WP. 27
ENGLISH ONLY

UNITED NATIONS STATISTICAL COMMISSION and ECONOMIC COMMISSION FOR EUROPE

CONFERENCE OF EUROPEAN STATISTICIANS

Work Session on Statistical Data Editing
(Ottawa, Canada, 16-18 May 2005)

Topic (iii): Electronic data reporting - editing nearer source and multimode collections

EDR IMPACTS ON EDITING

Supporting Paper

Submitted by the National Statistics Institute, Spain [1]

I. INTRODUCTION

1. Electronic Data Reporting (EDR) and, in particular, Web surveys offer the opportunity for new editing strategies. Moving editing closer to the respondent can significantly contribute to improving editing effectiveness. We can go a step further by integrating the respondents into the editing processes. Electronic questionnaires offer new possibilities of moving editing closer to the respondent. The possibility of using built-in edits allows respondents to avoid errors as they are made. The elimination of data keying at the statistical agency directly gets rid of a common source of error. Hence, some of the traditional editing tasks could be reduced.

2. Many statistical institutes are offering electronic questionnaires as a voluntary option in order to improve the efficiency of statistical processes and to reduce respondent burden. Hence, a mixed mode of data collection (partly paper, partly electronic) is used. Global strategies should be designed, because data editing strategies may differ when using paper than when using an electronic questionnaire. Some crucial questions arise: What kind of edits should be implemented on the electronic forms? How many? Only fatal edits or fatal edits and query edits? What kind of edits should be mandatory?

3. Like many other statistical institutes, the National Statistical Institute of Spain (INE) has a significant interest in Web-based data reporting. An example of this was the possibility offered to all citizens to fill in the Population Census 2001 using the Internet. The INE is working on a general project of giving reporting enterprises the option of submitting their responses to statistical surveys using the Internet. A major target of this project is to offer the reporting enterprises another option to fill in the questionnaires, in the hope of reducing respondent burden, or, at least, improving our relationship with them.

4. While there are a lot of expectations about the role of Web questionnaires in the years to come, the use of Web questionnaires is often lower than expected. More research is needed to look for the reasons why the rate of using electronic questionnaires is quite low, while technical conditions are available for many of the respondents. Probably, the electronic forms do not have as many advantages for the respondents as for the statistical offices. For this reason, encouraging the use of Web

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questionnaires by respondents is a key issue. Several methods can be used. For example, explaining the benefits to the respondents or considering statistical Web questionnaires in a wider context of all administrative duties and all EDR (e-commerce, e-administration, etc.). Given incentives (temporary access to information, free deliveries of tailored data) is another method to increase the take-up of Web questionnaires.

5. This paper explores the possibilities of Web questionnaires in order to reduce editing tasks. The combination of built-in edits and selective editing approach appears very promising. Our target for the future is that, after implementing correct Web edits, no traditional microediting will be needed. Some practical experiences in the Spanish Monthly Turnover and New Orders Survey are presented. For this survey, we offer tailored data from the Web. When an enterprise sends a valid form, it immediately receives tailored data from the server. Taking this advantage into account, we expect more enterprises to use the Web survey.

6. In the following section, the challenges and opportunities of electronic questionnaires are discussed. In section III, some practical experiences are presented. The paper concludes with some final remarks.

II. CHALLENGES AND OPPORTUNITIES OF ELECTRONIC QUESTIONNAIRES

7. Web surveys offer new opportunities on moving editing closer to respondents. Whereas Computer Assisted Interviewing (CAI) integrates into one step previously distinct phases such as interviewing, data capture and editing, Web surveys go a step further by shifting such activities to the respondent. Hence, Web surveys offer the opportunity for re-engineering editing processes, in a way reporting enterprises may play a more active role in data editing.

8. Many statistical offices are experimenting with the use of different EDR options in data collection. Web surveys offer some advantages over other more complex EDR methods. The Web is a mature technology for EDR because of widespread public acceptance in enterprises and institutions (and increasingly, also in households). The prerequisites are only a PC, access to the Internet, and a browser. There is no need, in principle, to incorporate other software on the reporting enterprises. The Web makes it simple to put electronic forms at the disposal of almost every enterprise, whatever its size.

