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**DATA CAPTURING STRATEGIES USED IN ISTAT
TO IMPROVE QUALITY**

Invited Paper

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I. INTRODUCTION

1. CASIC² techniques were introduced at Istat in the 1980s. CATI³ and CAPI⁴ were adopted first; in a second phase, nearly one decade later, the emerging CASI⁵ techniques were taken into consideration. As for the advantages of using such new modes of operating in the data collection phase, global explicit results were obtained in terms of cost, quality and timeliness. It should be underlined that the different techniques show specific favourable characteristics that suggest how to apply them in different real situations, in order to gain the maximum advantage. For instance, it is clear that the human role of interviewers, well trained and assisted by properly designed automatic tools, can guarantee the best results in terms of quality of collected data, whereas a Web survey, when applicable, is the cheapest way of getting data from respondents. Besides, CATI/CAPI, which offer already mature and well-tested solutions, have a higher rate of consolidation than CASI techniques, which are younger and depend more on the continuously evolving IT solutions and network tools.

2. Nevertheless, thinking of the Italian experience, some unifying characteristics valid for the whole set of CASIC techniques can be recognised. First of all, it can be noticed that the internal demand for all the techniques shows an increasing trend pointing out that statisticians are satisfied with using them. Secondly, the experience shows that it is important, when applying data capturing solutions, to keep at least the design and the monitoring phases of the process inside the Institute, in order to get standard solutions driven by quality requirements and enriched with suggestions coming from previous results. In fact, after experiencing several cases where the private companies were charged of developing complete CATI, CAPI or Web CASI solutions, the present adopted data capture strategies suggest that Istat plays a more active role, necessary to create and maintain internal competences about the new techniques while promoting quality of tools and environment.

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² Computer Assisted Survey Information Collection

³ Computer Assisted Telephone Interviewing

⁴ Computer Assisted Personal Interviewing

⁵ Computer Assisted Self Interviewing

II. STRATEGIES FOR CATI AND CAPI SURVEYS

A. CATI and CAPI surveys management in Istat

3. The use of CATI technique for Istat surveys is growing in recent years. This trend is due to its well-known advantages in terms of reduction of costs and time necessary to have data ready to be processed (Groves et al. 2001), but, above all, is due to its feature to help in preventing non-sampling errors, through the management of vast consistency plans during the interviewing phase. This possibility is particularly exploited in Istat for households surveys, in which skipping and consistency rules between questions or sections of questionnaires are often numerous and very complex.

4. CAPI technique presents similar advantages as well, but it is still not widely used in Istat, mainly because it is certainly more expensive than CATI. Until some years ago, for all the CATI surveys the following strategy was adopted: the content of the survey, made clear in the questionnaire, was designed in Istat, while private companies were charged with the entire data capturing procedure. This organisation always succeeded in concluding the data capturing phase, but often presented problems, due to the fact that private companies were often very experienced in telemarketing or opinion polls, but:

- had never faced in advance the development of electronic questionnaires so complicated in terms of skipping and consistency rules between variables
- had never put in practice strategies to prevent and reduce non-response errors
- had not at their disposal a robust set of indicators to monitor the interviewing phase.

5. That is why, in 2002, a new strategy, called '*in-house strategy*', was tested for a new survey (the Birth Sample Survey) and then used in other important surveys. It consists in relying on a private company only for the fieldwork phase (call centre plus interviewing staff), but in giving it all the software procedure, developed in Istat, to manage the data capturing phase, concerning:

- the calls scheduler,
- the electronic questionnaire,
- the set of indicators to monitor the interviewing phase.

6. The internal design and implementation of all the procedures related to these aspects allowed to overcome many problems relative to the quality of data, the monitoring of the results and the timeliness of the delivery of data, that were quite recurrent when an external company was in charge of their development.

B. Features of the '*in-house strategy*'

7. As already mentioned, the '*in-house strategy for CATI surveys*' was implemented for the first time for the Birth Sample Survey in 2002 and it is now used for other five CATI surveys. The software package includes all the procedures to manage the data capturing phase - the electronic questionnaire, the calls scheduler and the delivery of data - and the monitoring phase - traditional reports to monitor the trend of telephone contacts and innovative tools for peculiar aspects of CATI surveys.

