



Project Document Cover Sheet

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Introduction

Data visualisation has been defined as:

The set of techniques used to turn a set of data into visual insight. It aims to give the data a meaningful representation by exploiting the powerful discerning capabilities of the human eye.¹

Part 1 of this briefing paper will highlight some examples of new collaborative web services using Web 2.0 technologies which venture into the numeric data visualisation arena. These *mashups* allow researchers to upload and analyse their own data in 'open' and dynamic environments. Broadly speaking the numeric data being referred to could be micro-data (data about the individual), macro-data² or country-level data, derived or summary data.

Part 2 will investigate and showcase examples of spatial (or geographic) data mashups using Web 2.0 technologies and how they can be utilised in a research environment.

This paper does not intend to conduct an investigation into the definitive merits of each utility but rather compare the functionality, 'openness' and usability of such utilities from the perspective of a researcher willing to share or analyse their data.

A word of warning - researchers will have to account for the inconstant nature of the web - resources such as those described above may not be around in two, five or ten years. Not only will there be further advances in web technologies but services merge, are bought out or indeed cease to exist. Services that start off open or free may become 'closed'. Resources may start up with a particular rationale but may evolve into a completely different service or resource. Thus it would be unwise for users to deposit the only copy of a dataset within such a utility, i.e. use it as an archive or trusted repository. Certain data held within such utilities may often lack any authority or obvious provenance. Indeed data deposited may well be open to edits and uses unforeseen by the depositor. Many issues regarding the legal, cultural and technical aspects surrounding the sharing and publishing of data produced from personal or academic research abound. This paper does not purport to find solutions but highlights possibilities!

Utilities covered

There is a range of proprietary and academic domain-specific data visualisation tools, such as Nesstar (social science), CODA Centerview (business intelligence), GGobi (high-dimensional data visualisation), Crystal Xcelsius (business data), Ferret (oceanography / meteorology), Giovanni (earth sciences), to name but a few. There are also *Open Source* utilities such as the Prefuse visualisation toolkit which is a set of tools for creating interactive data models, visualisations and animations.

The data visualisation tools described in this briefing paper can be regarded as *Open Data* utilities in that they retain the ethos of other 'Open' initiatives such as *Open Source* and *Open Access* by allowing anyone to upload or use the data. They are generally commercial services embracing a Web 2.0 business model in which users pay to access additional features such as keeping data private. The tools described here have emerged on the World Wide Web in the last two years, namely: Data360, Many Eyes, Swivel, Gapminder, StatCrunch, Graphwise.

Note: Gapminder World has been included in this paper because the interactive data features are to be included in the forthcoming version of the utility.



¹ Edinburgh Online Graphics Dictionary
<http://homepages.inf.ed.ac.uk/rbf/GRDICT/grdict.htm>

² See Appendix 1 for visualisation tools for macro-level or country-level data

Data360

<http://www.data360.org>

Data360 embraces Web.2.0 concepts of participation and collaboration 'to provide clear context on important cultural, environmental, social and economic issues'. By using 'collaborative trend tracking' Data360 allows organisations and users to create their own Data360 space, as well as to collaborate with others. The datasets held are predominantly aggregated and from the US, with sources including: *US Environmental Protection Agency, National Science Foundation, US Geological Survey, Gallup, Federal Reserve, US Census Bureau, US Department of Energy*. There are also datasets sourced from *the World Bank, United Nations, the World Factbook Transparency International*. The frequency of the datasets is mainly annual although some daily, weekly, monthly and quarterly data are also available.



Home
My Data360
Platforms
Easy Upload/Admin
?

Data Sets
Data Graphs
Graph Groups
Reports
About Data360

"Your Data Dashboard"

Data360 is a tool for any organization to collaboratively analyze and report on key metrics, in a private or public fashion. Applications include:

- business analytics and reporting ([click here for example](#))
- large-scale collaborative issue analysis
- providing context and clarity to important issues
- business intelligence databases
- coach/trainee relationships

Data360 has been created by the team at [Webster Pacific LLC](#), a strategy, research and financial consulting firm. [Click here for pricing](#). We welcome your feedback, as well as any data or graphs you'd like to see on the site. (Note that anyone can upload time-series data to our public site. [Click here](#) for our easy upload.)

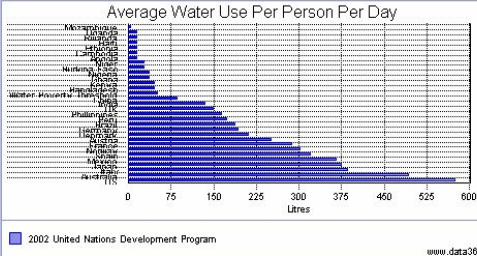
Sincerely,

Tom Paper tom@data360.org

(Use of this site implies acceptance of our [Terms of Service](#) . Patent Pending.)