9. Several advantages could be expected from using Web surveys. These include improving accuracy and timeliness, and reducing survey cost and enterprise burden. Improving accuracy results from built-in edits, which allow the reporting enterprises to avoid errors as they are made. The elimination of data keying at the statistical agency directly gets rid of a common source of error. Moreover, this elimination of data keying reduces the processing time of the survey. There are other factors that can also contribute to improve timeliness. Data transfer on the Web can be done much faster than using the postal system. Some electronic devises (automatic data fills and calculations, automatic skipping of no applicable questions, etc.) could help the respondent to fill in the questionnaire faster. The cost for statistical offices to carry out a survey using the Web could decrease. Savings could be achieved from reducing storage, packing, postal charges and eliminating data keying and keying verification. Some of the editing task could be reduced from built-in edits.

10. Nevertheless, to get the target of reducing enterprise burden using Web surveys is not so straightforward. The reduction in the enterprise burden is not always obvious. The respondents' benefits depend largely on the way metadata support the respondent in filling in the questionnaire (help texts, auto-fill rules, pre-filled data, etc). In any case, the respondents' benefits need to be clearly explained to convince them to use the Web questionnaire. An important element to improve the acceptance of Web surveys among reporting enterprises is to consider Web questionnaires in a wider context of all their administrative duties and of all electronic data reporting. It is unlikely that reporting enterprises are willing to adapt their systems only for statistical purposes. Hence, statistical

offices should be aware of the habits of respondents and try to adapt electronic questionnaires to these trends (for example, e-commerce, e-administration, etc.).

11. There are a lot of expectations about the role of Web surveys in the years to come. Nevertheless, the implementation of Web surveys and other EDR methods in enterprise surveys (and, even more, in household surveys) has often been lower than expected. The take-up of electronic data reporting for statistical data by business providers is generally less than 10%, and often less than 5% (Branson 2002). Other studies also find low rates of response via Internet. For example, Grandjean (2002) finds a rate of 18% for a survey used to construct the Index of Industrial Production in France. Different rates are found in this study by enterprise size (higher for large enterprises than for small and medium ones) and by sectors (for example, electronic and electric industries more than the average, furniture industries less than the average). In another study, Mayda (2002) finds a rate between 5% and 25% in two quarterly surveys on business and agriculture in Canada. Even though the usage of the electronic option by respondents has increased lately (for example, Paula Weir, 2005) it still leaves room for improvement.

12. More research is needed to look for the reasons why, up to now, the rate of using EDR is quite low, while technical requirements are available for many of the respondents. Probably, electronic forms have not the same advantages for the reporting enterprises than for the statistical offices. For many of the questionnaires, the most time consuming tasks are to look for the required data and computing the answers. There is no time difference between keying data on a screen and to fill in a questionnaire on paper. The advantages for the reporting enterprises would probably be bigger if the information could be extracted straight from their files. But this procedure may be expensive for both reporting enterprises and statistical agencies, because an initial investment is needed.

13. In any case, for most of the surveys, it is clear that, at the moment, EDR cannot be the only way of data collection. Paper data collection and associated procedures (like scanning) are probably going to stay with us for some years. Hence, a mixed mode of data collection (partly paper, partly electronic) should be used. Global strategies should be designed, because data editing strategies differ when using paper to an electronic questionnaire.

14. There are two contradictory targets. On one hand, to implement a single point of entry for all agency surveys, with a uniform security model and a common look across the entire site. And, on the other hand, to allow decentralised applications to cope surveys singularities. One aspect where the difference among surveys has to be taken into account is data editing. Combining the two targets (i.e. integrating a centralised platform with decentralised applications) is a non-trivial task.

15. Some crucial questions arise: What kind of edits should be implemented on the Web? How many? Only fatal edits or fatal edits and query edits? What kind of edits should be mandatory? When should the edits be performed? After each data item or after the whole form has been sent to the server?

16. On one hand, we need to include some edits. If we do not, then the information collected by a Web survey should be treated to the editing procedures in exactly the same way as collected by paper. In that case, we would lose an essential advantage of Web surveys: no need to editing again the information with a suitable set of edits implemented in the Web application. On the other hand, we need to be extremely careful with the set of edits to be implemented in the Web survey, because if we implement a big set, then respondents will give up and prefer the freedom they have in paper. Too many edits could even irritate the reporting enterprises and increase the burden. In that case we will lose all the advantages of Web surveys, as users will prefer the easy way (paper).

