan for a sustainable urban traffic system.

Star Analysis in the broadest sense, can be defined as a method to determine desired journey patterns from known (or assumed) origins to (public)destinations. In the sense that it is being used at present, it can be more narrowly defined as a method to determine desired journey patterns for non-motorised transport, within particular user groups. The method assumes that the journey from the origin to the destination is direct. Because the information source is journey motive and therefore destination-based, the resulting patterns
resembles 'stars' around various destination locations within the town LAYOUT. There is NO account of the NETWORK taken in the first stage.

The following phases in the determination of the optimum network can be distinguished:

1st. Locating ORIGIN points of non-motorised traffic and main DESTINATIONS
Straight lines are created between the particular origins and destinations, for a particular group of users. This indicates the extent and direction of the cycle relationships. These desire patterns can be regarded as an abstract picture of expected movements, without considering the actual infrastructural nature of the existing road network.

2nd. Development of the theoretical routes:
The first criteria in route development is the shortness of the route and the second is quality (for the cyclist). The principles of a route are that it is continuous, direct, attractive, safe and comfortable. The STAR assumes the straightest route, but the most direct non-motorised routes have to be determined allowing for existing and potential NETWORK.

CONTINUITY:
On the basis of the stars, theoretical corridors can be identified where existing and potentially high-use routes should be situated. It is important for investment, and good NETWORK use that the route network is concentrated as much as possible on a small number of high quality, well-used routes, called primary routes.

DIRECTNESS:
The journey chain is only effective when the distance between origin and destination is minimised. Detours or traffic light delays are not tolerated by cyclists, leading to potentially dangerous situations (often highlighted by accident statistics).

SAFE: The use of 30 km/h zones, within which marked routes are less necessary, reduces the length of marked cycle routes required, and therefore the need for traffic calming measures, because only gateway treatment is required.

3rd. Bundling and optimisation of the routes
Collecting all the desire lines together, referred to as 'bundling', gives a picture of the route sections that offer the most potential for promoting cycle traffic, and also the sections of the network that need to be given special consideration before the network is realised. Using the routes defined per user group and type of destination, the optimum concept network is built up for each group.

Final phase
The network is then tested for:
- The realisation of the shortest connection (EFFICIENCY of NETWORK);
- The (social/public/traffic) safety for the cyclist & pedestrian (CONFLICT);
- The well functioning of the residential areas (FUNCTION of LAYOUT).

If a pedestrian or cycle network is created along the lines of ad hoc investment at known blackspots instead of a Base network, then cycle use will not increase because there will still be (major) missing links in the journey chain.

Figure 5: Base Network developed from User-Group Patterns

"Star-Pattern" of a specific "User-Group"

Star-Pattern based development of theoretical routing (group specific)

Star-Pattern based intensity of LAYOUT & NETWORK use (or design)

3 PRACTICE

3.1 Modifying the concept: Railstation- & Centre Catchment

STAR-Analysis has been used primarily to ascertain the routing for cycling facilities within an integrated approach to urban traffic management. However there has been a need to adapt the technique to other situations. Station catchment for cyclists, and station infrastructure for pedestrians are two such examples.
It is a common belief that all stations have the same potential catchment area. In reality the real catchment of a station is reduced by the time lost during the walk or ride to the entrances of main (rail) transportation. This is a function of the NETWORK not efficiently providing for the functioning of the LAYOUT.

This has consequences for the nature of the station catchment. The optimum pedestrian station catchment has a radius of one kilometer. Commuters do not travel more than 15 minutes to get to a (light/rapid transit) rail station. Cycling at an average of 18 km/h, and being able to take 'shortcuts' or use 'radial' routes to a station in the Base Cycle Network is an essential element in increasing the catchment of main destinations. STAR-Analysis can help to determine the routes with the highest potential cycle use, and intersections where specific measures are required to ensure the fastest and most direct, safe route to the station.

Figure 6: Economical REGIONAL LIGHT RAIL needs the support of “User-Patterns” based local (radial) CYCLE NETWORKS

3.2 The case “Cycle-commuter Town Houten”

The case ‘Cycle Town’ of Houten proves that a ‘car-poor, direct and traffic-safe cycle network without delays (often caused by traffic lights) is attractive to station-commuters and other users.
Figure 7: The car ring road of Houten around the station-oriented safe and direct ‘radial’ Base Cycle Artery as spie of a large 30 km Zone (3.6 x 1.8 km), changes the average car commuting distance to this Rail-Station and the adjacent Local Centre, from the standard optimum of 600m to Catch Area of “X” = 1800m.
3.3 The case “Shopping-Mall Amsterdam Central Station”

STAR-Analysis proved to be a useful tool for providing information about the very complex pedestrian flow to the Amsterdam Central Station.
STAR-Analysis was successfully used to forecast the best location and a first survey of the economics of a proposed shopping-mall under Amsterdam Central Station.

In the case of Amsterdam station, STAR-Analysis was also used to determine the conflicts of NETWORK and LAYOUT within the station itself. Information regarding origins was deduced from passenger, pedestrian, and cyclist prognosis for each of the transport types in and around the station (rail, metro, bus, and tram), and car intensities along the north side of the station for the purposes of conflict analysis. STAR-Analysis determined the pedestrian patterns generated by these purposes, and indicate conflicts for:
- the pedestrian groups for the variants of the plan (station hall and corridor capacity problems);
- cyclists (permitted parking space, and routes into and around the station);
- and motorised traffic using the north side of the station (a function of LAYOUT and NETWORK conflicts).

The diagrams included in Appendix 2 were generated for the various users and flows.

