

# The benefits of visualization - how to eXplore a municipality

Haldorson, Marie  
Statistics Sweden  
701 89 Örebro, Sweden  
E-mail: [marie.haldorson@scb.se](mailto:marie.haldorson@scb.se)

Andersson, Jonas  
City of Gothenburg  
Gothenburg, Sweden  
E-mail: [jonas.andersson@cityhall.goteborg.se](mailto:jonas.andersson@cityhall.goteborg.se)

## Introduction

The purpose of this paper is to describe how the municipalities may benefit from using visualization in the planning process and when sharing knowledge within the municipality. As municipalities in different countries may have different prerequisites, a short overview of the local government in Sweden and the role of the Swedish municipalities give the necessary background. After that the outcome of a project that was carried out in 2009 with participation from three municipalities, Linköping University (National center for Visual Analytics, NCVA) and Statistics Sweden, SCB, is described. Two examples show the use of visualization in the municipality of Linköping, a participant in the project, and in the city of Gothenburg, that use visualization in a blog about sustainable development. The recent developments at Statistics Sweden conclude the paper showing how the Statistics Atlas may support municipalities and others interested in analyzing statistics on municipality level.

## Municipalities in Sweden

Sweden is divided into 290 municipalities, 18 county councils and two regions (Västra Götaland and Skåne). There is no hierarchical relation between municipalities, county councils and regions, since all have their own self-governing local authorities with responsibility for different activities. Local government has a long tradition in Sweden. The country's municipalities, county councils and regions are responsible for providing a significant proportion of all public services. They have a considerable degree of autonomy and have independent powers of taxation. Local self-government and the right to levy taxes are stipulated in the Instrument of Government, one of the four pillars of the Swedish Constitution.

Municipalities in Sweden are responsible for a large number of tasks: social welfare, incl. childcare, geriatric care, financial and other aid to individuals and families, public school, incl. compulsory school and upper secondary school, city planning, environment and health protection, garbage collection and street cleaning, emergency services and water and sewage systems. Municipalities also deal with leisure and recreation, culture, housing, trade and industry. To deal with all those tasks the municipalities need a lot of statistics and Statistics Sweden is the main provider of these statistics, to a large extent based on different registers allowing detailed information for small areas.

A lot of subjects may be described on a detailed geographic level, the municipalities use a division called key-code areas that is hierarchical and divide the municipality in areas useful for planning purposes - from subcity districts down to blocks. Most municipalities access the statistics needed by a database on the web and that way have a large amount of statistics, but perhaps not a good tool to analyze and visualize the data.

## The outcome of a project with three municipalities

In 2008 the visualization tool Statistics eXplorer, developed by NCVA, was presented to Statistics Sweden. We found it to be an interesting tool because of its many facilities for visualizing statistics, as we at this time was looking for a good tool primarily for maps. Statistics Sweden has worked for many years with data on maps and statistics on small areas. Statistics eXplorer includes other powerful facilities like scatter plot, parallel coordinates, table lens and more. Illustrating relations between variables and values became

easy.

Together with the university Statistics Sweden started a project on visualizing small area statistics. Three municipalities - Linköping, Norrköping and Karlstad municipality - were invited to participate. The project sponsored a master student, Jonas Thoursie, who was dedicated to the project and could carry out the proposals that were made - together with others in the team at NCVA.

There is one main difficulty in visualizing and mapping data on small areas and that is location, identifying the WHERE, which is the main reason for using a map in the first place. Location is not a major problem when mapping statistical data on areas as large as countries or even whole municipalities. On the wish list for further development of the application was therefore the possibility to show statistical data on a map with detailed background information. Another desired development was the possibility to show animated time-varying data, such as that found in the GapMinder application.

The idea was that municipalities should have their own application, covering the area of the municipality, running on the municipality homepage and in local web servers. Furthermore, the municipalities should be able to create and maintain their own eXplorer applications, with as little support as possible. This demanded a function that could be used to create an eXplorer application, an "eXplorer Wizard", and thus make it possible for a municipality to build eXplorer applications. In the Wizard you locate where your map and data files are stored and which elements (scatter plot, time animation and so on) that you want to include.