17. How to cope with the too few/too many edits dilemma? If we are trying to implement a Web questionnaire in an existing survey, a way is to analyse the current set of edits in order to determine the efficient set of edits to be used in the Web implementation. Hence, the implementation of new procedures obliges to the revision and redesign of the current procedures of the survey. But we should

make that revision from the user's point of view. Otherwise, it would be impossible to find out if the users are going to get fed up with the task of filling in a Web form or not. It must be stressed that making that sort of analysis is strictly necessary in order to implement a suitable set of edits that will not discourage users and that will make possible not to edit the Web information in the traditional paper way.

18. In order to achieve this target an analysis similar to that of Martin and Poirier (2002) should be carried out. It is important to have procedures allowing access to versions of data and additional processing metadata that describe how the data were transformed from collection to dissemination.

III SPANISH EXPERIENCES ON WEB SURVEYS: THE TURNOVER AND NEW ORDERS SURVEY

19. Like many others statistical agencies, the INE has a significant interest in Web-based data reporting. An example of this was the possibility offered to all citizens to fill in the Population Census 2001 using the Internet. The INE is working in a general project of giving respondents the option of submitting their responses to statistical surveys using the Internet. A major target of this project is to offer the respondents another option to fill in the questionnaires, in the hope of reducing respondent burden, or, at least, improving our relationship with them.

20. Moreover, an ad hoc prototype Web system to collect establishment data for the Turnover and New Orders Survey is also being implemented. This monthly survey uses a very simple form. Many problems using the Internet might be due to the various configurations and products installed on the respondents' machine. Each respondent's computer can have different components, different versions of operating systems and browsers, and different modem speeds. For this reason, and from using a very simple form, all the programs are going to be run through the server, without the need to install any software on the respondents' computer.

21. The Web form is being offered to the sample of reporting enterprises as a voluntary option to respond to the Survey. We think that, probably, many enterprises will not change to the Web form. For this reason, we offer tailored data to them. When an enterprise sends a valid form (i.e. passing the mandatory edits), it immediately receives tailored data from the server. These tailored data consist of tables and graphs showing the enterprise trend and its position in relation with its sector. Offering this data through the Web has some advantages (speed, possibility to edit the file) over sending this same data on paper by mail. Taking these advantages into account, we expect more enterprises to use the Web survey.

A. Editing in the New Orders/Turnover Industrial Survey

22. A monthly survey provides data to publish the Short Term Indicators of Industrial New Orders and Turnover. The sample size is of about 13,200 local units, for which 14 variables are requested:

- Orders: Total new orders, domestic market, eurozone non-domestic, European Union non-eurozone, non-EU, stock at the beginning of the month, cancelled orders, orders invoiced and stock at the end of the month.

- Turnover: Total turnover, domestic market, eurozone non-domestic, European Union non-eurozone, non-EU.

23. Hereafter, the variables Total Turnover and total New Orders will be referred as ‘main variables’. Since these variables are used for the computation of the indices, they receive a different, more exacting, editing process. When in the future, new indices are calculated, e.g. for the different markets, more variables will have the same consideration.

24. The data is collected in three different ways: a little more than 90% of the sample is collected by the local offices of the INE, about 8% is obtained directly by the national headquarters and from January 2005 a web reporting system (WRS) is working experimentally.

