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Topic (iii): Open source and software consortia in statistics

THE PC-AXIS SOFTWARE FAMILY – A "CONSORTIUM" FOR OUTPUT DATABASES

Invited Paper

Submitted by Statistics Sweden[1]

I.   INTRODUCTION

1.   PC-Axis is a suite of software created to serve as a platform for the coherent, efficient, and user-friendly dissemination of official statistics. It is ideal for national statistical offices and other organizations engaged in the dissemination of social and economic statistics. The suite supports the whole spectrum of dissemination products: comprehensive online databases, offline electronic products like CD-ROMs, and publications on paper or on the web.

2.   The PC-Axis software family is the result of a long tradition of statistics dissemination in machine-readable form from Statistics Sweden and other statistical offices in the Nordic countries. The development emerged from a thesis from the early 1970s by Dr. Bo Sundgren, concerning the use of multi-dimensional matrices in output databases. These ideas were first implemented in the mainframe system Axis used since the beginning of 1980s for commercial databases at Statistics Sweden and from the mid-1980s at Statistics Denmark for the same purpose. For the 1990 Swedish Population Census, PC-Axis was developed for the main users of the results from the Population Census. The **PC-Axis file format** (see below) is a file format in plain ASCII that mirrors the ideas used in the Axis system. This file format is very metadata-rich. From 1997, the same ideas have been implemented in a relational output database that supersedes the Axis system. This output database can be accessed on the Internet http://www.scb.se/indexeng.asp or internally by the PC-Axis SQL extension. The PC-Axis file has the extension PX, which explains the names of some of the products in the PC-Axis family.

II.   THE MAIN FEATURES OF THE SOFTWARE IN THE PC-AXIS FAMILY

3.   Keywords to describe the PC-Axis family (with the relevant piece of software mentioned in brackets) are:

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- Dissemination of statistics online (PX-Web or PX-Web components) and offline (PC-Axis Main module);
- Dynamic tables – pivot function (PX-Web and PC-Axis Main module);
- Conversion to different file formats (PX-Web and PC-Axis) i.e. Excel, Lotus, txt, etc. and for PC-Axis only Gesmes/TS (and XML when a DTD is available);
- Output database (PC-Axis database and/or SQL database);
- Multi-dimensional Matrices/Cubicles/Boxes (PC-Axis files and SQL database);
- Metadata rich data model in SQL and in the PC-Axis file format;
- Windows (PC-Axis) and Internet (PX-Web);
- PC-Axis files in a catalogue structure form a PC-Axis database, which is accessed without using SQL (PC-Axis Main module and PX-Web);
- SQL extension (Sybase/Oracle/MS-SQL-Server) for an SQL database, structured according to the common macro metadata model (PC-Axis SQL and, in some cases, PX-Web components and PC-Axis/PX-Batch components in Internet User Interface to a macro database);
- Grouping facilities (PC-Axis and PX-Web);
- Graphs (PX-iGraph under development);
- Maps (PX-Map and PX-iMap);
- Production of PC-Axis files from different sources (PC-Axis SQL, PX-Batch, PX-Make, PX-Edit and the Australian SuperStar/SuperCross);
- Tables direct from an SQL or a PC-Axis database inserted into MS-Word or MS-Excel (PX-Publ).