8. This strategy, which integrates different software and whose core part is developed with the Blaise system, is planned having the quality as the main purpose to fulfil. According to this, it defines quality standards for: *i*) the data capturing phase, *ii*) the monitoring phase and *iii*) the secure transmission of data. Besides, it offers generalised software procedures to take into account the peculiarities of each CATI survey.

9. The quality standards defined for the data capturing phase are aimed at preventing some of the non-sampling errors, like partial non-response, total non-response and non-consistent response. They cover different aspects of the construction of the electronic questionnaire and also other functions to be managed in the interviewing phase. They focus on different purposes, related to:

- the layout of the electronic questionnaire, to reduce or eliminate the 'segmentation effect';

- the customisation of questions' wording, to make the interview more friendly and questions easy to be answered;
- the management of errors, to prevent from all the possible type of errors without increasing the respondent burden and making the interviewers' job easier;
- the control of data with information from previous surveys or administrative archives, to improve the quality of the collected data;
- the assisted coding of textual answers, to improve the coding results and to speed up the coding process;
- the scheduling of contacts, to enhance the interviewers' productivity and to avoid distortion on the probability of respondents to be contacted.

10. The standards defined for the monitoring phase are aimed at producing a limited but exhaustive set of 'traditional' reports to monitor the trend of contact results and, when needed, at providing *ad-hoc* instruments to monitor peculiar aspects of the survey. Traditional reports are n-ways contingency tables useful to keep under control the interviewers' productivity and the presence of odd behaviours in assigning contact results (e.g. an excessive use of appointments in order to reduce the refusal rate, if, for instance, a too high refusal rate causes some penalties for the interviewer); this set of reports have been developed using Visual Basic, based on an Access database, which produces Excel files, that can be easily managed by statisticians. *Ad-hoc* reports are, for example, those consisting of control charts to monitor the assisted coding of textual variable (if used), like the Occupation; they have been developed through the use of the QC module of the SAS software.

11. Finally, for the data transmission, standards have been defined to assure both the secure transfer of survey data from the private company to Istat and *vice versa*, and the timeliness of the delivery. The daily transmission of data makes the Istat survey experts able to monitor the interviewing activity and immediately put in practice possible correctives if something does not work well. The transmission is based on a 'secure' protocol (HTTPS) and puts data on an Istat server, INDATA, placed outside the firewall and devoted to data collection (see paragraph 3.2). An automatic procedure transfers data on another server inside Istat firewall, where the persons in charge of the survey can accede (with their proper user_id) to get data. When data are transmitted, two e-mails are automatically sent, to the company and to the Istat survey experts, informing about the result of this activity.

C. Main results in terms of quality of data

12. The '*in-house strategy*' has been carried out for a number of CATI surveys in Istat, providing results that were considered really satisfactory by the surveys researchers. The characteristics of these surveys and of their electronic questionnaires are shown in the following two tables.

Table 1- Characteristics of surveys which used the 'in-house strategy'

<i>Surveys</i>	<i>Nr of interviews</i>		<i>Interviews' length</i>	<i>Response rates</i>	<i>Refusal rates</i>
<i>Sample births survey 2001</i>	<i>Long</i>	16,597	12'00''	92.6%	5.4%
	<i>Short</i>	33,838	5'00''	93.2%	4.9%
<i>Sample births survey 2004</i>	<i>Long</i>	15,642	13'48''	94.7%	3.9%
	<i>Short</i>	33,515	5'43''	96.8%	2.2%
<i>University-to-work transition survey and perspectives 2004</i>	25,510		10' 56''	95.8%	3.6%
<i>Upper secondary school graduates survey 2004</i>	20,408		13' 20''	94.7%	4.8%
<i>Water System Surveys (preliminary survey) 2006</i>	1,320		9'03''	99.8%	0.1%