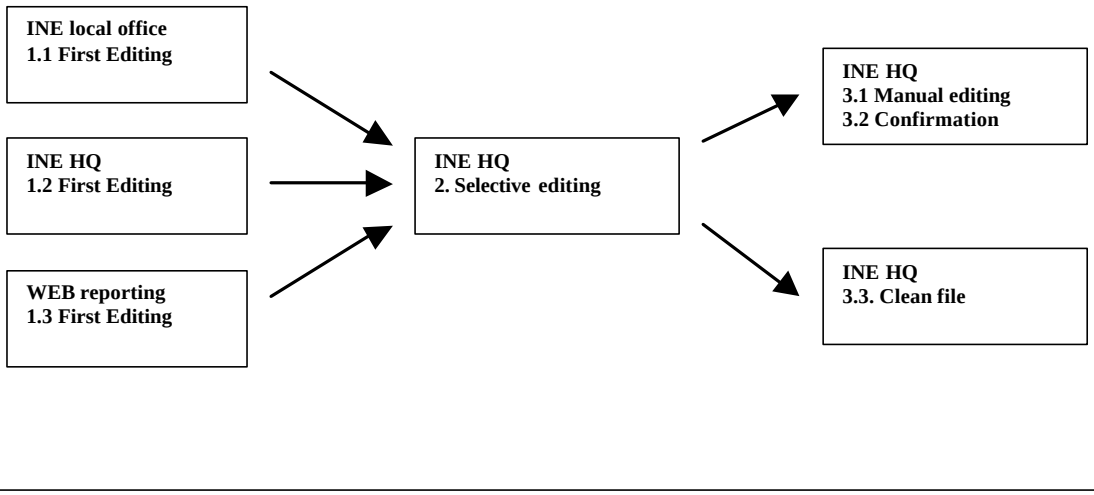

Figure 1 Microediting Scheme

B. First editing of paper questionnaires

25. The processes 1.1 and 1.2 are very similar, since the edits implemented are the same. The main differences are due to the closeness of the 1.2 editing team to the people in charge of the calculation of the indices and the fact that the same team performs also phase 3. Thus, the result of 1.2 is intended to be more reliable, since the team receives a more direct feedback from the computations and analysis done with the edited microdata. Moreover, the team in 1.2 is more specialized (working only in this survey) and more qualified (university degree).

26. The interest of having this data collecting channel in the INE headquarters is to guarantee the quality of the data from some enterprises of great importance for the computation of the indices.

27. Two kinds of edits are distinguished in **phases 1.1 and 1.2**: type I and type II.

I edits are mandatory, checking that:

- There are no non-numeric characters and the values are within the range [0,9999999999]. The upper value is due to the format of the files used for transmitting the data. Negative values are not allowed.
- All the variables are reported.
- The market desegregation sums up to the main variables.
- The stock at the end of the month equals the stock at the beginning plus new orders received, minus orders cancelled, minus orders invoiced.

II edits are not mandatory. The only effect is that the person in charge of recording the questionnaire is forced to type a remark. These edits check that:

- The stock of orders at the end of the month equals the stock at the beginning of the next month. This edit was decided to be non-mandatory because some enterprises argued that due to price changes, the value of the stock is recalculated when passing from one month to another.
- The change rate of any variable is within a defined range. The rates are computed comparing the current value with those of the previous month and the same month of previous year. The intervals are described in Table 1. It should be noted that they are very narrow, so there is an important risk that the frequency of errors, most of them unnecessary, makes the staff keying the questionnaires to type standard remarks which are of no use to the subsequent process.

Variable	Previous month		Previous year	
	Min	Max	Min	Max
Total new orders	-30%	+30%	-30%	+30%
Domestic market	-50%	+50%	-50%	+50%
Eurozone non-domestic	-50%	+50%	-50%	+50%
EU non-eurozone	-50%	+50%	-50%	+50%
Non-EU	-50%	+50%	-50%	+50%
Stock at the beginning	-30%	+30%	-30%	+30%
Orders cancelled	-30%	+30%	-30%	+30%
Orders invoiced	-30%	+30%	-30%	+30%
Stock at the end	-30%	+30%	-30%	+30%
Total Turnover	-30%	+30%	-30%	+30%
Domestic market	-50%	+500%	-50%	+500%
Eurozone non-domestic	-50%	+500%	-50%	+500%
EU non-eurozone	-50%	+500%	-50%	+500%
Non-EU	-50%	+500%	-50%	+500%

Table 1

C. First editing in the web reporting system

28 The process in the **web reporting system 1.3** is somewhat different. The mandatory edits are the same but for the fact that some variables in the market desegregation are allowed to remain blank. In this case, the system assumes that their real values are zero (which implies that the remaining variables sum up to the total value reported).

29. There is a strongly reduced list of informative errors, since the change rates are checked only for the main variables. The ranges also differ between the annual and monthly rates and are much broader. The larger width of the monthly intervals is due to the seasonality of some series. A further difference is that in this case, the remarks are optional. The ranges are described in Table 2.

Variable	Previous month		Previous year	
	Min	Max	Min	Max
Total New Order	-99%	+9800%	-90%	+4000%
Total Turnover	-99%	+9800%	-90%	+4000%

Table 2

D. Selective editing

30. The questionnaires from the 1.1, 1.2 and 1.3 proceed to phase 2. Some questionnaires are selected for manual editing according to the following criteria:

- Strong **variation** from the previous values.
- **Influence** on the value of the branch indices, i.e., the value of the index is very different depending on whether the microdata is used in the calculation or not.