4.   Below are descriptions of the different main programs in the PC-Axis family.
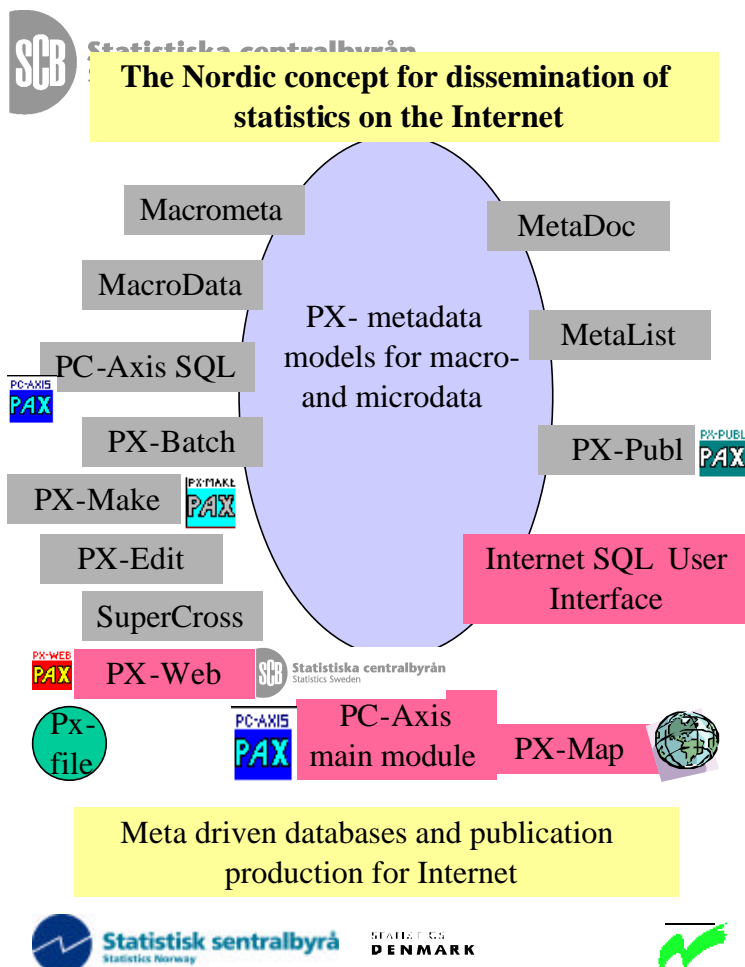
5.   In the figure, the elliptic area represents the metadata model used for the output database. The names in the squares touching the ellipse are the names of pieces of software that directly use the metadata model. Software not touching the ellipse only uses the PC-Axis file and can be used without a metadata base. The PC-Axis file format is key and is developed in harmony with the development of the data model used in the Meta database. The PC-Axis file can be downloaded from the Internet and is also used as a temporary file inside the Internet SQL User Interface using components from the **PX-Web** system.

6.   Clients downloading files from the database on the Internet, use the **PC-Axis main module**. It is also used for CD-ROM products. These CD-ROM products also include the **PX-Map** software developed at Statistics Norway. PC-Axis files can be retrieved as mentioned above on the Internet, but internally they can also be produced by the **PC-Axis SQL** addition as well as the batch version of that software, **PX-Batch**. Other ways of making PC-Axis files are by using **PX-Make** (from Statistics Denmark), **PX-Edit** (from Statistics Finland) or SuperCross (from Space Time Research in Australia). **PX-Publ** delivers

tables from the output database into MS-Word or MS-Excel using macros developed by Statistics Denmark and produces ready-to-print statistical publications.

7.   There are different conditions concerning the data entry of metadata and data at different national statistical institutes (NSIs). The NSIs each have their own history concerning how they handle metadata, classification and documentation. The following systems are used at Statistics Sweden and are not transferable, although UN/ECE have taken some inspiration from the programs. **Macrometa** is an interactive program for entering the metadata. The **Metalist** program makes listings from the Meta database. **MacroData** is a program to load the data into the database according to the descriptions in the Meta database. For a description of individual microdata in registers, another data model exists. That metadata can be entered using the **Metadok** program.

PC-Axis main module

8.   The PC-Axis main module looks like this. It has options to change between stub and heading (pivot function), put the present table into other software like MS-Excel, it brings footnotes on different levels, it can make simple diagrams and has a link to the map program PX-Map.

PC-Axis is a Windows program that can be linked to a web browser as a helper application. PC-AXIS provides rich information on the statistics, restructuring of a table, converts tables to other file formats and can establish a well-structured local database on your PC.

PC-Axis file format

9.   The PC-Axis file format is a kind of tagged file format. When a XML DTD for this type of file structure is developed in Finland, PC-Axis software will have a transformation function into XML.
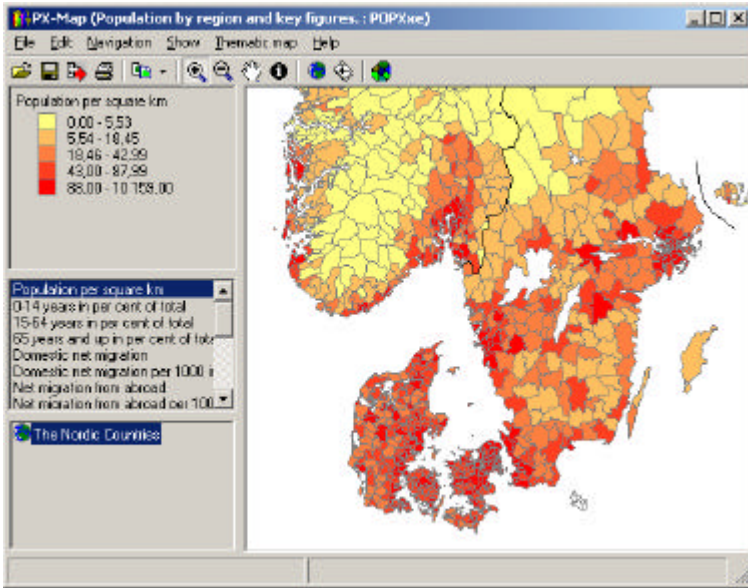
PX-Map

10. PX-Map can make Choroplet maps and symbol maps from PC-Axis files. PX-Map was developed at Statistics Norway.

PX-Map is also available in a Web version called PX-iMap.