There were a number of results accomplished during the project, and today these functionalities are included in the geospatial family of eXplorer: an optional background map was included, time animation was introduced and an eXplorer wizard, used to create Statistics eXplorer applications, was developed and tested. The project showed that it is possible for the municipality planner with a little IT-support to make a tailor made application displaying some of the large amount of statistics that the municipality has access to. The real challenge is to create interesting stories about the statistics and also to get a good routine for updates, both of the data and of new versions of the tool.

### **Outcome of the project - the example from Linköping**

Linköping municipality has used the Statistics eXplorer after the project and created a website with a number of illustrative stories connected to different topics: <http://www.linkoping.se/Om-kommunen/Fakta-om-Linkoping/Statistiska-fakta-om-Linkoping/visualisering/>. The municipality planner Jimmy Lindahl has published three different eXplorer versions on their website: one showing the development in the municipality on subcity district level, one showing the election 2010 results on electoral districts and one showing the development in the county on municipality level. All three versions have the use of stories in common; this way it gets easier for the users to know what interesting patterns that the statistician has discovered.

A challenge for the municipality planner is to communicate how to interpret statistics and population trends in dialogue with the politicians. In Linköping the use of visualization has increased the shared knowledge and by looking at what might happen if the population trend comes true it is easier to be prepared and to make knowledge based decisions. By combining statistics in new ways interesting conclusions may be drawn about the diversity of the municipality - for instance why some districts perform below average in almost every way.