E. Variation

31. At this stage, the microdata files are augmented with two flags indicating whether the variation rates of the main variables exceed some limits. There is one flag for each main variable which activates if any of the ranges is exceeded. The limits are the ones in Table 2. In fact, these ranges were applied to the web reporting system after being used for selective editing. One aim of the experiment is to know if the fact that the reporter is warned of the values exceeding the limits allows a relaxed later editing.

32. When the flag is activated, the microdata is not used in the computation of the index unless it is validated in the phase 3 of the editing scheme. Otherwise, the data is considered as validated, so it is used in for the computations, unless its validity is revoked in phase3.

F. Influence

33. The influence is computed in a different way depending on whether the variation flag is activated or not.

- In the first case, the aim of computing influence is to **know the effect of validating the microdata**. Thus, we compare the monthly rate of the branch with and without the microdata. By compaing the variation rate instead of the index, we remove the effect of the index level, which can be very different between activities.

- In the second case, the influence has a further function, that is **to detect anomalous values**. Thus, due to the seasonality of many series, it proved more useful to compare the annual rate on the branch with the one obtained **removing the value** under analysis from the **current total** (month t) and removing the value of previous year to the corresponding total (month t-12).

34. The first influence is easy to calculate. We compute the variation rates:

$$V^M = \frac{\sum_j \widehat{x}_{i,j}^t}{\sum_j \breve{x}_{i,j}^{t-1}} \qquad V_k^M = \frac{x_{i,k}^t + \sum_j \widehat{x}_{i,j}^t}{x_{i,k}^{t-1} + \sum_j \breve{x}_{i,j}^{t-1}}$$

EQ 1

- V^M is the monthly rate of variation with all data and V_k^M is the rate obtained adding the value under analysis.
- $\widehat{x}_{i,j}^t$ is the value of unit *j* in activity *i* at time *t*, among the validated units common to time *t-1*.
- $\breve{x}_{i,j}^t$ is the value of unit *j* in activity *i* at time *t*, among the validated units common to time *t+1*.
- $x_{i,k}^t$ is the value of the (non-validated) unit under analysis *k* in activity *i* at time *t.*

35. The influence thus, is computed as:

$$I_k^M = 100 \times \left(V_k^M - V^M \right)$$

EQ 2

36. The influence measure used for the validated microdata involves more complex calculations. The following formulae are used:

$$V^A = \prod_{s=1}^{12} \frac{\sum_j \widehat{x}_{i,j}^{t-s+1}}{\sum_j \breve{x}_{i,j}^{t-s}} \qquad V_k^A = \frac{\sum_{j \neq k} \widehat{x}_{i,j}^{t}}{\sum_j \breve{x}_{i,j}^{t-1}} \left(\prod_{s=2}^{11} \frac{\sum_j \widehat{x}_{i,j}^{t-s+1}}{\sum_j \breve{x}_{i,j}^{t-s}} \right) \frac{\sum_j \widehat{x}_{i,j}^{t-11}}{\sum_{j \neq k} \breve{x}_{i,j}^{t-12}}$$

EQ 3

37. Where:

- V^A is the yearly rate of variation with all data and V_k^A is the rate obtained removing values as explained above.
- $\widehat{x}_{i,j}^{t}$ is the value of unit *j* in activity *i* at time *t*, among the validated units common to time *t-1*.
- $\breve{x}_{i,j}^{t}$ is the value of unit *j* in activity *i* at time *t*, among the validated units common to time *t+1*.

38. Thus, the influence can be computed as:

$$I_k = 100 \times \left(V^A - V_k^A \right)$$

EQ 4

G. Interpretation of the influence

39. We can express the monthly influence in a different form:

$$I_k^M = 100 \times \left(\frac{x_{i,k}^t + \sum_j \widehat{x}_{i,j}^t}{x_{i,k}^{t-1} + \sum_j \breve{x}_{i,j}^{t-1}} - \frac{\sum_j \widehat{x}_{i,j}^t}{\sum_j \breve{x}_{i,j}^{t-1}} \right) = 100 \times \frac{\left(x_{i,k}^t + \sum_j \widehat{x}_{i,j}^t \right) \sum_j \breve{x}_{i,j}^{t-1} - \left(x_{i,k}^{t-1} + \sum_j \breve{x}_{i,j}^{t-1} \right) \sum_j \widehat{x}_{i,j}^t}{\left(x_{i,k}^{t-1} + \sum_j \breve{x}_{i,j}^{t-1} \right) \left(\sum_j \breve{x}_{i,j}^{t-1} \right)}$$