Featured Graphs

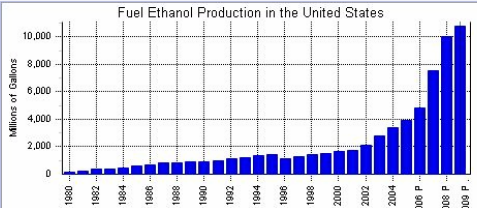
Average Water Use Per Person Per Day



2002 United Nations Development Program

[www.data360.org](#)

Fuel Ethanol Production in the United States



Featured Reports

	Name	Slideshow	PDF	PowerPoint	Platform
1.	Chart of the Day	Slideshow	PDF	PowerPoint	Data360
2.	S&P/Case-Shiller® Home Price Indices	Slideshow	PDF	PowerPoint	Data360
3.	US Education Overview	Slideshow	PDF	PowerPoint	Data360
4.	US Union Overview	Slideshow	PDF	PowerPoint	Data360

Data360 spaces can be built for free, as long as users are willing to a) share all their data openly and b) potentially (although not in the current version) have small advertisements on their pages. For those who want the software and access to the public data on the site, but still want to keep their data private, the software is available for a fee.

The screenshot displays the Data 360 interface. At the top, there are navigation tabs: Home, My Data 360, My Favorites, Easy Upload Admin, and Help. Below this is a search bar and a 'Data Sets' section with a table listing various data sets. A line graph is prominently displayed, showing 'Median Square Feet in New Single-Family Homes' from 1977 to 2007. The graph compares three categories: United States (blue line), Inside MSA (red line), and Outside MSA (green line). All three lines show an overall upward trend over the period. Below the graph are buttons for 'Transpose', 'View Data Set', and 'Generate CSV'. To the right of the graph, there is a 'Data Graph Name' field and a 'Graph Group(s)' section. A sidebar on the left lists various data sets, and a right sidebar shows graph options and a 'Data Graph Name' field.

Users can choose to represent the data graphically and create bookmarks. Data can be downloaded as raw ASCII comma separated values.

Many Eyes

<http://services.alphaworks.ibm.com/manyeyes/home>

This IBM utility aims to "democratize" visualisation and to enable a new social kind of data analysis'. Many Eyes allows registered users to upload their own data on the understanding that the data is made available to all. It also has the facility to visualise numeric data in a spatial manner (using the proprietary mapping utility World Map). Users can view (or create) topic hubs which are pages devoted to a particular topic or theme. It serves as a way to collect related visualisations and data sets.

The screenshot shows the Many Eyes website homepage. It has a dark brown background with a navigation menu on the left. The main content area is titled 'Try Our Featured Visualizations' and includes four featured visualizations: 'Status of U.S. Bridges by Year Built', 'Candidate Expenditure Matrix', 'What colors make up mario?', and 'Violent Crime in Keene, NH'. Below this is a 'Featured Topic Hubs' section with three hubs: 'Transportation', 'Matrix Charts', and 'OECD Factbook 2007'. The page is branded with the 'many eyes' logo and the tagline 'for shared visualization and discovery'. The IBM logo is visible in the bottom right corner.

Data Visualisation Tools: Part 1 - Numeric Data in a Web 2.0 Environment

There is a range of visualisation tools with a range of functions, namely:

- Compare values (bar charts, block histograms, bubble and matrix charts)
- Tag clouds (to view word popularity in given text)
- Data point relationships (network diagrams, scatter plots)
- Parts of the whole (pie charts, tree charts)
- Track rises and falls over time (line graphs, stack graphs)

Browsing Data Sets

Here are the most recent data sets uploaded to Many Eyes. The link in the "data" column takes you to a view of the data set itself. The blue "visualize" button lets you visualize the data.

The "source" column shows the source as described by the person who uploaded the file. Please be aware that these files have been provided by users of the site, we cannot vouch for their accuracy or authenticity. To upload your own data, use the [upload page](#).

To edit or delete yours, use [your user page](#).

Showing 181 / 210 of 8040
Previous 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 ... 189 Next

Data Set	Tags	Source	Contributor	Added	Rating	Existing Visualizations	Visualize
U.S. Highway System (both National & Non-National) Deficient Bridges by State	transportation bridges safety "bridge safety" "U.S. Department of Transportation" "Federal Highway Administration"	U.S. Department of Trans...	Susanne	02 August 2007	5.0	0	Visualize
Non-National Highway System Deficient Bridges by State	transportation bridges safety "bridge safety" "U.S. Department of Transportation" "Federal Highway Administration"	U.S. Department of Trans...	Susanne	02 August 2007	5.0	0	Visualize
National Highway System Deficient Bridges by State	"U.S. Department of Transportation" "Federal Highway Administration" bridges transportation safety "bridge safety"	U.S. Department of Trans...	Susanne	02 August 2007	5.0	0	Visualize