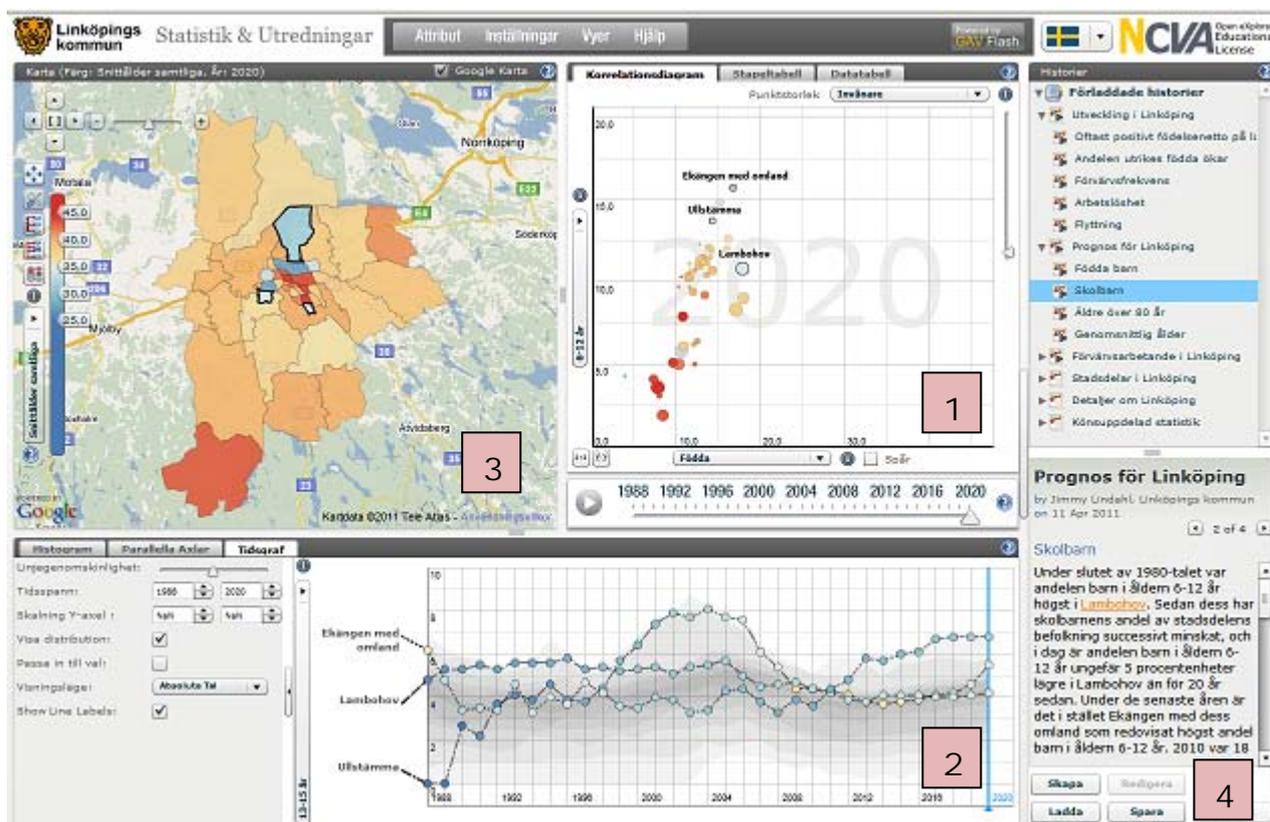


Figure 1: Linköping eXplorer, population trend on subcity district level.

By combining time series and population trends Linköping has created an animation covering more than 30 years, Figure 1 - no 1. Often it's the use of more than one diagram/map simultaneously that creates an increased understanding of a phenomenon. When looking at time series a good way is to show both the **scatter plot** and get the relation between two variables together with the **time graph** - which may show one of the variables from the scatter plot, or an additional variable as shown in Figure 1 - no 2.

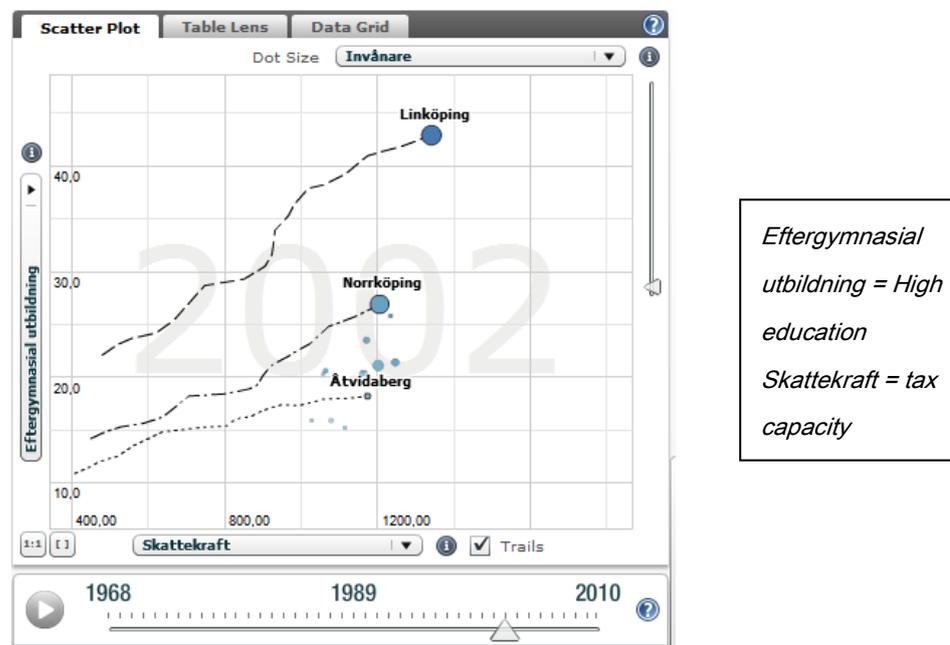
To look at territorial patterns the **map** is also necessary and when presenting statistics on detailed level of a municipality the background map is essential. The choropleth maps created in the visualization tool is possible to have with "full" colour, or with an opacity that allows the background map to show beneath the colours. In the example shown in Figure 1 - no 3 some details from the background map is visible, to help the viewer to know where the subcity districts are located.

The last component is the **story**, giving the user a prepared analysis made in this case by the municipality planner, Figure 1 - no 4. In the story it's possible to highlight important findings and to draw conclusions from the pattern that evolves when playing a time animation or when looking at selected districts. This is a very good way for the planner to use his/her skills in statistics and in the local context to bring the statistics from numbers to knowledge. By describing all the components used to support the story (population trend for newborn, children of different age groups and average age), giving some background and comments on how the population trend may effect different districts the story is the last piece of the "visualization jigsaw".

Stories might work both as a description of what the planner wants to highlight and as a starting point for the reader to make discoveries of their own. What happens if I change one of the variables? Why does the trend look different if I choose another variable? By looking at a time animation step by step (year by year)

you might find interesting turning points and need to explore the dataset for possible explanations.