PX-Make

11. With PX-Make, you can produce PC-Axis files from Excel or any table in a grid within Windows.

12. The metadata are entered interactively using cut and paste from any source including the use of other PC-Axis files. PX-Make was developed at Statistics Denmark.
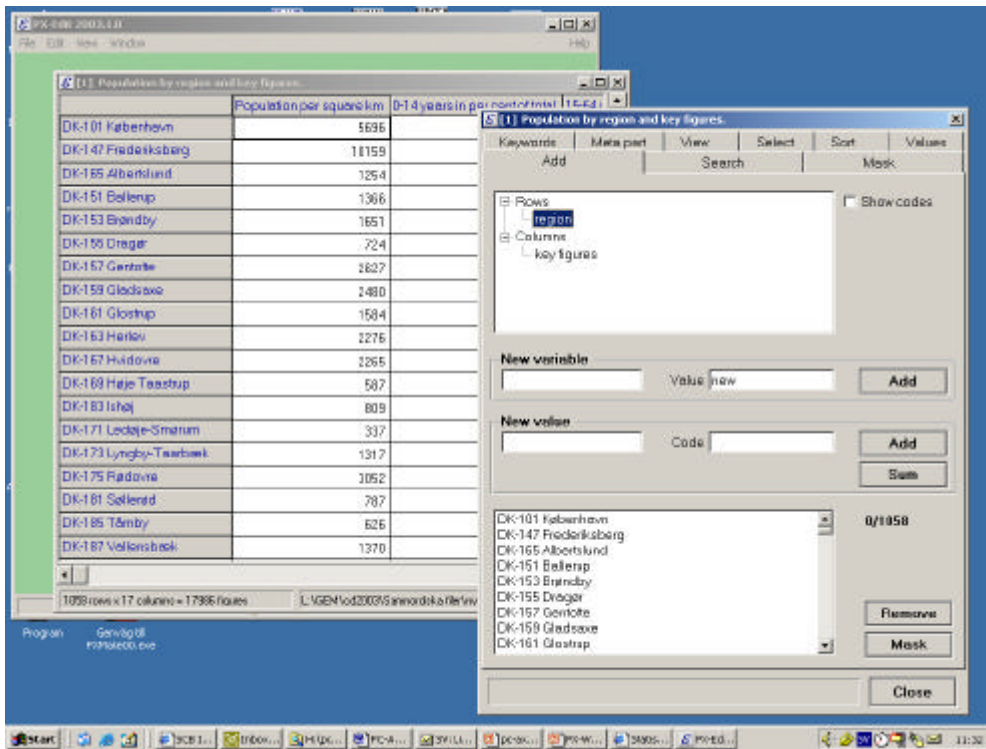
PX-Edit