Table 2- Characteristics of the electronic questionnaires

Surveys	Nr of variables of the electronic questionnaire		Nr of checking rules
	Long		
<i>Sample births survey 2001</i>	Long	677	195
<i>Sample births survey 2004</i>	Long	707	205
<i>University-to-work transition survey and perspectives 2004</i>		218	324
<i>Upper secondary school graduates survey 2004</i>		315	122
<i>Water System Surveys (preliminary survey) 2006</i>		30,000 ⁶	52
<i>Violence against women survey (in progress)</i>		2,774 ⁷	280

13. The number of variables and of checking rules included in the data capturing phase can be surely considered significant indicators of the complexity of the survey questionnaire (keeping in mind that also the interview's flow has a great influence on this aspect). So, as it can be seen in table 2, all the surveys managed with the *'in-house strategy'* are really complex from this point of view, but this complexity has not negatively affected the response and refusal rates (see table 1), which are quite good in general and also in comparison with those registered in other ISTAT CATI surveys. For example the ISTAT survey about the victimisation (2002) shows a response rate of 82.2% and a refusal rate of 17.1%, while for the survey on tourism (1997-1999) these two rates reach, respectively, the 80.5% and the 18.1% on average.

14. It is necessary to observe that both response and refusal rates are not so homogeneous among the surveys carried out with the *'in-house strategy'*. This is due to the different target populations and to the treated issues: the response rate of the survey on Water System is very high because the respondents are municipalities, whose 'nature' of public bureaus guarantees a high level of collaboration; on the other hand, the response rate of the Violence against women survey is really low, due to the sensitivity of the survey subjects.

15. Regarding, in particular, the checking rules included in the electronic questionnaire, the *'in-house strategy'* allowed to manage complex and big consistency plans without lowering down the response rates. This is mainly because the number and the type of checking rules implemented in the electronic questionnaires were established taking into account the trade-off between the quality of data and the fluency of the interview, avoiding, during the interview, a too frequent display on the pc-screen of a dialog window asking for the confirmation of the given answer. So the consistency plans included in the electronic questionnaires comprised a great part, even if not all, of the rules proper of the edit and imputation plans (including the complete edit plan in the data capturing phase would have guaranteed a high quality of the answer but would have definitely burden the respondent and the interviewer, thus increasing the interruption rate). Besides, not all the rules to detect errors have been treated in the same way: some of them, those regarding very important variables for the survey, were treated in the so called 'hard mode' (meaning that it was not possible to go on with the interview without solving the error), while the others were treated in the so called 'soft mode' (the respondent could confirm his 'inconsistent response', without compromising the completion of the interview).

16. For two of these surveys, 'University-to-work transition survey and perspectives' and 'Upper secondary school graduates survey', it has also been possible to measure the performance of the *'in-house*

⁶ This huge number of variables (30,000) is only a maximum value defined considering the maximum numbers of different entities which could belong to each respondent/form (any respondent/form reaches this maximum values for all the entities).

⁷ For this survey, the high number of variables is due both to the complexity of the questionnaire but also to a great number of variables used for the questions administration and not used for the interpretation of the final results.

strategy' in terms of quality of data, by comparing its results with those obtained in a previous wave, when the CATI technique was adopted but the entire design and development of the software procedures were carried out by private companies.

17. A first comparison is among the response and refusal rates. The table below shows how the *in-house strategy* improved them, especially for the 'Upper secondary school graduates survey' where, in 2004, the response rate grew up of about 9 percent points and the refusal rate registered a reduction of about 50%.

Table 3- 2004 and 2001 response and refusal rates

	<i>Upper secondary school graduates survey</i>		<i>University-to-work transition survey and perspectives</i>	
	<i>2004</i>	<i>2001</i>	<i>2004</i>	<i>2001</i>
<i>Response rate</i>	94.7%	85.4%	95.8%	94.0%
<i>Refusal rate</i>	4.8%	10.8%	3.6%	3.9%

18. A second comparison consists in evaluating the impact of the two different data capturing strategies (*'in-house strategy'* and *'external company strategy'*) on the quality of data, verifying the number of errors detected per record on the raw data: preventing from non sampling errors is, indeed, the main aim to reach with a well performing electronic questionnaire and an efficient interviewing monitoring system. For this aim the 'Upper secondary school graduates survey' has been considered as a 'case study'.