One experience from using time animation in Linköping is that you need to be careful with the animation and not try to illustrate too much at the same time. It might be very powerful if you choose some variable that supports the development over time, like tax capacity which increases steadily over time. In this way when looking at the time animation you may focus on the development of just one variable, which is easier to grasp, Figure 2.



*Figure 2: Linköping eXplorer, time animation using tax capacity to support the development over time and making it easier to focus on the increase of people with high education level in some municipalities.*

In the story published together with this time animation some interesting facts are highlighted: the two largest municipalities in Östergötland county Linköping and Norrköping have a totally different profile when it comes to population with high education, which also reflects the history of these two municipalities. By the end of 2009 Norrköping had reached the level that Linköping had already back in 1997 (32 percent of the population 20-64 years with high education). Even if there is a transition going on in Norrköping it takes time and it's a long way to go before they reach the same level as Linköping.

### **Bringing a 'wow' into urban planning - the example from Gothenburg**

The City of Gothenburg was early to discover the benefits of visualization and has been a user of Statistics eXplorer since 2009. Unlike Linköping the use in Gothenburg has focused on the possibility of publishing stories directly on webpages, so called Vislets.

#### **URBAN SYSTEMS 'TAKE THE STRAIN'**

Stakeholders in society acknowledge more and more the need for an integrated approach in order to achieve sustainable urban development. Issues typically have many dimensions: economic, social, cultural and ecological. Attention also needs to be paid to scale, from very local to global challenges. This introduces a further dimension – governance.

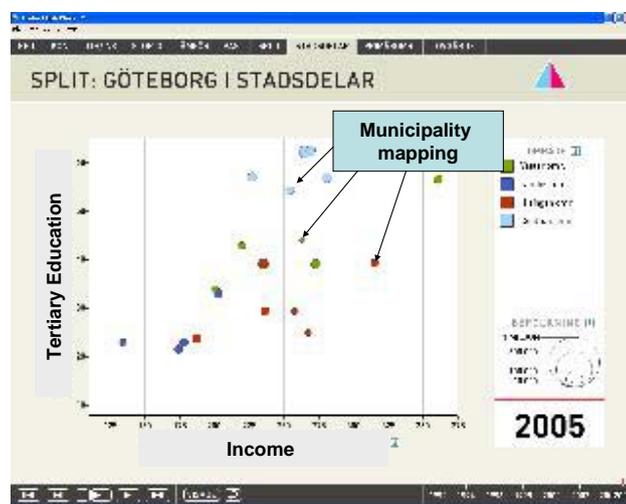
A key challenge for urban planners and statisticians in this regard is not a lack of data, but rather how to illustrate, explain and explore the extensive interconnectedness of the different dimensions of sustainability. In a world where we expect more performance from typically aging urban infrastructures, and constrained resource, a deeper level of understanding is needed.

The Urban Analysis and Statistics unit at the City Office in the City of Gothenburg, Sweden, concluded several years back that the need for a common and holistic understanding could not be met by dense spreadsheets, lengthy reports or slides with three-bullet-points-summaries. A new approach was needed.

### PILOTING VISUALISATION OF URBAN SYSTEMS

A project was initialised with Professor Hans Rosling and the Gapminder Foundation where the global Gapminder tool was adapted and customized to the needs and conditions of a city. The result was a tool called Gotrends. It offered a dynamic and intuitive visualisation of large quantities of complex data, which then were made comprehensible, accessible and engaging. It introduced meaning to what previously was bland data.

Gotrends was primarily used to present the socioeconomic segregation between regions, municipalities and city districts over a time span of 15 years, Figure 3.

