

TRAINING OF SURVEY STATISTICIANS IN GOVERNMENT STATISTICAL AGENCIES

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1. Introduction

The workforce of a statistical agency is a mix of many competencies. One simple classification is operations and research (Dillman 1996). The operations people carry out the often complex survey plans and the researchers are the ones responsible for technical planning and methodological development. These broad categories are not fixed once and for all. Operations people certainly contribute to methodological development and researchers certainly participate in the conduct of surveys and all successful survey work requires collaboration between the two categories. Depending on background, organization and culture the researchers are labelled statisticians, mathematical statisticians, survey researchers, behavioral scientists, survey methodologists or just methodologists. In this paper we denote all these researcher categories by *survey statisticians*. All survey workers are important in the conduct of survey work but this paper is about the role of survey statisticians and how their skills can be improved. As pointed out by Särndal (not dated) the purpose of R&D is to keep the organization abreast with the methodology and technology that are vital for its survival. Leading statistical organizations have powerful methodology work that guarantees a certain quality output as well as a competitive edge. It is important for an organization to have a critical mass of survey statisticians that can provide methodological service and advancement. The critical mass is necessary but not sufficient. The survey statisticians also need to continuously improve their skills and most government statistical organizations have something in place to address that need. What they have in place differs between organizations due to differing infrastructures and cultures but also on how the role of survey data in society is perceived. It is clear that these circumstances differ a lot between organizations world-wide.

In this paper we will discuss challenges that face survey organizations and survey statisticians, how training needs are or should be assessed, and the structures of some general training models. Examples of training programs for survey statisticians are provided for a number of statistical agen-

cies around the world. Finally, we list some potentially useful approaches and some suggestions for improving the training of survey statisticians.

2. Tasks of survey statisticians

The tasks of survey statisticians are manifold. In their study of R&D work in statistical organizations Lehtonen et al (2002) conclude that statistical agencies have to conduct new research even though many believe, at least in principle, that such work belongs in universities and other scientific communities. The reason why research must be performed within agencies is that official statistics, the most common output of statistical agencies world-wide, is not taught nor researched to a large extent in special university programs. Basically there are no departments or faculties for official statistics. Instead official statistics cuts across many disciplines and many problems must be approached from research traditions from all these different disciplines.

3. General problems and challenges for survey statisticians

The problem picture regarding survey methods is a bit strange. On the one hand there are surveys and even organizations that use rather primitive survey methodology approaches. Typical for such approaches is that only a few error sources are addressed, for instance sampling and nonresponse. Survey statisticians in these surveys or organizations are not aware of recent developments and might be unfamiliar with error structures associated with measurement and processing survey steps. Another possibility is that managers are not well educated in survey methodology and have difficulties identifying problems. Also special priority situations might be at hand. As a result surveys conducted in such environments may generate results that can be questioned. For instance, in a survey of 14 government statistical organizations in Europe, Japoc (2000) found that eight of the 14 organizations used some kind of measurement error reduction method but only on 10% or less of their surveys.

On the other hand, there is an abundance of survey literature and an awareness of problems that is reassuring. Many statistical organizations have

very ambitious research programs and there is a lot of general research programs going on associated with official statistics and survey work. For instance, see Eurostat (2001).

Survey organizations and survey statisticians face many problems. First, there are some unsolved issues related to basic survey design. For instance, the proper allocation of resources to the various survey steps is basically unknown and so is the proper balance between cost, errors, and other quality dimensions. The relationship between resources spent on error reduction and actual error reduction is also unknown and all quality dimensions and constraints on them limit design flexibility (Biemer and Lyberg 2002). Second, at the same time there is a rapid growth in survey research, since the range of topics has increased leading to new approaches (Kalton 2000). Third, many organizations have been forced to work more intensively with organizational improvement during recent years. Although efficient, this kind of work demands new skills that have to be learned.

Platek and Särndal (2001) claim that statistics production appears to be a collection of practices without a strong theory. They say that randomization theory and the total survey error theory have not lived up to expectations. Kish (1995) thought, however, that theory lags behind practice and tends to do so almost by definition. For instance, new technologies are used long before the error structures have been reasonably investigated. This is the case for technologies such as scanning, audio-CASIC, web surveys, and automated coding. On the other hand, as pointed out, there is an abundance of new reliable methods that are not used due to ignorance, organizational features, and other reasons. In those cases we might say that practice lags behind theory.

Perhaps Biemer (2001) is right when suggesting that survey theory is a collection of many related theories somewhat topic and population-specific. What is needed is more research on integrated modelling, more attention paid to nonsampling errors and routine measurements of mean squared error components.

The need for training seems obvious but although all statistical agencies have some kind of training program for their survey statisticians the general perception is that current training support falls far short of what is needed (Kalton 2000, Biemer 2001).

4. General training approaches

When studying training programs in various government statistical agencies around the world a specific set of ingredients stands out.