Choose a data set | Choose a visualization

LoggedIn as [email] | Logout

Choosing a visualization type for U.S. Highway System (both National & Non-National): Deficient Bridges by State, 2006

Compare a set of values

- Bar Chart**
How do the items in your data set stack up? A bar chart is a simple and recognizable way to compare values. You can display several sets of bars for multivariate comparisons. [Learn more](#)
- Block Histogram**
This versatile chart lets you get a quick sense of how a single set of data is distributed. Each item in the data is an individually identifiable block. [Learn more](#)
- Bubble Chart**
How so many items that your bar chart is baffling? Do the values vary so much that one bar pushes to the top of the screen while another virtually disappears? Try our bubble chart, which displays values as circles of different sizes. [Learn more](#)

Swivel

<http://www.swivel.com/>

Swivel aims to 'liberate the world's data and make it useful so new insights can be discovered and shared'. Swivel charge for any restrictions a user may impose on the data. Swivel Geography or Swivel G allows users to zoom in and out and move seamlessly from one part of the globe to another. Swivel G also includes interactive features that enable users to drill down into specific data points in more detail.

Swivel preview [Home](#) [Graphs](#) [Data](#) [People](#) [Groups](#) [Upload](#)

[Economics](#) | [Entertainment](#) | [Health](#) | [Politics](#) | [Science](#) | [Society](#) | [Sports](#) | [Technology](#) | [Miscellaneous](#) | [Official Source](#)

Search

Upload and explore data.
As a preview it's rough around the edges, may your love for data guide you.

Are you a programmer? Sign up for our [early access API](#).

Spotlight [Who is bringing home the bacon?](#)

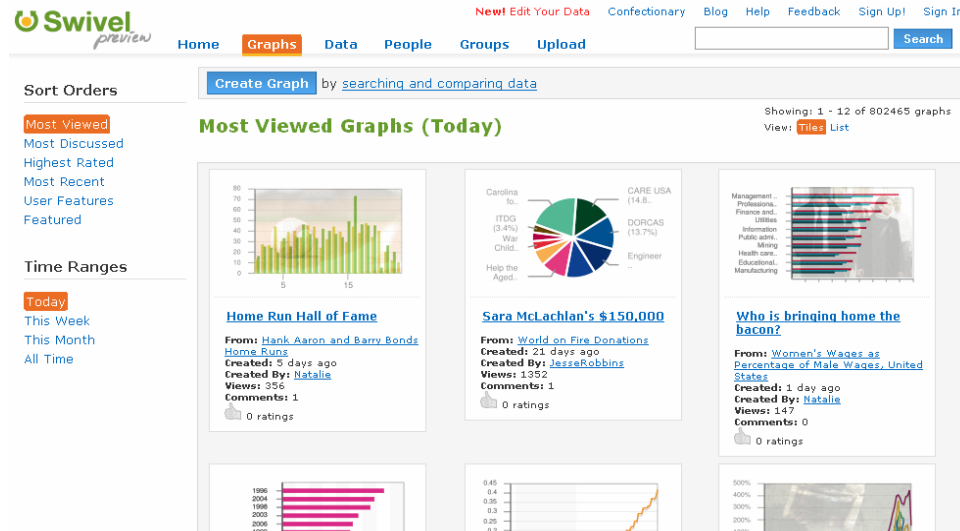
Source: [2005 American Community Survey](#)

In recent years the wage gap between men and women in the United States has begun to narrow more slowly, and women are still making less than men on a national scale.

Official Source Program
Does your organization disseminate data?
OFFICIAL SOURCE
Become an Official Source. It's free!
[Learn more >](#)

Swivelicious Bloggers
people blogging swivel data
[Visualizing Economics](#) · about 6 hours ago
[Robs Place](#) · about 6 hours ago
[Robs Place](#) · about 6 hours ago
[Robs Place](#) · about 6 hours ago
[The 33 year-old Intern](#) · about 7 hours ago

Non-Government Organisations are directly uploading their data into Swivel. Swivel are also ingesting freely available data directly from NGO websites. This exposes their data (and ultimately their commercial products) to a wide audience in addition to providing users with access to trusted data from recognized and official sources.³