19. This study (Macchia et al. 2006) demonstrates the positive effect of the *'in-house strategy'* that significantly increased the number of records with no errors at all. This can be seen from the table below which shows the incidence of errors per records: in 2004 survey the absolute absence of errors was detected in the 63.8% of records versus the 52.6% of 2001 survey.

Table 4 – Errors per record

<i>Errors per record</i>	<i>2004 survey (conducted with the in-house strategy)</i>			<i>2001 survey (conducted with the external company strategy)</i>		
	<i>Abs</i>	<i>%</i>	<i>Cumulate %</i>	<i>Abs</i>	<i>%</i>	<i>Cumulate %</i>
<i>No errors</i>	13,013	63.8	63.8	12,245	52.6	52.6
<i>From 1 to 2 errors</i>	5,742	28.1	91.9	9,029	38.8	91.4
<i>From 3 to 4 errors</i>	1,183	5.8	97.7	1,582	6.8	98.2
<i>5 and more errors</i>	470	2.3	100	406	1.8	100
<i>Total</i>	20,408			23,262		

20. Although the great part of this difference (11,2%) was probably absorbed by records which presented 1 or 2 errors (their proportion fell down from 38.8% to 28.1%), this result is still a confirmation of the improvement of the quality of data provided by the *in-house strategy*, mainly thanks to the team work between the expert of the survey and those of the technique.

21. Finally, an analysis has been made also on the incidence of errors on the variables. The most positive result regarded the Occupation variable that, with the *'in-house strategy'* was coded during the interview with an assisted coding function, while with the *'external company strategy'* was manually coded after the interview. For this variable the 4.92% of raw data had to be corrected, during the edit and imputation phase, with the old strategy, while this percentage was only the 0.81% with the new one.

III. STRATEGIES FOR CASI TECHNIQUES

A. The Web mode

22. As for the data collection activity the use of the Web plays a crucial role: starting from the first prototypal experience realised in the late 1990s, Istat has got to the current situation which comprises several Web sites, located at Istat side and dedicated to the capture of surveys data for approximately 30 surveys.

23. The respondent classes interested by the new collection methods are mostly enterprises and institutions, whereas the domains dealt with – even though not in complete measure – are Population, Education and Labour, Health and Welfare, Prices, Industry and Services, Agriculture and Zootechnics.

24. The significant growth of Web data capture solutions developed in the last two years has led Istat to reflect on the need of designing a new environment and new rules aimed at introducing more standard solutions and effective security measures. Presently, Istat is setting up a cross data capturing Web site to be used as the unique front-end for respondents to any survey. The new policy, already launched but still in progress, is expected to favour portability and reuse of solutions and to produce a sort of consolidation of the different present Web site platforms: on one hand this will guarantee the reduction of the costs for maintaining the different HW/SW systems, and, at the same time, it will limit the external intervention for developing new Web capturing applications. Finally, the image of the Institute towards respondents should gain more stability and a uniform character.

25. The candidate Web site for fulfilling the new data capturing policy is the already existing INDATA (<https://indata.istat.it>), which hosts the majority – nearly 20 – of the present applications.

B. The INDATA platform

26. The INDATA Web site was initiated in a prototypal form in the late 1990; presently, it is being renewed to fulfil the new strategy and it is expected to be released by the end of the current year. In the following the characteristics of the new INDATA system will be described. The system is based on a three-level redundant architecture with 6 servers (2 Web servers, 2 application servers, 2 DB servers); it runs under LINUX Red Hat 2.6.9 operation system, APACHE 2.0.52 Web server and preponderance of PHP 5.1.2 language for application developing. The software equipment for Web applications (APACHE, MYSQL and PHP) belongs to the open source software family, whose code is completely known and available to users who are authorised to use and to modify it, guaranteeing in this way its correctness and evolution. The DB servers, storing acquired data, are equipped with Oracle 9 dbms. The INDATA Web server is provided with an authenticity certificate and uses the SSL/TSL protocol for cryptographed transactions.