- a) The assessment of training needs seems rather weak with some exceptions.
- b) Typically the agencies offer their survey statisticians to participate in short courses on sampling, the use of software packages, and tools

for analysis. These courses are either internal or external. Relatively seldom do courses, short or longer, treat nonsampling errors. Especially rare is the treatment of the measurement and processing errors.

- c) Some agencies have developed ties with universities and these ties can take different forms. There are examples of academic institutions that have developed master's and PhD programs in official statistics, statistical systems, or survey methodology. Other agencies have professors working part-time for the agency and part-time for the university. One obvious task for these professors is to serve as supervisors for agency staff that want to pursue advanced studies.
- d) Whether there are formal ties or not with academic institutions, many agencies support advanced studies for their employees. The support can range from unpaid leave to varying degrees of financially supported studies. In the latter case the students usually have to promise to stay with the agency for a certain time after the degree has been accomplished.
- e) Some agencies use a system of visiting scholars who work at the agency for short periods of time up to several years. These scholars bring with them an expertise and they train other employees in their areas of expertise. The scholars can be part of research teams but they can also serve as supervisors and teachers.
- f) It is very common that agencies encourage all expert visitors to also give seminars or short courses on a topic they master. It goes without saying that the topics discussed on those occasions may be somewhat outside the immediate needs of the agency.
- g) Other international collaboration is also common. There are more international projects today than ever before. The creation of the European Union and the demands for harmonized statistics across member countries automatically mean that countries within the Union have to collaborate to find solutions. Participation in international projects and working groups is usually very rewarding from a professional point of view.
- h) Most agencies send survey statisticians to conferences and workshops. This environment is very good for networking and generation of development ideas.
- i) Agencies working with quality management models such as the Malcolm Baldrige Award criteria or the Balanced Scorecard (Lyberg 2000) find that training and staff development are central components for a successful agency rating. In the same spirit agencies have found that teamwork can enhance the skills and performance of survey statisticians. The teams can consist of experts as would be the case

when developing a generalized estimation system or software for automated coding or the teams can consist of people who work on a process as would be the case when improving the nonresponse reduction process or the process of manual editing.

- j) Some of the measures described above are examples of on-the-job training. It is important that survey statisticians get the opportunity to work on different projects with different colleagues and perhaps also in different capacities. Lots of skills developments are generated by the “self-education” that takes place when new problems must be solved and when literature and colleagues are consulted.

5. Examples of specific programs offering training in survey research

Many of us complain that universities do not teach survey methodology as a discipline but that does not mean that training opportunities for survey statisticians are lacking. Many university departments around the world offer courses in sampling and analysis. It would take up too much space to list them all. Here we list some of the programs that are specifically designed to fit the needs of government statistical agencies and other survey research workplaces.

5.1 University Survey Methodology Programs

The following is a list of universities that offer more extensive programs related to survey research.

- University of Cincinnati, Graduate Certificate Program in Public Opinion and Survey Research.
- University of Connecticut, Graduate Program in Survey Research.
- George Washington University, Graduate Credit Certificate in Survey Design and Analysis.
- Hebrew University, Diploma in Official Statistics.
- University of Maryland (with University of Michigan and Westat), Joint Program in Survey Methodology.
- College Merici, Techniques de recherche, enquete et sondage.
- College Rosemont, Techniques de recherche, enquete et sondage.
- University of Michigan, Interdisciplinary Program in Survey Methodology.
- University of Jyväskylä, Master’s Program in Statistical Systems.
- Catholic University of Brussels, Master’s Program in Quantitative Analysis in the Social Sciences.
- University of Nebraska, Survey Research and Methodology Graduate Program.
- Ohio State University, Graduate Interdisciplinary Specialization in Survey Research.
- University of Southampton (with UK Office for National Statistics), Master’s Program in Official Statistics.
- York College, Certificate Program in Survey Research.

- George Mason University, Certificate in Federal Statistics.

We will describe a few of these programs in more detail below.

5.2 Joint Program in Survey Methodology (JPSM)

The JPSM, a consortium of the University of Maryland, the University of Michigan, and Westat, serves U.S. Federal statistical agencies and other workplaces with training in statistical science and social statistics, with common courses in survey methodology. Many of the U.S. statistical agencies are cosponsors of the program and have a large influence on the contents of the JPSM training program.

The JPSM collaborates extensively with its major stakeholders, the Federal statistical agencies. Researchers in the federal system are used as teachers, supervisors, and developers of course materials and survey practica. Faculty at the JPSM conduct research and JPSM is essentially a university department of survey methodology. Topics of courses provided include regression analysis with complex data, design of customer satisfaction surveys, questionnaire design, survey management, survey estimation, statistical methods using computers, data collection methods, applied sampling, sampling theory, inference from complex surveys, randomized/nonrandomized design, total survey error, the federal statistical system, and social and cognitive foundations of survey measurement. For a description of JPSM see Groves and Clark (2002).