13.   PX-Edit is used for editing of very large PC-Axis files.
PX-Edit was developed at Statistics Finland.

PX-Web
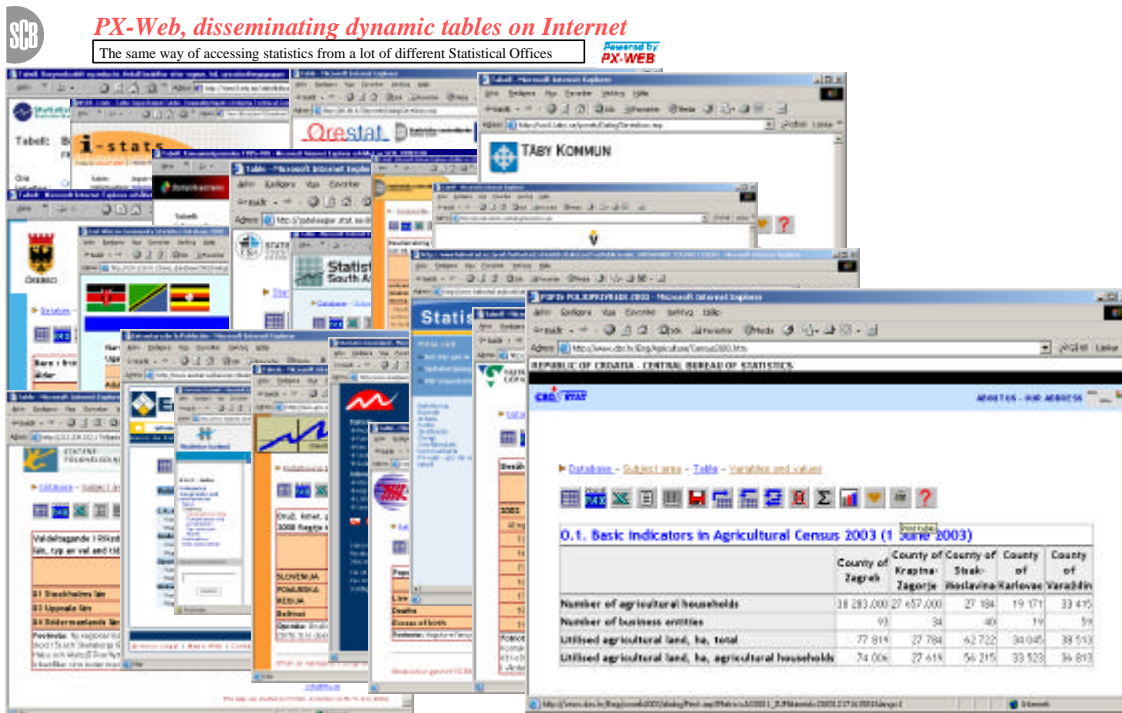
14.   PX-Web is used to establish dynamic tables on the Internet from PX-Axis files on an MS-Internet Information Server. It is used at more than 25 statistical agencies all over the world.

PX-Web application generator
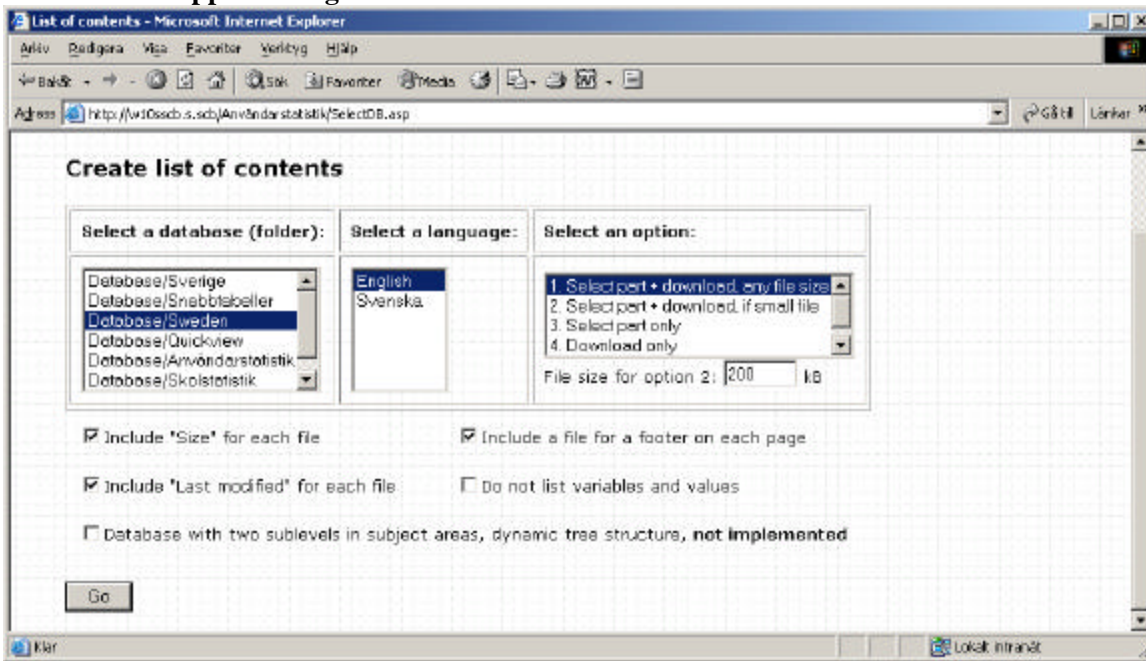
15.   The PX-Web applications are generated automatically from a PC-Axis database i.e. a catalogue structure containing PC-Axis files. See above how to select a database, language and options for how the PX-Web application shall appear. By using style sheet techniques, the application will fit into most website layouts