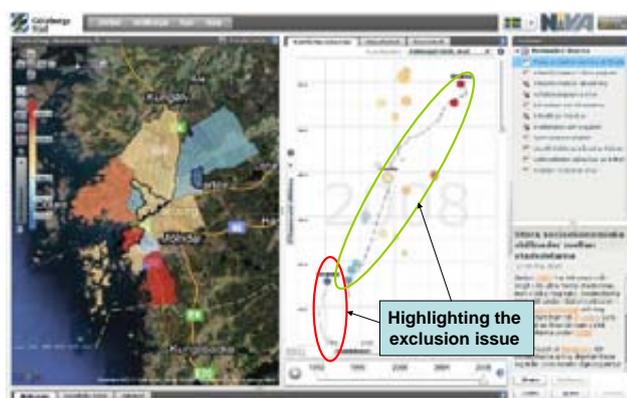


**Figure 3: Snapshot of Gotrends showing the socioeconomic segregation between city districts in 2005.**

The ability to relate two variables, income and education, to each other and animate them over time proved to be a successful pedagogic means for people to truly understand what they already had heard so often before, but had not seen so clearly shown. In the case of Gothenburg the segregation between city districts in terms of education and income was a major and growing problem. Visualization had that wow! effect, and this was a common reaction no matter if the audience was leading politicians or grammar school pupils. Gotrends became a powerful support for strategic discussions on sustainable development.

### DEVELOPING A ROBUST VISUALIZATION TOOL

The City of Gothenburg had assumed the role of a software developer of the urban visualization tool up until 2009, due to lack of suitable alternatives. This all changed with 'Statistics eXplorer'. This new tool included the functionality of Gotrends, and offered a number of additional features, notably geographical map layering, which added considerably to intuitive use and communications, Figure 4.



**Figure 4: A snapshot of Statistics eXplorer Gothenburg**

By the end of 2009 the City of Gothenburg was the first municipality that became an official partner to the National Center for Visual Analysis (NCVA) that is developing Statistics eXplorer. The city focused on becoming a skilled practitioner, providing Professor Mikael Jern's development team with collaborative and very real co-development opportunities.

#### TANGIBLE BENEFITS FOR GOTHENBURG

The Gothenburg Statistics eXplorer has received much interest. It is considered an exciting and promising tool for departments to share and combine data within the city. Data that before was confined at best to numerous spreadsheets is now easily available, compared and visualized online. The revelation that occurred when Gothenburg mapped municipality and district income and education levels highlighted the severe issue of exclusion, and had a significant impact on decisions on transport policy and programmes, and housing strategy.

Creating a common understanding and picture of this issue across departmental borders would have been much more difficult to achieve without the tool. Further correlations have been developed to inform planners on a number of scenarios like the ageing population in Sweden and its impact on the city, the relation between waste and the trade cycle or residents' satisfaction with their area's place.

#### PROMOTING CITY STAKEHOLDER PARTICIPATION

Making use of the vast quantities of public data that is collected in a more open way has offered Gothenburg a host of benefits – not least of which is the ability to engage the public in the process of developing their city. Statistics eXplorer offers a very effective communication tool to present urban development analysis, strategies and plans. In workshop consultations, the audience rapidly becomes involved in exploring possible correlations and engaging in reasons why trends appear the way they do.

Gothenburg city hall now publishes their urban development plans on-line in a far less complex and more accessible manner, enabling drill down by readers into areas they select of particular interest. Different modules of Statistics eXplorer have been integrated in the City of Gothenburg website – as such the city is pioneering. What used to be annual, lengthy printed reports concerning the development in the city can now be presented as an interactive blog: <http://www.samhallsutvecklingen.se> (English translation available). Users are able to interact with the dynamic map and diagrams, and are guided through the story by links that automatically change what is shown.

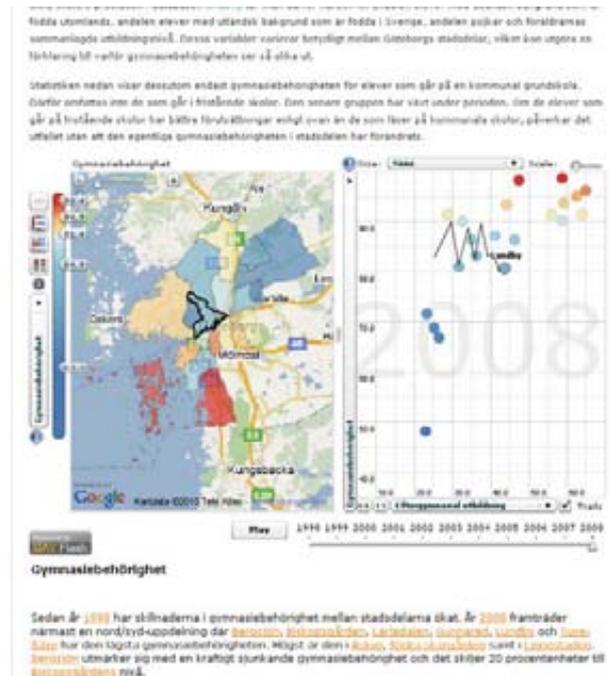


Figure 5: A snapshot of blog integration of Statistics eXplorer.