5.3 The MSc in Official Statistics in UK

The University of Southampton and the UK Office for National Statistics (ONS) have developed a master’s program to cover the core skills and knowledge needed by professional government statisticians working in the UK and in other countries. Also short courses are offered. The master’s degree comprises an instructional component and a dissertation based on supervised research. The instructional component requires the completion of 16 courses out of 22 offered and the successful completion leads to the award of Diploma in Official Statistics. If the Diploma assessment is passed the student is permitted to undertake the dissertation work. The current topics of the courses are elements of official statistics, statistical computing, introduction to survey methods, data collection, questionnaire design and question testing, survey data processing, data quality and survey error reduction, basic survey sampling, further estimation methods, further sampling methods, compensating for nonresponse, evaluating and monitoring, demographic methods I and II, national accounts, index numbers, regression modelling, generalised linear models, analysis of complex survey data, multilevel modelling, analysis of longitudinal data, and time series I and II.

5.4 The Centre for Applied Social Surveys (CASS)

CASS is a resource center of the Economic and Social Research Council in the UK. CASS is run jointly by the National Centre for Social Research, the University of Southampton and the University of Surrey. Topics for 2001/2002 are postal and self completion surveys, quantitative survey design and data collection, pretesting survey questionnaires, descriptive and inferential statistics, exploring relationships, evaluation methods, survey sampling, multivariate data analysis, in-depth interviewing, and group discussions.

5.5 Institute for Postacademic and Further Academic Education

The Catholic University in Brussels offers a master's program in Quantitative Analysis in the Social Sciences. The aim of the program is to train students in multivariate analysis used in quantitative scientific research in the social sciences.

5.6 The Summer Institute in Survey Research Techniques

The Summer Institute in Survey Research Techniques has provided courses on survey-related topics since 1948. The course-lengths vary from eight weeks to one week and participation is a full-time activity regardless of course length. Course topics include Introduction to survey research techniques, analysis of complex sample survey data, workshop in survey sampling techniques, methods of survey sampling, data collection methods, analysis of survey data, multilevel analysis of survey data, cognition, communication and survey measurement, questionnaire design, computer analysis of survey data, population research in developing countries, event history calendar interviewing methodologies, event history analysis, questions for interviewer-administered surveys, introduction to survey quality, building and testing structural equation models, evaluation research design, semi-structured interviewing, combining qualitative and quantitative methods, web survey design, web survey implementation, focus groups, qualitative data analysis, small area estimation, model-based small area estimation, statistical analysis with missing data, and workshops on exploring bereavement among older adults and on examining the Health and Retirement Study.

The Michigan Inter-university Summer Training Program (ICPSR) provides additional courses and workshops some of which are relevant for survey statisticians. Examples of topics include advanced analysis, resampling techniques, statistical graphics, data visualization, and data mining.

5.7 Directorate of Higher Learning and Research of INSEE

INSEE is the French national statistical institute. Besides statistics production it has a general mission of teaching and conducting research in the

fields of statistics, economics and sociology. This general mission goes beyond the field of official statistics.

There are four education and research units associated with INSEE: Two units for higher education, ENSAE and ENSAI, one center for training, le CEPE, and one research center, le CREST.

The schools ENSAE and ENSAI provide training for new professional staff at INSEE but also for students coming from other workplaces in the private and public sectors. The syllabus the last three years and the level of the programs is equivalent to the first year of a U.S. Ph.D. or a top-level U.S. Master's degree in economics or statistics.

The ENSAE has two main tracks, mathematics and economics, and courses are mixed with training at workplaces. The final majors within mathematics are A: statistics, econometrics, B: finance, actuarial science, and within economics C: macroeconomics, and D: microeconomics, firms, markets, regulation.

The ENSAI main fields are statistics and probability; computing; economics, management, social sciences; communication; languages; and sport.

5.8 European Statistical Training Program (TES)

The training program for European statisticians started in 1990. Its mission is to provide the European Union with a high-quality statistical training program. The program consists of courses and both Eurostat and the statistical offices within the union play important roles in the analysis of training needs and the actual development of courses. The courses given during 2001 covered use of auxiliary information in sample surveys, seasonal adjustment methods, basic principles of the publication and dissemination of statistical products, the European Statistical System, geographical information systems, adding value through strategic management, business cycle statistics, nomenclatures and classification standards, statistical disclosure control, the European system of accounts, measuring economic activity on the Internet, towards a user-friendly statistical reporting, marketing and sales of statistical products and services, sampling techniques and practices, national accounts statistics in practice, quality management in statistics, the use of administrative sources for statistical purposes, labor cost and labor price statistics, advanced sampling techniques, theory and application of enterprise panel surveys, environmental expenditure statistics and accounts, introduction to applied time series analysis, confidentiality and protection of privacy, enterprise statistics, and systems of social statistics.