PC-Axis SQL Macro
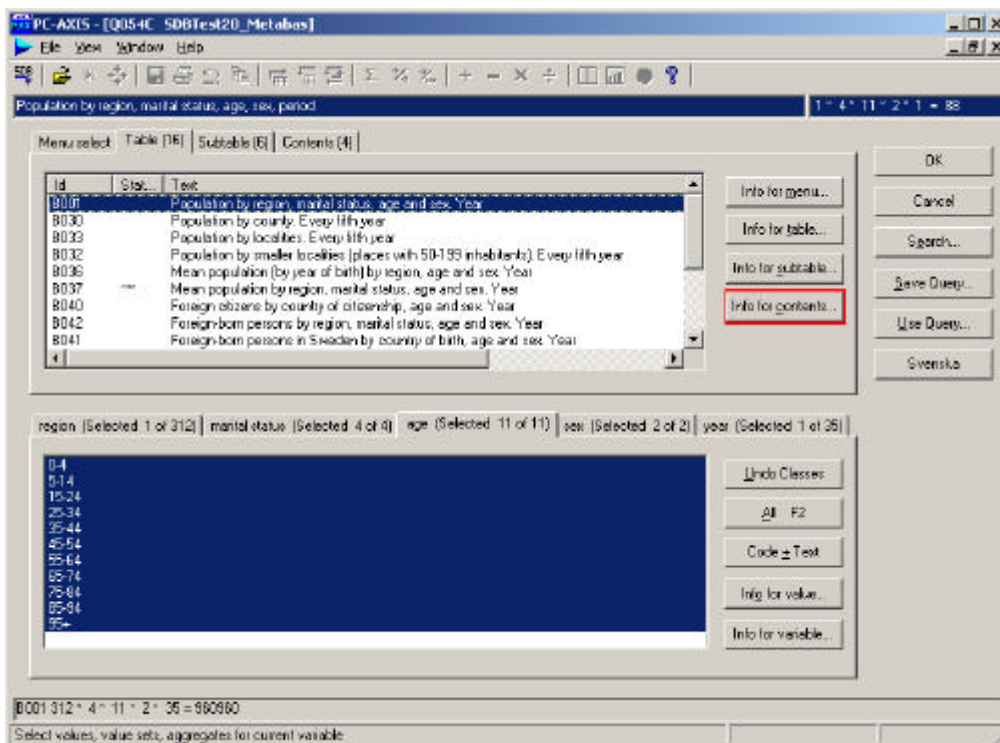
16.   PC-Axis SQL Macro accesses the relational database containing metadata in the process of selecting statistics from the output database.

17.   The same user interface is used from PX-Publ when accessing the output database from MS-Word, as can be seen below. By using the option Save Query the selection can be used later online or as a batch in the software PX-Batch