If the value of $x_{i,k}^{t-1}$ is small compared with the total $\sum_j \breve{x}_{i,j}^{t-1}$, we can make the approximation:

$$I_k^M \cong 100 \times \frac{\left(x_{i,k}^t + \sum_j \widehat{x}_{i,j}^t\right)\sum_j \breve{x}_{i,j}^{t-1} - \left(x_{i,k}^{t-1} + \sum_j \breve{x}_{i,j}^{t-1}\right)\sum_j \widehat{x}_{i,j}^t}{\left(\sum_j \breve{x}_{i,j}^{t-1}\right)^2} = 100 \times \frac{x_{i,k}^t \sum_j \breve{x}_{i,j}^{t-1} - x_{i,k}^{t-1}\sum_j \widehat{x}_{i,j}^t}{\left(\sum_j \breve{x}_{i,j}^{t-1}\right)^2} =$$

$$= 100 \times \frac{x_{i,k}^{t-1}}{\sum_j \breve{x}_{i,j}^{t-1}}\left(\frac{x_{i,k}^t}{x_{i,k}^{t-1}} - \frac{\sum_j \widehat{x}_{i,j}^t}{\sum_j \breve{x}_{i,j}^{t-1}}\right)$$

EQ 5

40. Thus, the influence is approximately equal to the **weight of the unit** *j* in *t-1*, multiplied by the **difference between the rates of variation** of the unit and of the whole branch.

41. In a similar way, for the annual influence we can compute:

$$I_k^A \cong 100 \times A \frac{x_{i,k}^{t-12}}{\sum_j \breve{x}_{i,j}^{t-12}}\left(\frac{x_{i,k}^t}{x_{i,k}^{t-12}} - \frac{\sum_j \widehat{x}_{i,j}^t}{\sum_j \breve{x}_{i,j}^{t-12}}\right)$$

Where:

$$A = \left(\sum_j \breve{x}_{i,j}^{t-1}\right)^{-1}\left(\prod_{s=2}^{11} \frac{\sum_j \widehat{x}_{i,j}^{t-s+1}}{\sum_j \breve{x}_{i,j}^{t-s}}\right)\sum_j \widehat{x}_{i,j}^{t-11}$$

42. The factor *A* is common for all units *k*, so it has no effect for comparison between the units of a branch.

H. Selection

43. The questionnaires are then distributed according to Table 3.

CASE	EDITING
Validated	The microdata with greater influence are selected for manual editing. The threshold is decided by the editing team depending on several criteria, such as the weight of the branch and results from the macro editing.
Non-Validated and Monthly influence in [-1%,1%]	The microdata are edited manually one by one.
Non-Validated and Monthly influence out of [-1%,1%]	Confirmation with the reporting enterprise is requested.

Table 3

III. FINAL REMARKS

44. A prerequisite of any editing strategy is obtaining high quality incoming data. The problem of how to get high quality incoming data can be faced from the perspective of the Total Quality Management (TQM). Using a TQM approach, it is considered that the suppliers (i.e. the reporting enterprises) are part of the production system. Hence, the statistical process begins with the production and transmission of microdata by the reporting enterprises. Data collection has to be adapted to the respondent conditions and possibilities. Also, statistical agencies should implement strategies to encourage the respondent to fill in questionnaires with confidence and care. A key success factor in achieving high quality incoming data is improving our relationship with reporting enterprises. One of the ways this is being achieved is by offering the enterprises free of charge data tailored to their needs. According with our experience, this new practice (Gonzalez and Revilla, 2002) has seen an increase of interest on the part of the enterprises, which are consequently filling in questionnaires more carefully. Moreover, an "auditing system" carried by reporting enterprises comes from that practice (Revilla, 2005).

45. The combination of the TQM approach, the built-in edits using in EDR and the selective editing strategy appears very promising. Our target for the future is that, after implementing correct Web edits, no traditional microediting will be needed. A selected editing approach based on statistical modelling will be used in a way that the most influential suspicious values could be detected. Hence, all fatal errors and the most important query errors could be corrected before the survey is disseminated.

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