5.9 The International Programs Center (IPC) of the U.S. Census Bureau

The IPC offers two to six weeks workshops filling very specialized needs in survey training. The workshops are product oriented and cover the practical skills needed in a statistical office. The

program is directed towards other agencies and the 2002 summer workshops cover editing specifications for censuses and surveys, microcomputer processing of censuses and surveys, effective data dissemination systems for the new millennium, sampling and statistical methods, geographic information systems, analysis and evaluation of gender statistics, and statistical methods for measuring economic development and growth. Each workshop is limited to 15 participants which means better opportunities for individual training and supervision.

5.10 Graduate School, USDA

The Graduate School, USDA, is a continuing education institution offering both career-related courses primarily to government employees as well as academic and personal enrichment courses open to all adults regardless of workplace or educational background.

The Graduate school contracts with a very large faculty to provide courses around the world. Its mathematics and statistics program contains courses of interest to survey statisticians. Examples are introduction to sample surveys, theory of sample surveys, and exploratory data analysis for computers.

5.11 Professional Societies

Many professional societies offer courses of relevance to survey statisticians. For example, the American Statistical Association, the American Association for Public Opinion Research, the International Association of Survey Statisticians, the Washington Statistical Society, the Royal Statistical Society and other national statistical societies provide courses, seminars and other activities on a regular basis.

6. The Issue of Standardization

One problem associated with training of survey statisticians is that the survey steps are performed differently in different cultures and environments. We have already noticed that there is a lack of a unified survey theory and that survey methodology seems to be based on a number of different theories whose connections are not fully investigated. In practice, this means that the emphasis on various survey steps can vary considerably between agencies and even within agencies. It is quite common that survey statisticians have different opinions regarding what weight should be put on error reduction versus error adjustment. They also often have different opinions on the relative importance of individual error sources. Some of this variation is justified since certain matters are indeed debatable but other variation is due to incomplete training. Survey statisticians are simply not sufficiently familiar with the problems associated with all different survey steps. One way out of this dilemma is to develop, for the main survey process steps, documents that contain descriptions of best practices or

Current Best Methods (CBM). These CBMs can then be used by survey statisticians to make sure that all important process issues have been addressed.

6.1 Development of Current Best Methods (CBM) documents

A number of survey organizations are currently creating CBM documents in an effort to achieve a higher degree of standardization of the statistical production process. The goal, of course, is to adopt standards that are considered "best" in the sense that they represent the most successful, proven methodology.

As implied by the name, CBMs should be updated periodically to remain current with new developments in survey methodology. The frequency of these revisions will depend the rate of progress of research and technological development in the field and the priority given to maintaining the CBMs within the organization. In Morganstein and Marker (1997) and Lyberg, Biemer, and Japac (1998) the role of CBMs in the improvement of survey quality is discussed in detail. They state that one of the most frequently identified sources of variation is the difference in performance or even approach among people assigned to do the same task.

6.2 The sharing of best practices

Usually best practices are shared through courses, conferences, benchmarking, job rotation and networking. These are all good procedures but the survey world might need some more directed effort. One such effort is the European project AMRADS (Accompanying Measure for R&D in Statistics). The AMRADS project is described in Charlton and Bailey (2002). The project aims to transfer identified current best practice from centers of excellence to government statistical agencies according to their needs.

It is of utmost importance that European government agencies start using the same general methods in their survey work and this wish can indeed be extended to the whole survey world (De Vries 2001). For instance, initial work has recently begun on developing one common framework for describing quality dimensions in official statistics world-wide.

6.3 Documents describing large parts of the survey process

We have complained about the need for comprehensive descriptions of the survey process and the theories behind the methodologies used. There is a lack of textbooks describing the whole or large parts of the survey process. Books that come close include Lessler and Kalsbeek (1992), Groves (1989), and Biemer and Lyberg (2002).

VL-CATS is a virtual library on official statistics. This ongoing project will create an Internet site with reference material and multimedia enhanced

training courses. Tutors will be able to develop courses on a variety of topics by consulting the web site (Eurostat 2001).

Statistics Canada is in the final stages of preparing a 400 plus page document called the Survey Methods and Skills Manual covering, to varying degrees, all aspects of managing, planning, designing and implementing a survey—from inception through to evaluation and dissemination.

Statistics Sweden is developing a textbook on The Production of Official Statistics. The textbook will cover all major process steps. The final product consists of two parts. One part is a conventional paper textbook version providing a general description of the production steps. The second part is a web version where each user, i.e., statistical organization, adds specific links describing procedures and software used locally.

Statistics Norway is developing a handbook on the Use of Statistical Methods in Statistics Production at Statistics Norway.

It is not unlikely that more agencies are in the process of developing similar documents.