PX-Publ

18.   Notice the extra tool bar in this template where all the extra facilities for a proper table presentation are available. One of the options is the access to the Output database using PX-Publ.
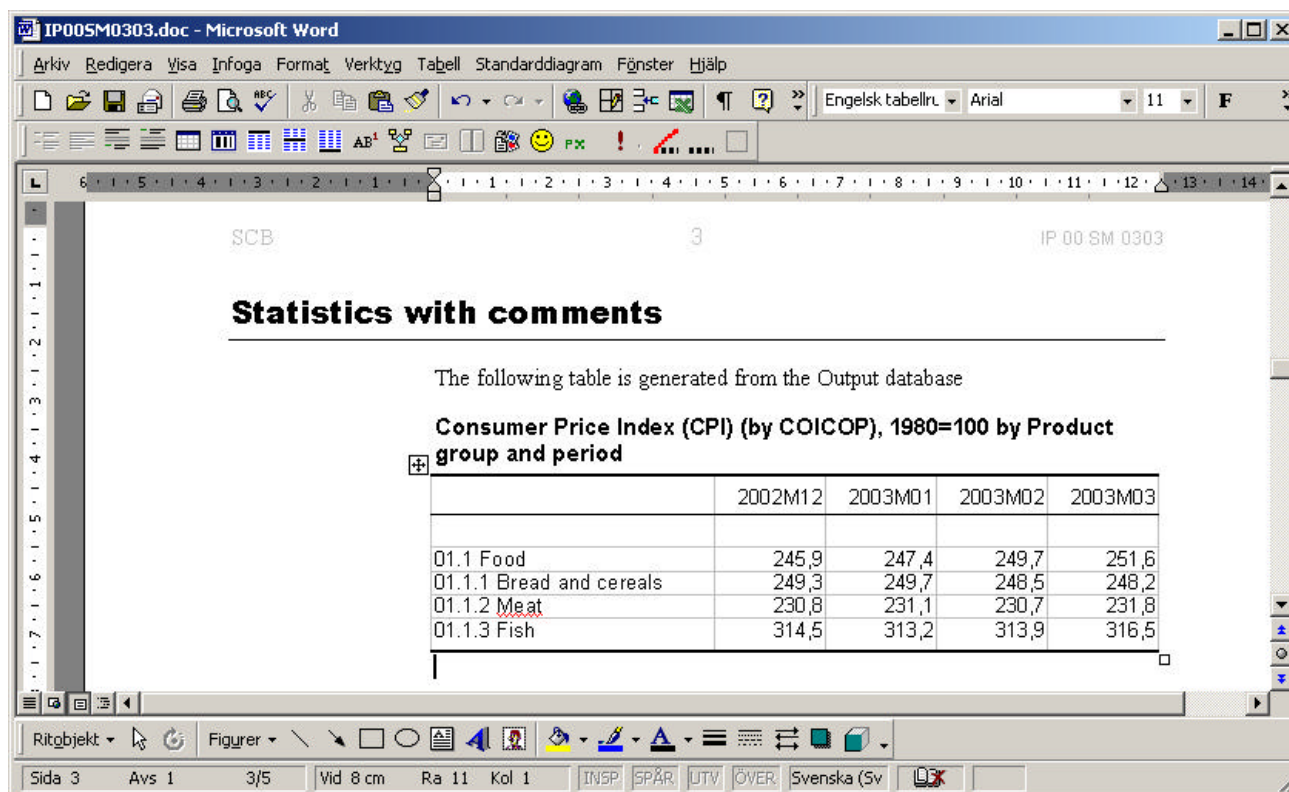
List of software in the PC-Axis family

Software name	Origin	Transferable	Documents in English
PC-Axis Main module	SCB	Easy for new languages	Users and systems manual
PC-Axis SQL Macro	SCB	Easy for new languages	Users and systems manual
PC-Axis SQL Micro	SCB	Easy for new languages	Users and systems manual
PX-Batch	SCB	Easy for new languages	Users and systems manual
PX-Web	SCB	Easy for new languages	Installation instructions
PX-Check	SCB	English	No
PX-Publ	SCB	Easy for new languages	Describing the SCB installation
PX-Publ Macros	DSt	Not so easy	No
PX-Make	DSt	English	Users manual, also Spanish
PX-iGraph (to come)	DSt	Easy for a new language	No
PX-Map	SSB	Easy for a new language	Users and producers manual
PX-iMap	SSB	Easy for a new language	No
PX-Edit	SC	English	Users manual
Outside the family but used in SCB			
Macrometa	SCB	Swedish, not easy to transfer	No
Metalist	SCB	Swedish, not easy to transfer	No
Macrodata	SCB	Swedish, not easy to transfer	No

III. USERS OF THE PC-AXIS FAMILY

19.   As mentioned above, different NSIs are using PC-Axis software in different extensions. Some offices are only using the PC-Axis main module internally, while others are using the SQL-extensions and also have PX-Web for the Internet access to the PC-Axis database. In the table below, the users of PC-Axis are shown with the different parts of the software used indicated.

The use of the PC-Axis family in different organisations updated 2003-12-01 1(2)

Software used	PC-Axis main module CD	On Internet	Internal use	PX-Web comp.	PX-Web	PX-Make	PX-Edit	Superstar	PX-Map	PX-iMap	PC-Axis SQL Macro	PX-Publ	PC-Axis SQL Micro	date/sign
1. Organisations outside Sweden														
Algeria, NSO			i			i								
Arab League, Cairo, Egypt			i			i								
Basque country, Spain, EUSTAT	x				x	i, Excel					own system			
Bolivia			i		p	i, Access			p					
Brasil, IEBG			i											
Croatia	p	p	t		x	t,Excel	t		t	p				030315/LN
Denmark, Statistics	x	x	i	x, SQL	und	i, Excel	x		x	p	x, Oracle	i		030315/LN
ECE, Geneve											t, MS-SQL			030315/LN
East African Community: Tanzania, Kenya		x	i		x	i, Access								
Estonia, ESA	x	x	p		x	own dbf,e	x		x			t,modified		030324/EF
Faroe isles, Hagstovan	x					i, Excel			x					
Finland, Statistics	x	x	i		x	i, Excel	x	x	x					
Greenland, Statistics	x	x	i		x	i, Excel			x	i				030325/LB
Iceland, Hagstofa Islands	x		i		x	i, Excel	t		x					030324/BS
Ireland, CSO			i		i						i, Sybase			
Kuwait, P.A.C.I.			i			i, Excel								
Latvia, Central Statistical Bureau	p	p	t		p	i, Excel			p		p, MS-SQL		t, MS-SQL	
Lithuania	p	p	i		p	i, Excel					t, MS-SQL		t, MS-SQL, Oracle	030324/VA
Norway, Statistics	x	x	i	x, SQL	x	i, Excel	x		x	x	x, Oracle	i		030324/LR
Philippines, NSCB	x	x			x	i, Excel								030315/LN