Gapminder World

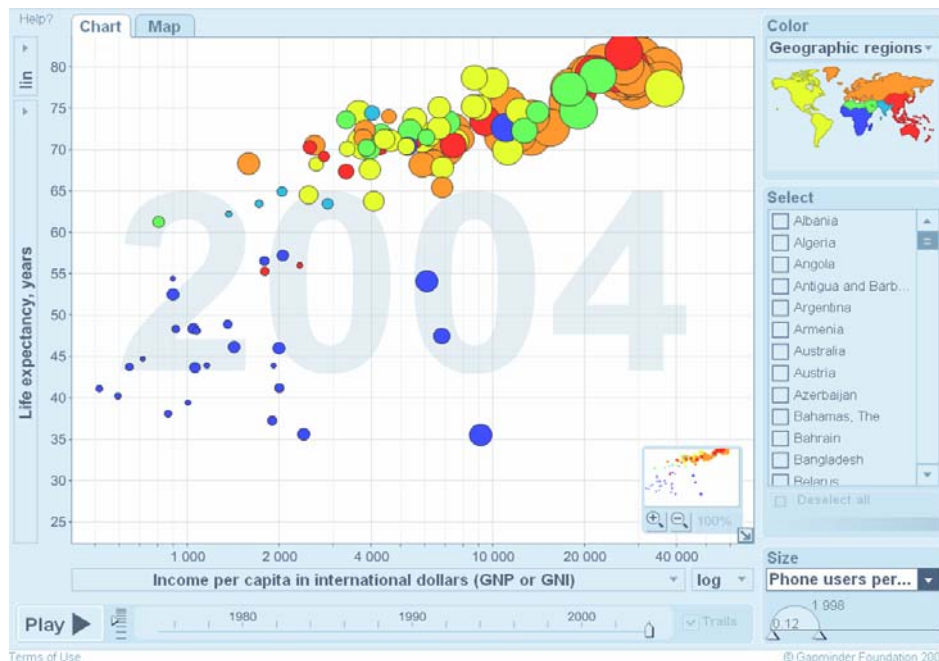
<http://www.gapminder.org/downloads/applications/>

Gapminder was originally funded by the Swedish International Development Cooperation Agency but has recently been acquired by Google. As with Data360, Gapminder's strength is the delivery of time-series data, in this case at the country level. The underlying *Trendalyzer* software imports data from Excel and shows moving graphics on the screen in a range of formats including PowerPoint.

At present Gapminder World contains only 16 variables. However collaboration is planned with the UN Statistics Division to visualise the Millennium Development Goals, and the UN Common Database with Trendalyzer on a test website, with a view to opening up the software for wider use.

A range of advanced features are under development, including: data importation, chart customisation, export charts as pictures/movies, share facility.

³ In December 2007 Swivel announced the creation of a new Firefox search engine extension which searches for data at Swivel directly from the Firefox toolbar. Swivel also announced the release of Swivel Private Edition (invitation only) which enables sharing and collaboration on private data.



StatCrunch

<http://www.statcrunch.com/>

StatCrunch started life as a web-based statistical analysis tool, though recently it has been deploying more and more Web 2.0 functionality culminating in StatCrunch 5.0, launched in August 2007. It offers users the options to browse data sets, results and reports. However it differs from the 'open data' models described above in that users have to subscribe for a nominal monthly or annual fee in order to upload and analyse data files, create reports, export and share.

Academic institutions can also purchase a site licence to install the StatCrunch software on an institutional server. This model has similarities with the 'private data' fees provided by abovementioned resources.

Graphwise

<http://www.graphwise.com/>

Graphwise describes itself as 'a beta release of a search engine for table data'. Upon registration, users can search for and upload tabular data from their local machine or 'scraped' from an internet web page in a number of formats including Excel (.xls), comma delimited (.csv), HTML (.html), PDF (.pdf), Lotus spreadsheets.

Users can also share data by: publishing graphs in paper and on-line documents, creating a graph log ('glog') to share with others, pasting a live graph into their website or blog. A newer version of Graphwise, with a social networking portal, will be released in the near future. That version will allow users to publish their graphs to be searched and viewed by others.

The screenshot shows the Graphwise website interface. At the top, there is a navigation bar with links for 'Welcome!', 'Register', 'Sign in', 'Graphs', and 'Upload'. Below this is the Graphwise logo with a 'Beta' badge and a search bar with a 'SEARCH' button and a link to 'Advanced Search'. A 'Stats' section displays: 'Source Documents Tracked: 1,065,320', 'Tables Extracted: 2,854,120', and 'System Graphs Derived: 178,720,680'. A central banner reads 'Charting a world of data.' and features three main steps: 'Search or Upload' (with an icon of a document and a green arrow), 'Visualize' (with a 3D bar chart icon), and 'Share' (with a monitor icon). Below the banner, there is a 'Welcome!' section with a description of the site's purpose and a 'Featured Glogs' section. The featured glog is titled 'Unchanging Priorities' and includes a bar chart showing defense spending in billions of dollars for the years 2006, 2007, and 2008. The 2007 bar is highlighted with a value of 460. A quote by Martin Luther King is also present: 'A nation that continues year after year to spend more money on military defense than on programs of social uplift is approaching spiritual doom. - Martin Luther King'. A tip at the top of the chart says 'tip: click & drag corner to adjust frame'.