The U.S. Federal Committee on Statistical Methodology (FCSM) is organized by the Office for Management and Budget (OMB) to address issues of data quality that affect federal statistics (Gonzales 1994). The FCSM serves as a forum to discuss and suggest improvements in federal data quality. An objective of the FCSM is to create greater awareness among federal statisticians of data quality problems. To address this objective, the FCSM selects topics to study and then publishes reports that recommend improvements in selected areas of federal statistics. The results are published as Statistical Policy Working Papers and have great relevance for survey statisticians also outside of the U.S. So far 31 papers have been published and serving on the committees seems to be a great opportunity to benchmark and learn from each other since committee members come from federal agencies and committee members change for each paper. Examples of topics include statistical disclosure-avoidance techniques, statistical uses of administrative records, time-series revision policies, questionnaire development, industry coding, quality in establishment surveys, coverage, editing, indirect estimators, electronic dissemination, and measuring and reporting sources of error in surveys.

The U.S. Committee on National Statistics (CNS) is a free-standing committee to advise on statistical matters of national concern (Fienberg et al 1995). CNS also publishes on topics of relevance to survey statisticians. Examples of topics include privacy and confidentiality, small area estimation, incomplete data in sample surveys, surveying subjective phenomena, cognitive aspects of survey methodology, meta-analysis, and principles and practices for a federal statistical agency.

7. Training activities in government statistical agencies

One of the FCSM Statistical Policy Working Papers describes survey and statistical training in U.S. federal statistical agencies (U.S. Federal Committee on Statistical Methodology 1998). The report provides a study of training activities in U.S. government statistical agencies.

The subcommittee on training provided four recommendations.

- A. Elevate priority for training at the federal statistical agencies
- B. Assess training needs and opportunity within agencies
- C. Create a formal approach to employee career development
 - . Enhance statistical literacy outreach to agency clientele

These recommendations are valid also outside the U.S. Federal system.

We will now provide some brief descriptions of training activities used in a subjective sample of individual government statistical organizations. The organizations are all located in developed countries and listed in no specific order.

Statistics Norway. Statistics Norway has a school that offers courses for survey statisticians in questionnaire design, survey design in general, index theory, and register statistics. Several courses on the use of software are also offered.

Australian Bureau of Statistics (ABS). The ABS offers lots of short courses treating ABS's core business, basic survey design, its main statistical collections, accounting for non-accountants, economics for non-economists, how to liase with clients on survey design and content, provider contact training, turning data into information and other topics. Many of these courses are suitable for survey statisticians in getting topic overviews.

ABS offers graduate certificate in statistics consisting of three one-week residential modules (probability and data analysis, sampling and inferential statistics, regression and time series modeling) and ten weeks distance learning on the business research methods module. This latter module is very interesting since it aims to make students able to conceptualize research problems, operationalize concepts, describe how research is defined, and develop a research question. The learning techniques consist of web-based teaching and discussions as well as critical review of students' individual research proposals.

ABS has a seminar series called Statistical Impact. Its purpose is to inform senior staff about new and emerging methodological initiatives within the agency, so that widespread understanding and appreciation are achieved.

New graduates are exposed to the work of several different parts of ABS during their first 12-18 months as employees. Rotation continues through-

out their careers albeit with longer placements as experience grows. Staff is expected to present their work at seminars and also participate in those seminars when others are presenting.

INE, Portugal. The training program for survey statisticians at the Portuguese statistical office is built on courses. The most relevant module is Official statistics with courses on general sampling notions (estimation, data collection, sampling errors, nonsampling errors) with different contents depending on students' backgrounds, preliminary data analysis (bivariate data analysis, multidimensional analysis using SPSS, index numbers), elementary and basic econometrics, and statistical analysis of time series.

U.S. Bureau of Labor Statistics (BLS). The BLS has a fully equipped on-site training and conference center that provides a wide variety of classes and seminars. An ongoing information technology training program is designed to meet the needs of staff. In addition to the on-the-job training and technical training attended during regular work hours, there are opportunities to attend courses at local universities, especially courses given by JPSM, and to participate in conferences and seminars around the U.S. and abroad. Sometimes the JPSM courses are taught in the BLS conference center. Some employees can get a paid sabbatical, usually a year, to work on a degree.

Statistisches Bundesamt, Germany. The training program at the German statistical office is built on 1-5 days in-house courses, among them index theory, SAS, sampling theory, business registers, time series analysis, and confidentiality. The German office also uses TES as a vehicle for training.

The Statistical Office of the Republic of Slovenia (SORS). SORS has outlined an internal educational overview program covering many aspects of the survey process. Each module takes 3 to 16 hours course time. The modules are introductory statistics, descriptive statistics, sampling, panel surveys, index numbers, time series, quality measurement, nonresponse, imputation, questionnaire design, system of classifications, data analysis, official statistics and administrative data sources, disclosure control, media-relations, demography, and national accounts. This in-house training is estimated to take three years before all eligible staff have completed it.

RTI International. RTI International is not a government agency but conducts government surveys. The methodology training is mainly dictated by the needs of particular staff members. RTI takes advantage of course opportunities that exist, such as the JPSM short courses, courses offered by universities in the Triangle area, and courses offered in connection with conferences. Sometimes RTI invites experts to provide on-site training for its staff of survey statisticians.