27. The Web data capturing environment complies with the following general requirements:

- to present a homogeneous and stable image of the Institute on the outside;
- to guarantee identity of sender and receiver to each other;
- to guarantee the confidential nature of data and the comprehensive environmental security during the collection process;
- to minimise the impact on the operational environment of the external user;
- to replay to the user about the operation he carried out with a confirmation message;
- to favour the monitoring activity about data collection;
- to favour the internal management of the operations related to the data collection;
- to contain costs.

28. Both *primary* (single questionnaire) and *secondary* data collection (collection of data) are dealt with; an example of the secondary data collection is the daily transmission of CATI data collected by private companies in charge of the telephone interviews, as described at 2.2.

29. The main functions offered to users accessing INDATA are:

- to be informed about the survey;
- to get and print forms and instructions;
- to fill in electronic forms online;
- to download electronic forms;
- to upload forms completed offline;
- to transfer any dataset in a safe way.

30. When using the Web in the primary data collection activity a CSAQ (Computer Self Administered Questionnaire) has to be adopted, which means that the respondent has no human help available to assist him; for this reason the INDATA Web frame tries to provide also a helping and guiding function which let the respondent to be assisted in his task.

31. Also people in charge of managing the survey can access a proper portion of the site to carry out some monitoring of the behaviour of respondents and check the progress of the collection activity.

C. Surveys treated by INDATA

32. The use of the Web can be exploited in more than one way as regards the treatment of the form. Respondents - through their browsers - can access an electronic questionnaire put on the Web site and fill in it online. On the other hand, respondents could prefer to download the electronic form and fill in it offline, which makes them independent of Internet connecting time and of the number of people involved in the interview. The first method maximises the timeliness in the availability of data at the server side, whereas the second one can be perceived as more comfortable by the respondent, specially if the questionnaire is long and needs different competences to be filled. In general terms, the choice should take into account the peculiarities of the class of respondents to be interviewed, as well as the type and amount of the information to be collected.

33. Table 5 contains a list of the surveys for which a Web solution is already regularly working on INDATA. The data capturing chosen mode and the questionnaire format are specified too.

Table 5- Surveys and data capturing mode

	<i>SURVEY</i>	<i>DATA CAPTURING MODE</i>
1	Survey on book production – Works published in 2005	PHP language - EXCEL questionnaire - offline compilation
2	Quarterly survey on turnover and orders	PHP language - PDF questionnaire via TELEFORM - online compilation
3	Quarterly Business Survey on job vacancies	PHP language - PDF questionnaire via TELEFORM - online compilation
4	Periodic Survey on Hotel Activity	PHP language - PDF questionnaire via TELEFORM - online compilation
5	Monthly Survey on employment, working hours and wages	PHP language - PDF questionnaire via TELEFORM - online compilation
6	Monthly Survey on retail sales	PHP language - PDF questionnaire via TELEFORM - online compilation
7	Yearly Survey on transports by	PHP language - PDF questionnaire via

	rail	TELEFORM - online compilation
8	Yearly Survey on Information Technology in financial businesses	PHP language - PDF questionnaire via TELEFORM - online compilation
9	Yearly Survey on Information Technology in non-financial businesses	PHP language - PDF questionnaire via TELEFORM - online compilation
10	Yearly Survey on business accounts	PHP language - EXCEL questionnaire - offline compilation
11	Yearly Survey on Provisional Estimation of the Value Added	PHP language - EXCEL questionnaire - offline compilation
12	Yearly Industrial Production Survey (PRODCOM)	PHP language - EXCEL questionnaire - offline compilation
13	Yearly Survey on the Structure of Labour Cost	PHP language - EXCEL questionnaire - offline compilation
14	Yearly Survey on Telecommunication Enterprises	PHP language - EXCEL questionnaire - offline compilation
15	Yearly Survey on structure and production of farms	PHP language – BLAISE executable questionnaire - offline compilation
16	Quick Survey on certificates of balance accounts of Municipalities	Documentation and instructions for sending a file
17	Quick Survey on certificates of balance accounts of Provincial Administrations	Documentation and instructions for sending a file
18	Three-year survey on graduates (<i>survey addressed to Universities</i>)	PHP language - EXCEL questionnaire - offline compilation
19	Six-month estimative survey on the consistency of livestock	PHP language - PDF questionnaire via TELEFORM - online compilation
20	Yearly Survey on fishery in lakes and artificial docks	PHP language - PDF questionnaire via TELEFORM - online compilation
21	Yearly Survey on economical results of farms	PHP language - EXCEL questionnaire - offline compilation

34. Concerning the involved statistical domains, the 21 surveys are distributed like this: 13 at Central Directorate for Structural Surveys on Businesses, 6 at Central Directorate for Short Term Surveys on Businesses, 2 at Central Directorate for Surveys on Institutions.