The use of the PC-Axis family in different organisations updated 2003-12-01 2(2)

Software used / Organisation	PC-Axis main module CD	On Internet	Internal use	PX-Web comp.	PX-Web	PX-Make	PX-Edit	Superstar	PX-Map	PX-iMap	PC-Axis SQL Macro	PX-Publ	PC-Axis SQL Micro	
Slovenia	p	t	i		x	i, Excel	x		p, t			x	t, MS-SQL	
South Africa, SSA	t				x	i, Excel		x	p					
Spain, INE	x	x	i			i, Excel	t		x			t		030411/AT
Taiwan, R.O.C.			t		t	t,Excel	t		t	p	t	p	t	030926/BC
Uganda Bureau of Statistics		x	i			i, MS-Acc								
2. Within Statistics Sweden														
Sweden's Statistical Database	x	x	i	x, SQL	x	x,Excel			x		i, Sybase	i	i, Sybase	030315/LN
RAPS				x, SQL										030315/LN
Regional commission services, OSDB				x,Superc	x				x				i, Sybase	030428/JB
Regional commission services, ODB				x,SQL										030428/JB
3. Sweden, outside Statistics Sweden														
Folkhälsoinstitutet			i		x	i, Excel								030315/LN
Integrationsverket			i		x	i, Excel								030315/LN
Halmstad kommun			i		x	i,Excel								030624/LN
Helsingborgs kommun			i		i	i,Excel								031125/LN
Kommerskollegium											i, Sybase			030315/LN
Linköpings kommun			i		i	i, Excel								030315/LN
Täby kommun			i		x	i, Excel								030315/LN
Västerås kommun			i			i, Excel	i							030428/JB
Västra Götalands landsting			i			i, Excel	i							030428/JB
Örebro kommun			i		x	i, Excel								030315/LN

p= plan to use, t= testing, i=internal use, e=external use, x= internal and externa use

20.   One can say that the PC-Axis family consists of a Nordic core and then other users of PC-Axis. The Nordic core consists of Denmark, Norway and Sweden, working very closely with each other to develop the common Meta data model. The model that is used together with PC-Axis SQL and PC-Axis components in Internet user interfaces with the macro database. These databases can be accessed on the following addresses: www.dst.dk , www.ssb.no and www.scb.se . They are all free of charge.

21.   Other institutes using the SQL parts but not yet on the web are CSO of Ireland, Slovenia, Croatia and UN/ECE Statistics Division in Geneva. The heaviest users of the PC-Axis file level of the concept are Statistics Finland and INE Spain. In addition to this are all the NSIs using PX-Web for dissemination of statistics on the Web. Institutes using PX-Web, where the applications are accessible externally, can be found and studied from the PC-Axis website www.pc-axis.scb.se

22.   Of the members, Denmark, Finland, Ireland, Spain and Sweden are in the European Union and Croatia, Estonia, Latvia, Lithuania and Slovenia are in the next group of countries to join the EU. Iceland and Norway have EES status.

IV.   FUNCTION OF THE PC-AXIS CONSORTIUM

23.   The structure of the "consortium" can be described as follows:
- Statistics Sweden as the leading country managing the cooperation;
- The PC-Axis International Reference Group for all parties outside Sweden using PC-Axis as a dissemination tool;
- A Nordic core for cooperation in the output database area where Denmark, Norway and Sweden use the same data model;
- A Swedish user group for the use of PX-Web applications in other organisations in Sweden.
- An internal user group at Statistics Sweden;
- A board where some of the main end users are consulted concerning the development of Sweden's Statistical Database;
- A steering committee for the Database Project at Statistics Sweden, where PC-Axis constitutes one of the important ingredients.