RTI offers several basic training programs. The Survey Research Seminar Series (SRSS) is an eleven-part series designed to provide staff with a basic overview to the survey research process. The topics covered include an overview to survey research, total survey error, field surveys, telephone surveys, self-administered surveys, questionnaire design, sampling, human subjects research, CAI instrumentation, tracing, data processing, and marketing/business development. The series is designed with the inexperienced staff person in mind but specific modules can be of use to more experienced survey statisticians who may not have worked in all aspects of the survey process. By providing this series of seminars RTI is hoping to foster a mind set whereby staff are thinking critically about how each aspect of the survey process is affected by, and affects, other parts of the survey process.

Recently an Office of Quality Assurance and Regulatory Affairs (QARA) has been established. QARA provides training to research and technical staff on good clinical practice. It also implements and maintains a series of standard operating procedures, technical operating procedures, and quality management plans designed to assure quality systems. For instance, there are technical operating procedures in place for coding, data entry, mail receipt, and scanning. These procedures resemble the CBMs discussed above.

National Statistical Institute of Italy (ISTAT). ISTAT has a written policy for the development of its human resources and carries out very extensive training activities. ISTAT has developed a model for learning where staff are invited to discuss strategic goals, professional profiles, competence development, and agency priorities. The concept of professional identity is used to define training needs and implement training. By thoroughly analyzing work processes the necessary competencies are determined. The courses offered to survey statisticians include survey methodology, modelling, analysis, survey quality and verification tools.

Statistics Denmark. Statistics Denmark offers a number of courses for its survey statisticians including index theory, demography, data collection and questionnaire testing, seasonal adjustment, editing, time series analysis, regression analysis and logistic regression. There are also courses on software for variance estimation and data analysis. The courses take 1-3 days to accomplish.

USDA NASS. The employee training and development process at USDA NASS begins with an annual training needs assessment where learning needs and priorities are obtained from all units. The assessment methodology varies from year to year depending on work cycles, number of new employees, budget, and anticipated software or statistical changes. Some years all managers are asked to evaluate the job competencies of all employees and in other years data are collected from a sample of

managers and staff via questionnaires, interviews or focus groups. Based on these data a training group develops an annual training plan which is modified and approved by NASS leaders. Any annual plan has three features: full time education programs in survey methodology, continuing training workshops in survey techniques, and continuing training and development workshops in organizational methodologies.

The training group designs and delivers numerous workshops that focus on survey and estimation techniques required by employees to sustain their job performance at a level enabling NASS to provide quality products and services.

The Polish Central Statistical Office. The Polish Central Statistical Office has developed a three level training program on methodology for its workforce. There is an elementary level describing the basic concepts associated with survey design. The programs of interest to survey statisticians are the basic level and the higher level. The basic level treats questionnaire design, pilot surveys, control and analysis of errors, panel surveys, retrospective surveys, and elements of statistical analysis. The higher level is more mathematical including estimation and adjustment for errors, post-enumeration methods, small area estimation, time series analysis, quality management and statistical thinking. Due to lack of resources the program has not yet been implemented.

Statistics Finland. Statistics Finland finances in part the master's program in statistical systems at the University of Jyväskylä mentioned above. The program offers methodological training to some of the survey statisticians at the agency. It also has a visiting scholar program where the scholars lead workshops, seminars, and lecture series. Many survey statisticians are enrolled as post-graduate studies at Jyväskylä and other universities and the visiting scholars sometimes serve as supervisors for these students.

UK Office for National Statistics (ONS). ONS has decided to devote significant resources over the next few years to improving its methodology and statistical infrastructure. There is therefore a need to build up numbers of skilled survey statisticians and then to maintain a stable pool of expertise in the future. Like many other agencies ONS feels that its main strategy must be to develop the skills of the staff already recruited since few recruits have the appropriate skills. ONS does not favor early specialization so there is need for arrangements for staff to develop broad expertise early in their careers.

An analytical and research skills competencies framework is currently being developed. The framework is a tool which can be used during the career reviews and also in conjunction with annual performance appraisals. They will assist staff and managers to assess development needs and how to

address them, whether through formal training, development in the current job or a career move. To illustrate how the framework is functioning let us provide the following example:

Coding procedures.

An employee on level 1 understands the principles of coding, including uses of computer assisted coding (CAC). On level 2 he or she is able to develop coding frames for open-ended questions and can evaluate existing coding schemes. He or she can also develop simple new classifications and CAC procedures. On level 3 he or she can develop more complex new classifications and CAC procedures. On level 4 he or she can design overall coding or classification strategies for new complex surveys or for application across most/all surveys and can also develop standard/strategic CAC.

It is obvious that with a framework like this it becomes much easier to assess skills than without one.

The ONS strategies are outlined in more detail in Martin (2001).

The Swiss Federal Statistical Office. The Swiss office has developed a human resources policy and a number of operative measures to implement the policy. Courses offered to survey statisticians include sampling, data analysis and seminars on official statistics.