How do the data visualisation utilities compare?

Table 1 aims to measure the functionality, versatility and *fitness for purpose* with regards to the deposition and utilisation of 'open' data held within the resources in question. One point has been assigned to a feature deemed present within the utility. A zero defines a missing function. 0.5 points have been attributed to a feature deemed as having neither a positive nor negative impact on the effectiveness of the utility, or a function that has been advertised via the resource as 'coming soon'. The exceptions are 'Contains adverts' and 'Privacy/Subscription fee' which have been assigned zeros.

From the objective criteria chosen it is evident that each data visualisation utility has associated strengths and weaknesses with regards to functionality and features, with each having a particular focus and/or business model.

Table 1: Functions and Features

Functions and features	Data360	Swivel	Many Eyes	Gapminder	StatCrunch	Graphwise
Contains adverts	Coming soon = 0.5	Coming soon = 0.5	N = 1	N = 1	N = 1	Y = 0
Bookmark facilities	N = 0	Y = 1	Y = 1	N = 0	N = 0	Y = 1
Uploads NGO/IGO data	Y = 1	Y = 1	Y = 1	Y = 1	N = 0	Y = 1
Privacy/subscription fee	Y = 0	Coming soon= 0.5	Y = 0	N = 1	Y = 0	N = 1
Offers spatial visualisation	N = 0	Y = 1	Y = 1	Y = 1	N = 0	N = 0
Data download e.g. via Excel plugin	N = 0	Y = 1	N = 0	N = 0	N = 0	N = 0
Blog	Y = 1	Y = 1	Y = 1	N = 0	N = 0	N = 0
Registration required	Y = 0.5	Y = 0.5	Y = 0.5	N = 0.5	Y (Fee) = 0.5	Y = 0.5
Plugin required e.g. Java, Flash, SVG	N = 0.5	N = 0.5	Y (Java) = 0.5	Y (Flash) = 0.5	Y (Java) = 0.5	Y (SVG) = 0.5
Help/FAQ available	N = 0	Y = 1	Y = 1	Y = 1	N = 0	Y = 1
Creative Commons Licence	N = 0	Y = 1	N = 0	N = 0	N = 0	N = 0
Keyword tagging facility	N = 0	Y = 1	Y = 1	N = 0	Y = 1	Y = 0
Application Programming Interface	N = 0	Y = 1	N = 0	N = 0	N = 0	N = 0
User comment facility	N = 0	Y = 1	Y = 1	N = 0	Y = 1	Y = 1
Tutorial / Getting started	Y = 1	Y = 1	Y = 1	Coming soon= 0.5	Y = 1	Y = 1
User topic hubs	N = 0	Y = 1	Y = 1	Coming soon = 0.5	N = 0	N = 0
Subject groups	Y = 1	Y = 1	N = 0	N = 0	N = 0	Y = 1
Report download	Y = 1	N = 0	N = 0	N = 0	Y = 1	N = 0
Data edit facility	N = 0	Y = 1	N = 0	Coming soon= 0.5	N = 0	N = 0
Syndication (RSS, Atom)	N = 0	Y = 1	Y = 1	Y = 1	N = 0	Y = 1
Search facility	Y = 1	Y = 1	Y = 1	Y = 1	Y = 1	Y = 1
Share facility	Y = 1	Y = 1	Y = 1	Coming soon = 0.5	Y = 1	Y = 1
Data upload	Y = 1	Y = 1	Y = 1	Coming soon= 0.5	Y = 1	Y = 1
TOTAL	9.5	20	15	10.5	9	12

Table 2: Number of Data sets

	Data360	Swivel	Many Eyes	Gapminder	StatCrunch	Graphwise
Start Date*	Jan 2006	Dec 2006	Jan 2007	Feb 2005	Aug 2007	Apr 2007
No. Public Data sets**	10619	7844	10364	16***	3421	N/A

* in present format

** as of December 2007

*** under review. Currently no public data upload

Table 3: Visualisation options*

Data360: line graph, stack graph, line – log Y-axis, bar regular, bar stacked, pie chart, scatter plot, bubble chart, marimekko

Swivel: bar chart, horizontal bar chart, scatter plot, line graph, transpose

Many Eyes: world maps, country maps, line graph, stack graph, bar chart, block histogram, bubble chart, matrix chart, scatter plot, network diagram, pie chart, tree map, tag cloud, word tree, transpose

Gapminder: world maps, bubble chart, line – log X/Y-axis, change-over-time visual