It is worth highlighting that, at the moment, two formats are mainly used: the spreadsheet format which meets a great favour among respondents for its familiarity and easiness, and the PDF format, generated by Teleform, a data capture software system got from the private market. Besides, it must be said that the Web mode is always associated to other techniques, usually a self-compiled paper form, in a few cases a CATI interview.

D. The quality aspect in the Web data capturing

35. We could say that the most significant contribution of Web mode to the quality of data collection concerns the timeliness aspect, which lets us produce fresher statistical information, more and more precious for both national and international policies.

36. As for the quality of collected data it should be remembered that the design and development of Web solutions need the maximum care, perhaps more than any other CASIC technique; in fact there is no human role during the interview to solve critical situations related to respondents. In general terms, with

the aim of containing the total non-response rate, it is recommended to offer an inviting Web environment, able to give to respondents all the information they need. Furthermore, a special attention should be paid to test the usability of the Web site as well as that of the electronic questionnaire.

37. With regard to the checking rules which can be activated in the electronic questionnaire, it is advisable to contain them, or at least to limit the so called ‘hard checks’ - which prevent the respondent from going on without correcting his error – so that the risk of giving up the interview is minimised. The checking activity applied to the two main formats of questionnaire presently used on the INDATA Web site is described below:

- **PDF** questionnaire: editing rules are implemented in javascript language and comprise both range and consistency rules; the outcome of the editing activity is presented to the respondent globally, as a sequence of error messages, at the end of the compilation after pressing the *submit* button;
- **EXCEL** questionnaire: no editing macro is implemented in order not to discourage the respondent with alarm messages; all the cells are blocked apart from the input ones; data validation in single cells and default formulas in calculated variables are available; no or minimum consistency checking is performed.

38. In order to measure the success of the Web mode and the impact of the electronic response on the total data collection activity the *e-response rate* is used; it is defined as ‘*electronic valid responses/total valid responses*’.

39. At the moment, complete reports are not available for all the surveys listed in table 5: the e-response rate can vary from 10% to 100%, but different subsequent waves of the same survey usually show an increasing trend of this indicator. In table 6, e-response rates are reported for the Structural Business Statistics (SBS) surveys (labelled like in table 5) which represent a regularly monitored statistical domain.

Table 6- *E-response rates for Structural Business Statistics*

Survey	Year	Observed users	Form Pages	E-response rate
10. BSA	2003	10,000	10	36%
	2004	10,000	10	60%
	2005	10,000	10	...
11. PVA	2004	10,000	1	32%
	2005	10,000	1	75%
12. PRODCOM	2004	45,000	2	23%
	2005	68,000	2	...
13. LCS	2004	15,000	15	30%
14. TLC	2004	250	3	100%
	2005	250	3	...

40. Despite of the encouraging results concerning the *e-response rate* we have noticed that total response rate does not increase significantly. In fact we continue getting a significant percentage of total non-response rate in SBS, which means that ‘chronic’ non-respondents are not fascinated by technology. This suggests to seriously consider the matter of *statistical burden* and possible ways of appealing to respondents offering back something useful for them, for instance online services related to their institutional activity.

IV. CONCLUSIONS

41. As confirmed by data reported in this paper, not only the use of computer assisted techniques for data collection is growing in Istat year by year, but their adoption in surveys is being made with the aim of exploiting at the best the advantages that each of them can produce. With this purpose, the identified strategy is that of carrying out in-house as many phases related to data capturing as possible: the design, the monitoring activities and also the software implementation ones. It has been proved that this solution guarantees a high level of collaboration during the survey process between the responsible of the survey and the experts of the data capturing technique, the use of standard tools and, above all, the enhancement of the quality of collected data.

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