Westat. Westat is a private organization in the U.S. that conducts government surveys. Westat is part of the consortium that leads the JPSM described above and this involvement is of course very important for the development of methodological skills at Westat. Through the JPSM Westat has available lots of short courses that staff are encouraged to attend and there are also ample opportunities for Westat to influence the contents of courses offered.

Westat has over the years been very influential when it comes to teaching quality management in various agencies around the world. National offices in Sweden, Finland, Norway, Holland and Switzerland have used Westat's services for training quality facilitators and conducting improvement projects. Westat has been particularly influential when it comes to the development of current best methods, which is now an approach that is widely used throughout the statistical system world-wide.

INSEE. The training activities at the French agency are routed through the schools mentioned above.

Statistics Sweden. Statistics Sweden used to have a school similar to the one that Statistics Norway has. For various reasons the school approach was abandoned and the current approach is a mixture of a number of activities. In-house courses are provided on demand. Recent courses have treated graphical methods and software for variance estimation. Foreign experts are relatively frequently invited to give courses on topics such as nonsam-

pling errors, data collection methods, cognitive methods, editing, multi-level analysis, questionnaire design, and web surveys. Sweden has a decentralized system for official statistics so staffs from all statistical agencies in Sweden are invited to these courses.

The production of the methodological Journal of Official Statistics generates many contacts and the journal serves as an efficient vehicle for keeping survey statisticians up to date with recent developments and provides an opportunity for statisticians to publish and serve as article reviewers.

U.S. Census Bureau. The Census Bureau places high priority on training for survey statisticians because the proficiency level of these individuals affects the quality of Census Bureau products. Five types of training are available: college and university courses, on-site seminars, statistical association conferences, outside vendors, and staff rotation. As for university courses each division decides what courses its statisticians should take to meet the needs of the division. Among the courses most often taken are: applied sampling, theory of sample surveys, econometrics, questionnaire design, probability, multivariate and regression analysis, demographic analysis, inference, and research methods.

The Census Bureau has strong ties with the JPSM described above and the agency places up to six employees in the master's program each year. The other forms of instructions that JPSM offers, such as the short courses, are also frequently used.

The Census Bureau has experimented with a career development program for mathematical statisticians. The program is described in U.S. Federal Committee on Statistical Methodology (1998).

Statistics Canada. Statistics Canada has developed principles governing survey statisticians' training and development. First, survey statisticians are responsible for their own development. Second, managers are supposed to provide an environment that enables survey statisticians to make and pursue development plans. Third, section chiefs are responsible for facilitating training and development of their employees. Fourth, any training program must conform to government wide and Statistics Canada training policies.

The principles listed above are described in more detail in a document called Training and Development Handbook. The handbook also discusses, under a series of headings, training options that should be part of a survey statistician's training plan.

The six-week Survey Skills Development Course provides a good grounding in the methods and skills that are applied at Statistics Canada. For survey statisticians it should be augmented, when necessary, with further training in different survey methodology areas.

Throughout their careers, survey statisticians are supposed to develop and broaden their skills by

undertaking a variety of assignments. To function effectively on an assignment, the statisticians are encouraged to obtain as much relevant knowledge and insight as they can. Once statisticians acquire expertise and experience many of them become involved in training and leading other statisticians.

Courses given within Statistics Canada include data analysis and presentation, advanced sampling theory and survey methodology, classical techniques for data analysis, analysis of data from surveys with complex sample designs, components of time series, benchmarking and interpolation, ARIMA modelling and forecasting, seasonal adjustment using X-11 ARIMA, questionnaire design, technical writing, as well as numerous courses on specialized software and microcomputer packages.

Statistics Canada puts a lot of effort into the recruitment process and has developed a Mathematics Recruitment and Development Program. It is the policy of Statistics Canada to hire the best-qualified graduates from universities across Canada.

Statistics Canada publishes a scientific journal, *Survey Methodology*, which serves the same purpose as the Swedish Journal of Official Statistics.

7. Discussion and Conclusions

We have seen examples of many different approaches when it comes to training of survey statisticians. There are some features described that might be considered by more agencies. For instance, it seems valuable to view the training of survey statisticians as a process with components such as assessment of needs, development of training policy, identification and/or development of training methods, actual training, and evaluation. By defining and observing key process variables it is more likely to obtain a good product quality (such as effective training) than if the approach is more ad hoc.

When it comes to contents we have seen many ambitious programs but an overwhelmingly large part of the contents consists of courses on statistical theory, sampling theory and methods, analysis and selected survey operations such as questionnaire design and nonresponse adjustment. There are few opportunities to learn about all known error sources (specification, coverage and nonresponse, the response process, interviewers, other modes of data collection, and data processing). Few organizations offer training opportunities on how to formulate research problems, the research process itself, optimization of surveys and how to evaluate surveys. The current emphasis on sampling and analysis is hardly justified considering the ever present non-sampling errors. Furthermore, only a few agencies offer training in statistical thinking as discussed by for instance Wild and Pfannkuch 1999 (process, variation, data) or Kish 1995 (population, replication, random replication, random variables).