Statcrunch: bar plot, box plot, chi square, column statistics, contingency table, correlation, covariance, dot plot, frequency table, histogram, index plot, Kruskal-Wallis, logistic regression, Mann-Whitney, means plot, multi plot, multiple linear regression, one/two sample T, one/two sample Z, one/two sample proportion, one/two sample variance, pairs plot, parallel co-ordinates, pie chart, QQ plot, R chart, row statistics, scatter plot, sign test, simple linear regression, stars plot, stem and leaf, Wilcoxon signed ranks, x-bar chart, x-bar, R chart, c chart, p chart, u chart

Graphwise:** bar chart, line graph, pie chart

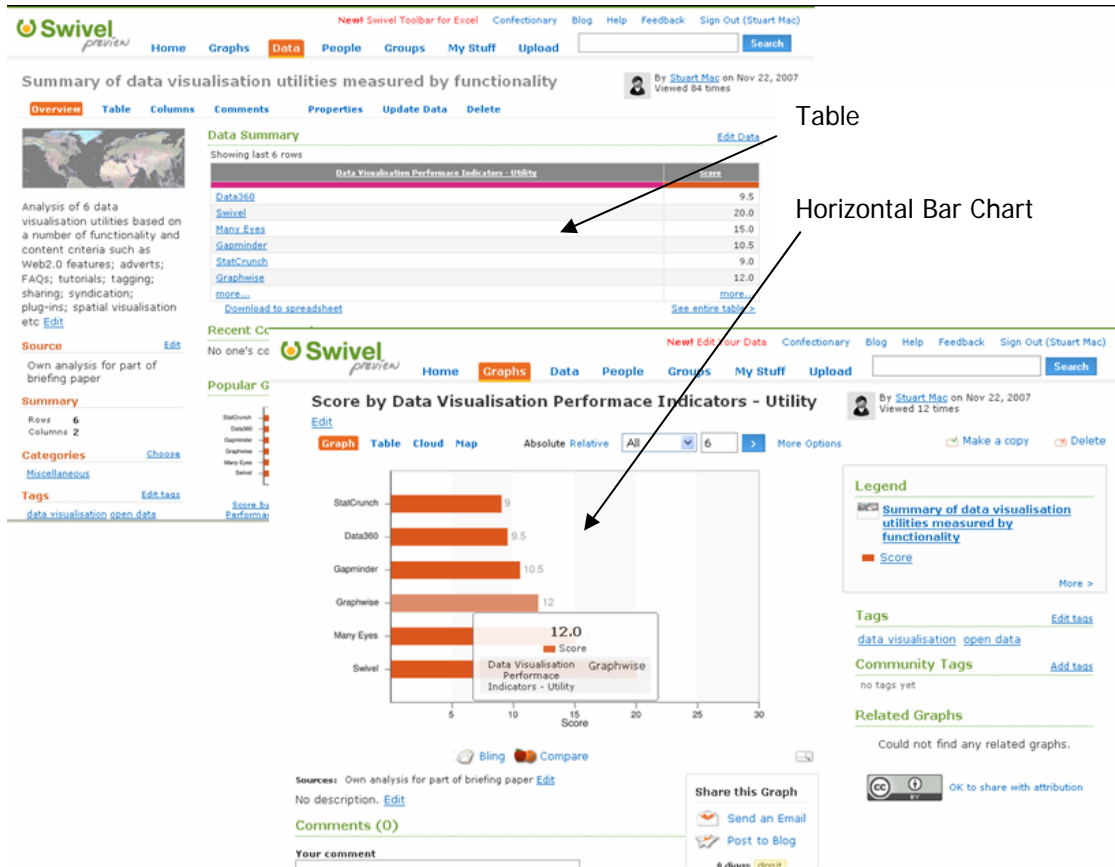
* descriptions are as detailed within each specific utility

** new features to be released soon

Swivel does appear to perform best with regards to overall Web 2.0 functionality; however this may be down to the fact that other utilities are more focused and hence have greater strength in other areas. For example, StatCrunch functions as a standalone statistical analysis package with a comprehensive array of graphing and charting functions, Graphwise places emphasis on its search engine functionality, and Gapminder focuses specifically on human development data.