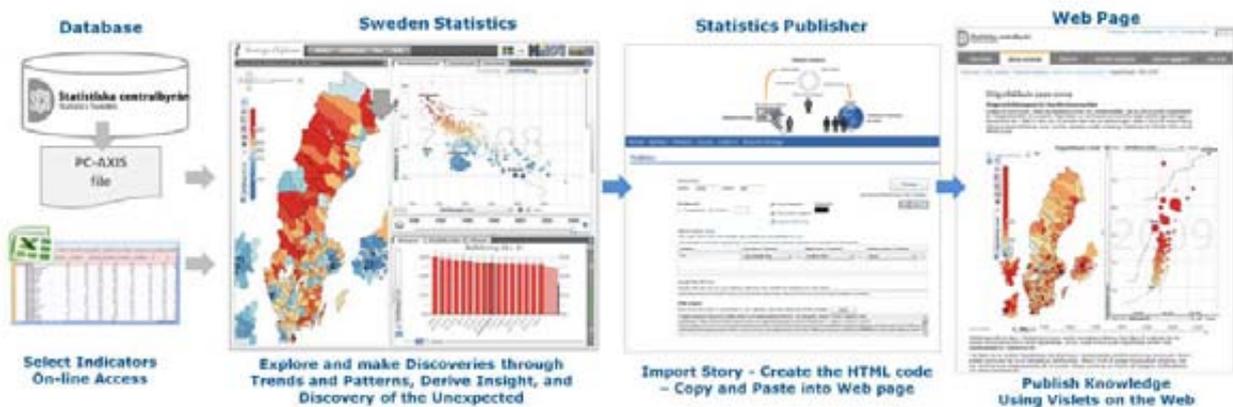
## MOBILISING EUROPEAN URBAN PLANNERS

The interest for eXplorer among urban planners is growing throughout Europe, partly due to the City of Gothenburg's prominent role as a pilot for the development of the pan-European Reference Framework for Sustainable Cities (RFSC). This new tool enables urban planners to swiftly correlate large numbers of time-series data sets, with the added benefit of geographical visualization. In many ways, they no longer need to know the precise question they want answered, as experimenting with eXplorer uncovers questions they had not previously considered. For instance: comparing healthcare statistics with sports and parks facilities; child demographics with school facilities; hospital emergency facilities with aging or other demographic groups. Such analysis provokes discussion. Urban planners can easily share stories and scenarios that they have prepared in eXplorer, as they develop new insights.

Statistics eXplorer takes urban analysis to a new level. It enables cities across Europe and beyond to employ the vast quantities of data that lie presently undervalued and underused to create new insights; to make smarter planning decisions; and to engage the public in shaping the destiny of their city.

## The Statistics Atlas may support the visualization in the municipalities

In 2010/2011 Statistics Sweden focused on implementing Statistics eXplorer on the website and now has a Statistics Atlas with municipality statistics covering a number of subject matter areas. As shown in the examples from Linköping and Gothenburg it's the more detailed subcity level that is most interesting to the municipalities, but comparisons of the municipality with surrounding neighbours might also be of interest. The Statistics Atlas contains of both the eXplorer tool and ready analyses published as Vislets directly on the webpage. As these analyses are made by subject matter experts in Statistics Sweden, they perhaps may serve as inspiration also for municipalities in their own analyzing work.



*Figure 5: The process from numbers to knowledge.*

The development of Vislets has been crucial for the decision to implement Statistics eXplorer at SCB. Vislets give the users not familiar with visualization and those who find the eXplorer too advanced a nice “snapshot” and a more extended story directly on the webpage. The Atlas is available on [www.scb.se/statistikatlasen](http://www.scb.se/statistikatlasen), use Google Translator for an English version.

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