- A. Statistical organizations should be particularly fit to collect and analyze training process data so that a good training product is obtained.
- B. In many cases it would be better for agencies to send employees to the training programs rather than developing similar activities on-site. In other cases it might be advantageous to contract with the special program to provide training at the agency.
- C. As a follow-up to B it would be good to have a web data base on training opportunities worldwide
- D. There is a general need for integration of different models in survey work and an increased standardization of survey methods and survey design across surveys, agencies and countries. One possibility would be to create excellence centers in different countries where there is an interest and available competence to develop best practices.
- E. As pointed out by Holt (1999) cooperative development between countries will maximize the use of special skills and training practices need to be exchanged. Two or three countries can start.
- F. Training of survey statisticians probably needs to be better organized than what is currently the case. All organizations should consider the kind of competence frameworks that ONS and Statistics Canada have developed.

8. References

- Biemer, P. (2001), "Comment on Platek and Särndal (2001), *Journal of Official Statistics*, 17, 1, pp. 25-32.
- Biemer, P., and Lyberg, L. (2002), *Introduction to Survey Process Quality*, Wiley (forthcoming)
- Charlton, J., and Bailey, S. (2002), "Sharing Best Methods and Know-how for Improving Data Quality," Report AMRADS Project, ONS.
- De Vries, W. (2001), "Good Practices in Official Statistics," Paper presented at the International Conference on Quality in Official Statistics, Stockholm, May.
- Dillman, D. (1996), "Why Innovation Is Difficult in Government Surveys," *Journal of Official Statistics*, 12, 2, pp. 113-198 (with discussions).
- Eurostat (2001), EPROS: Progress Report R&D in Statistics. Monographs of Official Statistics.
- Fienberg, S., Martin, M., and Straf, M. (1995), "The Committee on National Statistics: Fostering Interactions Between Statisticians in Academia and Government," *International Statistical Review*, 63, 3, pp. 257-269.
- Gonzalez, M.E. (1994), "Improving Data Quality Awareness in the United States Federal Statistical Agencies," *The American Statistician*, 48, 1, pp. 12-17.
- Groves, R. (1989), *Survey Errors and Survey Costs*, New York: John Wiley.
- Groves, R., and Clark, C. (2002), "The Joint Program in Survey Methodology: A Government Partnership for an Academic Program," Memo U.S. Census Bureau and JPSM.
- Holt, D. (1999), "Statistics in a Democratic Society: The Role of Methodology," Paper presented at the 4th Conference on Methodological Issues in Official Statistics, October 12-13, Stockholm.
- Japac, L. (2000), Results from the International Quality Questionnaire, Paper presented to the Leadership Group on Quality, Eurostat.
- Kalton, G. (2000), "Developments in Survey Research in the Past 25 Years," *Survey Methodology*, 26, 1, pp. 3-10.
- Kish, L. (1995), *The Hundred Years' Wars of Survey Sampling*, Centennial Representative Sampling, Rome.
- Lehtonen, R., Pahkinen, E., and Särndal, C.-E. (2002), "Research and Development in Official Statistics and Scientific Co-operation with Universities: An Empirical Investigation," *Journal of Official Statistics*, 18, 1, pp. 87-110.
- Lessler, J.T., and Kalsbeek, W.D. (1992), *Nonsampling Errors in Surveys*, New York: Wiley.
- Lyberg, L. (2000), "Recent Advances in the Management of Quality in Statistical Organizations," Paper presented at the Statistical Quality Seminar 2000, December 6-8, Cheju Island, Korea.
- Lyberg, L., Japac, L., and Biemer, P. (1998), "Quality Improvement in Surveys- A Process Perspective," *Proceedings of the Section on Survey Research Methods*, American Statistical Association, pp. 23-31.
- Martin, J. (2001), MAC Paper on Recruitment, Development and Retention of Methodologists, Internal memo, limited access, ONS, UK.
- Morganstein, D., and Marker, D.A. (1997), "Continuous Quality Improvement in Statistical Agencies," in L. Lyberg, P. Biemer, M. Collins, E. De Leeuw, C. Dippo, N. Schwarz, and D. Trewin (eds), *Survey Measurement and Process Quality*, pp. 475-500, New York: Wiley and Sons.
- Platek, R., and Särndal, C.-E. (2001), "Can a Statistician Deliver?" *Journal of Official Statistics*, 17, 1, pp. 1-20 and Discussion, pp. 21-127.
- Särndal, C.-E. (not dated), Research and Development at Statistics Sweden: An Analysis, Memo Statistics Sweden.
- U.S. Federal Committee on Statistical Methodology (1998), *Training for the Future*, Statistical Policy Working Paper 27, Washington, DC.: U.S. Office of Management and Budget.
- Wild, C.J., and Pfannkuch, M. (1999), "Statistical Thinking in Empirical Enquiry," *International Statistical Review*, 67, 3, pp. 223-265 (with discussion).