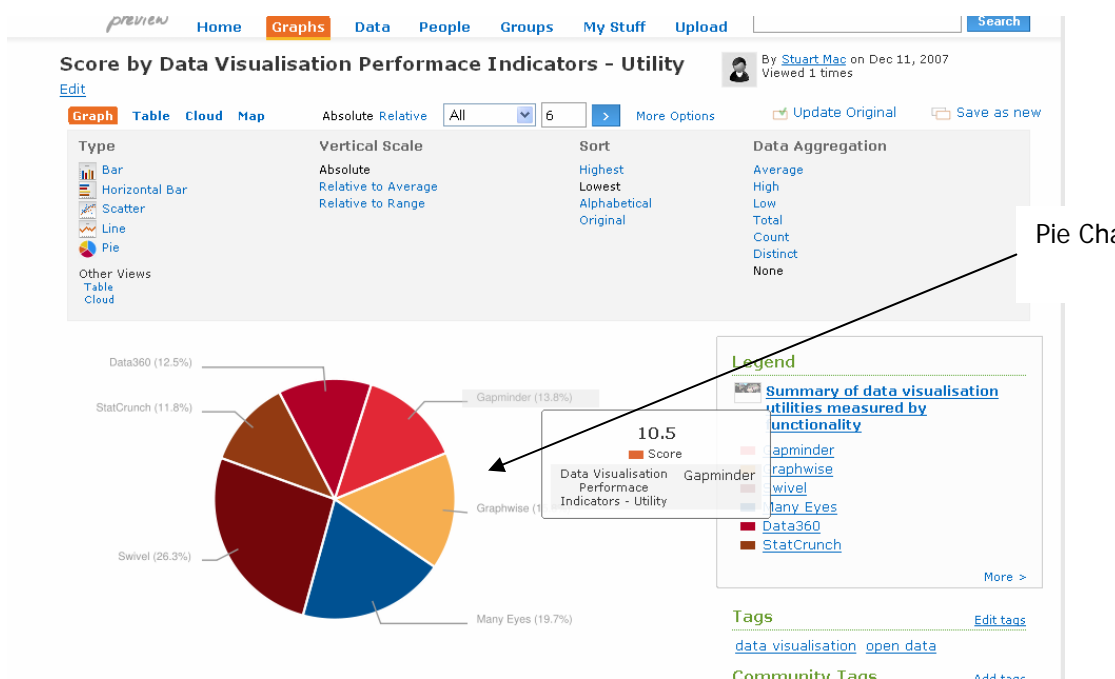
Visualisation examples in Swivel

As a fairly straightforward 'proof of concept exercise' the data collected in Table 1 have been summarised, converted to CSV and uploaded into Swivel [the 'winner' of the function and feature comparison]. The following are the resultant data visualisation examples:

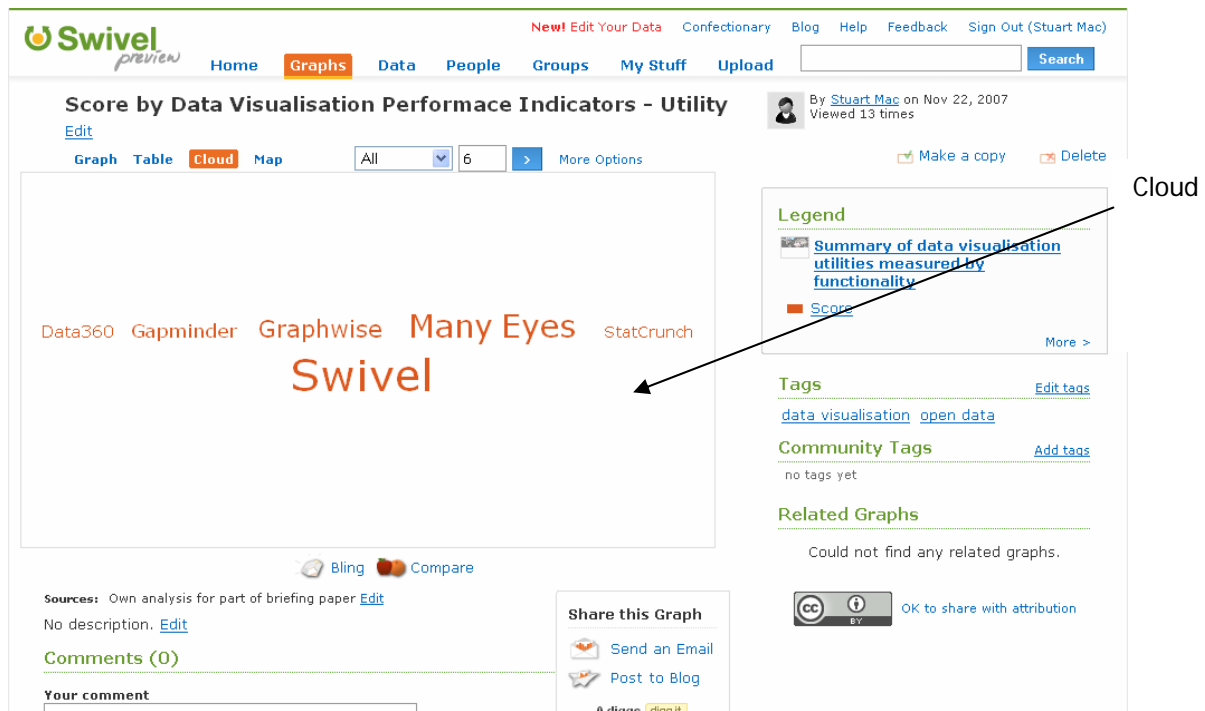


Table

Horizontal Bar Chart



Pie Chart



Summary

Much has been written about geographic visualisations using well publicised tools such as Google Earth and Microsoft Virtual Earth. Part two of this briefing paper will discuss such examples. There has been less publicity regarding the visualisation of numeric data, once thought the remit of domain experts. This paper has described a number of utilities that, to varying degrees, visualise data and allow users the opportunity to interact with and share data in an open environment.