3.4 Specific characteristics of the technique

STAR-Analysis runs in MiniCad 3.1+ on an Apple Macintosh computer because of the powerful capabilities of this combination with graphics, maps and a database. MiniCad+ has the potential for Pascal language MACRO’s to be written so that address (origin) information can be manipulated and provide visual data for determining optimum route networks can be.

The operators in the database allow the data to be quantified, and visually represented. This includes a calculation of the intensity of use of a bundled route; the analysis of (existing infrastructure based-) route deviation from the star pattern (most direct 'route' to the destination); and the quantification of conflicts of potential cyclists with the main car routes.
(see Appendix 3)
4 EVALUATION

4.1 Positive aspects

Nature of spatial information (shape - location - direction)
User group characteristics visually presented using Star Analysis allow the shape, location and direction of the pattern of potential trips by foot or bicycle to be determined. This can help decision makers and designers in the following ways:
- determining potential shape and size of a traffic calming (e.g. 30km-zones), or car-free area;
- the location of such a pattern refers to the user-groups and specific destinations that an urban network should bring in safe reach of certain groups;
- the direction of a pattern, together with shape and location, points to the best routing to raise the Sustainable Traffic Modal Split or improve the catchment of a railway-station.

The potential for LAYOUT and NETWORK conflict analysis
The planner can identify and define levels of vulnerability and acceptable level of confrontation with other users. Potential routes for special treatment in the conflict analysis can be determined. Understanding the requirements of the users means that planners can identify measures for certain situations. Stations with frequent, high quality public transport attract cyclists in the users groups 'employees', and 'pupils/students' among others. A route to such a point needs to satisfy all the design concept demands of all the groups.

Quantification of interests
The macros allow a quantification of the interests and potential conflicts of the users with each other. Police statistics can highlight accidents black-spots, but they are only the objective reality. The subjective and potential danger of any part of the network can be determined by the (Star Analysis) technique.

Efficiency in investment
An economic, and safe (cycle or pedestrian) network instead of ineffective ad hoc measures.

Flexibility in the design process
The uniqueness and intricacy of urban structures and journey patterns make fully automated MACRO's unwieldy. The benefit of the 'semi-manual' analysis is the insight designers gain about the local situation and the flexibility they have to consider various options.

Spin-offs
The application comprises macros which operate independently of one another. Although they refer to specific database record and field names, they can be fairly
easily adapted to new situations such as Amsterdam station. Some macros have been set aside in a library for generation of patterns from the route stage (i.e. visualising 'flow' information for non-motorised traffic) without creating the 'stars'.

4.2 Negative aspects

Time consuming
The current application requires significant input in the translation process from specific origin information into the computer database and generation of visual patterns concerning:
  a) postcode information and '100 house' data
  b) creation of route vectors

Not repeatable
Each new study requires new spatial information and data.

5 CONCLUSION, RECOMMENDATIONS, REQUEST

Star Analysis in it's present form using MiniCad+ is a useful tool for designing sustainable traffic and transport solutions. The future of this package depends on the availability and suitability of other hardware and software combinations.

The improvements required of a different approach, or hardware/software combination involve better translation or importation of the source data, and better compatibility with other sources of computer information. Some of the macros could be significantly faster, and make more efficient use of computer time and user input.

However, the software consultants (Macad Consult) no longer works with this version of the software and it's language, and there are no financial resources for a restructure at this time. Developments in the GIS world might provide a new solution, perhaps in DOS, and as of March 1996 there was an internal discussion taking place along these lines.

It would be appreciated if any other workers in this field would make themselves known to the authors, as further discussion could be of great benefit (please contact B. Bach; TU-Delft, POB 5043, NL 2600 GA Delft, The Netherlands or phone #31-15.578.4146 / FAX #31-15.578.3694).
REFERENCES


APPENDICES

Appendix 1: Post-Code based user-pattern of Amsterdam Central Station

Appendix 2: Theoretical 16h00-18h00 shopping time routes in the Amsterdam Central Station and on the Station Square
Appendix 3: Current STAR-Analyses technique using semi-manual database manipulation theoretical desire-lines from the centre of Postal Codes to the User-Group destination

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Appendix 4: A typical ‘MiniCad’ macro

procedure GiveMeMyPeople;
var
  TreeLay, TextLay: string;
  LCnt: Integer;
  theLocs: array[1..2, 1..500] of Real;
  thePeople: array[1..500] of string;
function GetTheHandles: Boolean;
var
  aStr, bStr: string;
function GetMyLayer (ActStr: string): Handle;
begin
  Message(ActStr);
  DoMenu(MLayers, NoKey);
  ShowLayer;
  GetMyLayer := ActLayer;
end;
function CheckLines: Boolean;
var
  TreeHdl: Handle;
  i: integer;
  myHths: Real;
begin
  Layer(TreeLay);
  CheckLines := True;
  Message("Controleer routelaag ....");
  TreeHdl := FActLayer;
  i := 0;
  while TreeHdl <> nil do
  begin
    if (GetType(TreeHdl) <> 2) then
    begin
      Message("Er staan ook andere objecten dan lijnen op deze laag ?");
      CheckLines := False;
    end;
    TreeHdl := NextObj(TreeHdl);
    i := 1 + i;
    Message(("ConCat(">Ben bezig met route ", (Num2Str(0, i)), ", ")");
  end;
end;
function CheckText: Boolean;
var
  myH: Handle;
begin
  Layer(TextLay);
  Message("Controleer tekstlaag ....");
  CheckText := false;
  myH := FActLayer;
  if myH = nil then
  begin
    CheckText := true
  else
    ADirDialog(Yo I De tekstlaag is niet leeg , dat is erg onhandig !)
  end;
end;