The first three instances above are described in more detail below.

24.   Statistics Sweden is the origin of the PC-Axis file format and the PC-Axis software. After presentations at different international conferences, other NSIs became interested in the product. Since Statistics Sweden has no funds for supporting other NSIs that are interested in or are using PC-Axis, it was decided to charge other organisations for using PC-Axis for the dissemination of statistics.

25.   After negotiations with the first interested countries, a price list for an annual license fee took form. Since Statistics Sweden is a non-profit organisation, and is also using the software, the price is nominal.

26.   The contract for the license for other NSIs also covers the right to disseminate the software on the Internet or CD-ROM, together with statistics. It also gives the right for the NSI to sub-license other organisations in the geographical area it covers, to use the product for dissemination of statistics. The NSI may also charge for the redistribution of the software or decide not to. This is the background to the existence of a differentiated price list.

27.   The license fee covers the cost of the administration of the customer contacts, part of the development of PC-Axis at Statistics Sweden, the arrangement of the annual PC-Axis Reference Group Meetings and the other meetings and contacts with the different groups mentioned above.

28.   The *PC-Axis International Reference Group* was established in 1992 and it generally meets once a year.
- The morning session on the first day is focused on the exchange of experiences in the field of dissemination statistics in electronic form and the use of the PC-Axis family software. The hosting organization has a more in-depth presentation of its work and plans in the field.
- The afternoon on the first day is devoted to demonstrations and presentations of news in the field. This includes developments at the different organizations and at Statistics Sweden, where the main developments take place.

- The second day is completely devoted to discussions on the developments that will take place the next coming year on the PC-Axis file dependent software.
- The third day focuses on the SQL extensions related to the PC-Axis family software. Experiences are exchanged and desired development discussed.

29.   The PC-Axis international reference group meetings took place at the following sites:

Meeting in	year	Vitoria-Gasteiz	1996	Kinsale	2001
Stockholm	1992	Stockholm	1997	Tallinn	2002
Stockholm	1993	Copenhagen	1998	Ljubljana	2003
Copenhagen	1994	Oslo	1999	Not yet decided	2004
Helsinki	1995	Madrid	2000		

30.   The Nordic core of *Cooperation in the field of Output databases and the PC-Axis family software.* As mentioned above, the development work is nowadays distributed among some of the users of the PC-Axis family software, namely Statistics Denmark, Statistics Norway and Statistics Sweden. These NSIs generally meet once a year for planning purposes and to discuss developments. The concept is divided into the common **Meta data models**, the common **PX-Main programs**, the common **PX-components**, **groups of cooperation** and other **groups for cooperation linked to the database activities**. For the common Meta data models and the PC-Axis file format, certain common rules are stated for how they should be used as well as for the creation of new versions. This is to ensure that users of the data model do not come to a dead-end. In a similar way, there are rules for the common PX-Main programs and PX components. A sketch showing the structure of the PC-Axis family is available in an attachment to this document.

V.   FINAL REFLECTIONS

31.   The use of PC-Axis in different NSIs is based on the common macro Meta data model that is reflected in the PC-Axis file format as mentioned above. Some of the NSIs only use the PC-Axis file format, while others also use the macro metadata model in a commercial Data Base Management System, DBMS, such as Sybase, Oracle or MS-SQL server.

32.   The step-by-step development for the dissemination of statistics on the web are:
- A simple way of establishing an Internet-based statistical database is to create PC-Axis files using PX-Make and put them together on a website with PX-Web;
- A further step then can be taken establishing a SQL based output database using the Macro Meta data model;
- Internal use of the PC-Axis SQL additions creating PC-Axis files for the PX-Web;
- Produce publications on paper or on the web using PX-Publ.;
- Establish an SQL user interface using components from PC-Axis SQL saved queries, PX-Batch and PX-Web.

Possible transfer of the software to other organisations for statistics dissemination

33.   It is possible to transfer the following programs, if a license is agreed with Statistics Sweden: PC-Axis Main module, PX-Web, PX-Make, PX-Edit, PX-Map, PX-iMap. For organizations using SQL, the SQL-related programs PC-Axis SQL, PX-Batch and PX-Publ can also be transferred.

Further information and questions

34.   For more information and references, visit the website http://www.pc-axis.scb.se/
Questions on the PC-Axis software family and the license conditions for the use of the software for dissemination of statistics can be put to lars.nordback@scb.se

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