Swivel appears to have a comprehensive range of functions and capabilities as measured by a range of Web 2.0 criteria and was used to highlight the visualisation of some simple data collected about 6 utilities. The visualisations produced give a flavour of how a user can quickly and simply turn raw data into a graphical representation, which enhances its value and versatility whilst stimulating discussion.

The examples showcased are by no means a definitive representation⁴ but rather provide an overview of the trends, functionality, content and technologies pertaining to those utilities visualising numeric data. As Web 2.0 continues to evolve and transform into Web 3.0⁵, we

⁴ Examples of numeric data visualisation utilities not showcased include Dabble, Open Economics, Insight, Numbrary

⁵ Web experts' definitions of Web 3.0

'The World Wide Database' (wide-area distributed database interoperability enabled by Semantic Web technologies) – Minding the Planet, Nova Spivack, October 2005 (http://novaspivack.typepad.com/nova_spivacks_weblog/2005/10/towards_a_world.html)

'Applications being pieced together' – Seoul Digital Forum, Eric Schmidt (CEO Google), May 2007, (<http://sdf.sbs.co.kr/en/index.sdf>)

'the distinction between professionals, semi-professionals and consumers will get blurred, creating a network effect of business applications' – Technet Summit, Jerry Yang (founder and Chief of Yahoo), November 2006, (<http://www.technet.org/transcript1/>)

'Giant Global Graph' – Decentralized Information Group (DIG) Breadcrumbs, Tim Berners-Lee's Blog (<http://dig.csail.mit.edu/breadcrumbs/blog/4>)

are seeing the boundaries between websites and web services blurring, as more and more web content becomes *remixable*. Many of the resultant applications can be achieved with no more than a basic understanding of the underlying technologies, which in turn enables the creation of further innovative resources. Thus the entire system is turning into both a platform and the global database (see www.twine.com; www.freebase.com etc) with data visualisation being but a tiny component of the continual evolution that is the web.

Appendix 1

Measuring societal progress through macro-data visualisation

One of the criteria used to evaluate the data visualisation resources was whether data from Non-Governmental Organisations (NGO) or Inter-Governmental Organisations (IGO) were being utilised within them. The statistical output of NGOs and IGOs are predominantly at macro-level and in the form of official statistics. There are a range of cutting-edge data visualisation and dissemination tools available for country-level statistics which span both the numeric and spatial data arenas. At present users cannot upload and publish their own data, although this may not always be the case. Examples include:

OECD Country Statistical Profiles – OECD statistics in SDMX (Statistical Data Mark-up eXchange) put into Adobe Flex

<http://stats.oecd.org/nawwe/csp/default.html>

IMF Data Mapper

<http://www.imf.org/external/datamapper/index.php>

Stat@tlas Europe - An online atlas of European statistical themes hosted by the Federal Statistical Office of Switzerland

<http://atlas.bfs.admin.ch>

Eurostat Tables Graphs Maps (TGM) – an interactive user interface to Eurostat data

http://epp.eurostat.ec.europa.eu/portal/page?_pageid=3013,65310704&_dad=portal&_schema=PORTAL

Other examples include Statistics Canada's Portrait of the Canadian Population in 2006: data tables, figures, maps and animations; Statistics Switzerland's regional and international comparators; Statistics Netherlands' Neighbourhood Information with Google Earth (see part two of this paper).

Following the World Forum on Statistics, Knowledge and Policy in Istanbul (June 2007) the Istanbul Declaration* has been adopted by the representatives of the European Commission, Organisation for Economic Co-operation and Development, the Organisation of the Islamic Conference, the United Nations, the United Nations Development Programme and the World Bank. The Istanbul Declaration develops further the Fundamental Principles of Official Statistics adopted by the United Nations in 1994 by creating a dynamic *to measure societal progress through statistical indicators*.

We are already seeing the data visualisation utilities participate in such a movement with, as detailed above, Gapminder World's plans to collaborate with UN Statistics Division to visualize Millennium Development Goals in addition to visualizing the UN Common Database. It can be argued that the dissemination, sharing and analysis of macro-data in Web 2.0 utilities (be it Swivel, Many Eyes or other proprietary solutions) can contribute to such a dynamic.

* <http://www.oecd.org/dataoecd/14/46/38883774.pdf>